TA-6293 REG: MANAGING THE CITIES IN ASIA - PFS IN MUNICIPAL SOLID WASTE MANAGEMENT, PROBOLINGGO (39185-012)

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List of Abbreviations

3R	Reduce, Reuse, Recycle
ADB	Asian Development Bank
APBD	Local government budget
Bappeda	Planning and Development Department (Badan Perencana Pembangunan Daerah)
Bestari	An abbreviation of bersih (cleanliness), sehat (healthy), tertib (orderly), aman (safe), rapi (neat), and indah (beautiful) and the motto of Probolinggo City
BLH	Environmental Agency (Badan Lingkungan Hidup)
CDIA	Development Initiative for Asia
CSS	City Sanitation Strategy
IDR	Indonesian Rupiah
IRR	Internal Rate of Return
KDL	Environmental Fee (Kompensasi Dampak Lingkungan)
MPWHS	Ministry of Public Work and Housing Settlement
NPV	Net Present Value
OBC	Outline Business Case
PB	Payback Period
PI	Profitability Index
POKMAS	Waste Bank Community and Group Society
PRIA	Putra Restu Ibu Abadi (Regional Healthcare Waste Treatment Facility in Mojokerto)
IDR	Indonesian Rupiah
RPIJM	Middle Term Investment Planning Document (Rencana Investasi jangka Menengah)
RT	Community level for neighbourhood
RW	Community level for hamlet
SWM	Solid Waste Management
UPTD	Local Technical Operation Unit
USD	US Dollar

Ringkasan Eksekutif (Bahasa)

Seperti yang dijelaskan dalam Kerangka Acuan, tujuan dari Studi Pra-Kelayakan ini adalah untuk :

- "Menilai studi dan sistem pengelolaan limbah padat yang sudah ada (termasuk limbah berbahaya) di Kotamadya Probolinggo dari pengumpulan sampah rumah tangga sampai pembuangan akhir dari perspektif teknis, keuangan, institusional, ketahanan iklim dan keberlanjutan.
- Menentukan studi kelayakan lebih dalam dan jenis studi lain yang dibutuhkan untuk meningkatkan efisiensi dan keefektifan kegiatan pengelolaan limbah padat.
- Membantu merancang dan memulai sistem pengelolaan limbah padat terpadu yang berkelanjutan secara sosial, ekonomi, teknis, keuangan dan institusional.
- Menyiapkan ikhtisar kasus bisnis untuk fasilitas pengelolaan limbah padat regional yang berkelanjutan.
- Mengidentifikasi pilihan dan melakukan mediasi yang menghubungkan strategi pengelolaan limbah padat yang diinginkan dengan keuangan." [1]

Karena itu, Konsultan diminta untuk mengatasi dua masalah utama: Pertama, memperbaiki kegiatan pengumpulan sampah dan daur ulang sampag di Kota Probolinggo. Kedua, menilai kelayakan TPA sehat regional yang melayani Kota Probolinggo dan distrik lainnya.

Berkenaan dengan sistem manajemen sampah di Kota Probolinggo, di mana Konsultan diminta untuk mengatasi sistem pengumpulan sampah lebih dulu, diharapkan hasil yang didapatkan menjadi sistem "fasilitas pengolahan menengah" dan "fasilitas pendukung."

Diketahui bahwa Kota Probolinggo sudah memiliku jaringan luar untuk fasilitas tersebut, terdiri dari tempat daur ulang, fasilitas kompos, stasiun pengiriman dan titik pengumpulan sampah. Jadi, persyaratan untuk Konsultan "Pilihan studi [...] (seperti pabrik pemisahan dan kompos, pabrik gas TPA menjadi energi/pencahayaan, *refuse derived fuels (RDF),* gas metan, briket sampah, dan pilihan lain yang sesuai) serta stasiun pengumpulan dan pengiriman"[2] adalah permintaan untuk mengajukan polihan untuk sesuatu yang sudah ada! Di sini, seharusnya ditekankan bahwa Kota Probolinggo selama beberapa tahun ini sudah fokus untuk membuat sistem pengumpulan sampah yang efisiean yang memaksimalkan minimisasi sampah, pemakaian kembali dan daur ulang; serta pembuangan sampah yang berkelanjutan secara lingkungan. Mengenai pilihan yang dituliskan di atas untuk dipelajari, status saat ini adalah:

- Ada banyak fasilitas pemilahan sampah di seluruh kota, serta inisiatif lain untuk mendorong pemisahan sampah mulai dari sumbernya, seperti 122 Bank Limbah;
- Kota ini memiliki lebih dari 10 pabrik kompos;
- TPA yang sudah ada memiliki sistem pengumpulan gas yangjuga dipakai untuk memasak di beberapa rumah terdekat, serta untuk pencahayaan;

[1] Terms of Reference (TOR) for Pre-Feasibility Study (PFS) on Municipal Solid Waste Management (SWM), Probolinggo, Indonesia. Page 2

[2] TOR Page 3

- *Refuse derived fuel* dan briket sampah tidak dibuat, mungkin ini bukan usaha yang memberikan keuntungan, karena kecilnya jumlah sampah dan fakta bahwa tak banyak pengguna energi – seperti tempat pembakaran semen – berada di dekat sana;
- Pembakaran sampah jauh lebih mahal daripada TPA sebagai piliha pengolahan sampah, jadi, itu tidak dipertimbangkan untuk Kota Probolinggo.

Jadi, saat ini Kota Probolinggo memiliki sistem yang sangat lengkap yang mengumpulkan hampir semua sampah padat yang dihasilkan kota itu sesuai batasan wilayah dan membuangnya dengan cara yang ramah lingkungan. Selanjutnya, Kota ini memiliki prioritas tinggi dalam hal minimalisasi sampah, daur ulang dan kebersihan kota; Profil BLH untuk tahun 2014 menyebutkan lebih dari 50 kelompok/program yang terkait dengan lingkungan, sampah, dan kebersihan. Karena itu, hanya ada sedikit lingkup untuk memperbaiki sistem manajemen limbah padat kota ini.

Kota Probolinggo juga secara efektif mengurus keuangan dan mengalami defisit pada tahun 2011 karena tahun belanja modal yang berat. Anggaran pengelolaan limbah padat juga cukup untuk membiayai kebutuhan operasional pengelolaan limbah padat, yang merupakan anomali dibandingkan dengan Pemerintah Daerah lain di seluruh Indonesia. Namun demikian, terlihat ada berbagai kekurangan, yang perlu diatasi dalam sistem dan laporan memberikan saran tentang cara untuk mengatasinya.

Berkenaan dengan kelayakan dari TPA sehat regional yang melayani Kota Probolinggo dan distrik lainnya, seharusnya lebih dulu disebutkan bahwa TPA regional bisa menguntungkan secara lingkungan, sebagai TPA sehat regional tunggal memungkinkan adanya penutupan beberapa TPA yang aktif. Namun, perhitungan keuangan menemukan dalam laporan ini yang mengindikasikan bahwa skala ekonomi (*tipping fee* lebih rendah per ton) tidak lebih penting dari biaya transportasi yang meningkat secara signifikan. Artinya, tak ada insentif keuangan yang menarik untuk Kota Probolinggo untuk melakukan solusi regional ini.

Juga harus dilihat bahwa *Studi Kelayakan Konstruksi TPA Regional 2014* sangat optimis dalam perkiraan kualitas limbah, maka dari itu, meningkatkan kelangsungan hidup TPA regional dengan menurunkan biaya unit pembuangan limbah melalui skala ekonomi. Namun karena asumsi itu tidak realistis, kesimpulan Studi ini tidak bisa dipakai untuk menilai apakah solusi TPA regional akan lebih baik daripada solusi TPA daerah untuk kota ini.

Selain itu, terbatasnya keinginan politik saat ini untuk solusi tersebut – bisa disimpulkan bahwa pemangku kepentingan tidak antusias mengenai TPA regional dan selain itu, solusi itu akan meningkatkan biaya pembuangan limbah mereka secara signifikan.

Setelah mempertimbangkan semuanya, Kota Probolinggi paling baik dilayani oleh rencana pembuangan limbah yang sudah ada.

Kota ini sudah baik dalam memproses perencanaan TPA masa depan untuk menggantikan TPA Sehat yang sudah ada. Perencanaan ini ditemukan dalam *Master Plan Pengembangan TPA Kota Probolinggo* di mana TPA sehat direncanakan di lokasi seluas 6 hektar. Setelah Kementerian Pekerjaan Umum dan Perumahan Rakyat membuat alokasi keuangan untuk TPA baru, rancangan mendetail, pengadaan dan konstruksi bisa dilaksanakan. Empat sel pertama akan meliputi area sebesar 2,7 hektar di area seluas 6 hektar dan dirancang untuk menerima semua sampah dari Kota Probolinggo selama periode 20 tahun. Dalam segala kemungkinan, TPA baru akan dibangun di timur TPA Sehat yang sudah ada.

Tentu saja, prioritas utama pengelolaan limbah padat kota saat ini adalah mendapatkan hibah untuk TPA baru ini dari Kementerian Pekerjaan Umum dan Perumahan Rakyat. Hal ini sudah ditentikan karena mereka mengerti bahwa donor internasional ragu untuk mendanai proyek kecil sementara pilihan KPS akan terlalu rumit dan di luar kemampuan institusi dari kota berukuran sedang di negara berkembang seperti Probolinggo. Di saat yang sama, Kota harus meminta pendanaan untuk *Kegiatan yang Direkomendasikan*

yang dijelaskan dalam seksi 5 dari laporan ini, yang akan memperkuat sistem pengelolaan limbah padat secara keseluruhan.

Diharapkan bahwa proposal tindakan yang direkomendasikan yang dikemas kembali ini akan meningkatkan kesempatan lebih besar agar pemerintah pusat menyediakan hibah untuk Kota Probolinggo untuk kebutuhan pengelolaan limbah padatnya. Paket ini, yang termasuk proposal untuk konstruksi TPA, kegiatan pengelolaan limbah padat yang sudah ditingkatkan dan pembangunan kapasitas serta peroleh peralatan baru, termasuk:

- TPA sehat baru untuk melayani Probolinggo selama 20 tahun ke depan;
- Kontainer dan truk baru untuk membantu proses dan pengiriman limbah;
- Pengumpulan limbah dari badan usaha daerah;
- Penutupan situs daur ulang informal untuk lebih merampingkan dan mengelola limbah;
- Perkuatan institusional dan keuangan melalui pembangunan kapasitas, reformasi institusi dan program pengembangan masyarakat;
- Meningkatkan pengelolaan limbah berbahaya
- Penutupan TPA yang sudah ada yang sudah terlambat dari jadwal, dan;
- Memperbaiki kinerja fasilitas pengolahan lindi untuk memastikan keberlanjutan situs TPA yang sudah ada dan masa depan.

Tabel 17 menyediakan tinjauan biaya untuk perbaikan yang direkomendasikan ini.

Kesimpulan yang diambil dari Studi Pra-Kelayakan ini akan mendukung Kota Probolinggo untuk lebih memperbaiki sistem pengelolaan limbah padat yang sudah berfungsi dengan baik di masa depan dan memungkinkan kota untuk terus berusaha secara ekonomi dan lingkungan.

Executive Summary (English)

As described in the Terms of Reference, the objectives of this Pre-Feasibility Study are to:

- "Appraise existing SWM (including hazardous waste) studies and systems in the Municipality of Probolinggo from household collection to final disposal from a technical, financial, institutional, climate resilience and sustainability perspective.
- Specify further feasibility studies and other types of studies as required to improve the efficiency and effectiveness of SWM activities.
- Help design and initiate an integrated municipal SWM system that is socially, economically, environmentally, technically, financially, and institutionally sustainable.
- Prepare an outline business case (OCB) for a future sustainable regional SWM facility.
- Identify options and mediate in linking the preferred SWM strategy to finance." [1]

Accordingly, the Consultant is requested to address two key issues: Firstly, to improve the waste collection and waste recycling activities in Probolinggo City. Secondly, assess the feasibility of a regional sanitary landfill serving Probolinggo City and other districts.

Pertaining to the waste management system in Probolinggo City, where the Consultancy is requested to firstly address the waste collection system, it is envisaged that the outcome could be a system of "intermediate treatment facilities" and "supporting facilities."

It was found that Probolinggo City already has an extensive network of such facilities, consisting of recycling stands, composting facilities, transfer stations and collection points. So the requirement that the Consultant "Study options [...] (such as sorting and composting plants, landfill gas to energy/flaring plant, refuse derived fuels (RDF), methane gas, waste briquettes, incinerator and or other options as appropriate) as well as collection and transfer stations"[2] is a request to propose options for something that is already in place! Here it should be stressed that Probolinggo City has for a number of years focussed on establishing an efficient waste collection system that maximises waste minimisation, reuse and recycling; as well as environmentally sustainable waste disposal. Regarding the options listed above to be studied, the present status is:

- There are numerous waste sorting facilities throughout the city, as well as other initiatives to encourage waste sorting at source, such as 122 Waste Banks;
- The City has over 10 composting plants;
- The existing landfill has a gas collection system that is both used for cooking in some adjacent houses, as well as flare;
- Refuse derived fuel and waste briquettes are not made, this would probably not be a rewarding venture, given the small quantities of waste and the fact that there is not large energy user - such as a cement kiln - close by;

[1] Terms of Reference (TOR) for Pre-Feasibility Study (PFS) on Municipal Solid Waste Management (SWM), Probolinggo, Indonesia. Page 2

[2] TOR Page 3

- Waste incineration is far more costly than a landfill as a route for waste treatment, so that should not be considered for Probolinggo City.

So today Probolinggo City has a very complete system that collects most of the city's solid waste generated within its boundaries and disposes of it in an environmentally responsible manner. Furthermore, the City places a high priority on waste minimisation, recycling and urban cleanliness; the BLH (Environmental Agency) Profile for 2014 mentions over 50 groups/programmes concerned with environment, waste and cleanliness. Hence, there is very little scope for improving the City's solid waste management system.

Pertaining to the feasibility of a regional sanitary landfill serving Probolinggo City and other districts, it should first be mentioned that a regional landfill could be beneficial environmentally, as a single regional sanitary landfill would allow for the closure of several active landfills. However, the financial calculations found in this report indicate that the economies of scale (a lower the tipping fee per tonne) do not outweigh the significantly increased transportation costs. This means that there is no compelling financial incentive for Probolinggo City to push for a regional solution.

It should also be noted that the *2014 Feasibility Study of Regional Landfill Construction* is very optimistic in its estimate of waste quantities, thereby improving the viability of a regional landfill by bringing down the unit waste disposal costs through economies of scale. But because the assumptions are unrealistic, the conclusions of this *Study* cannot be used to assess whether a regional landfill solution would be better than a local landfill solution for the city.

Furthermore, there is currently limited political will for such a solution - it can be concluded that the stakeholders are unenthusiastic about a regional landfill and that furthermore such a solution would significantly augment their waste disposal costs.

All in all, Probolinggo City is therefore best served by building on its existing waste disposal plans.

The City is already well into the process of planning for a future landfill to replace the existing Sanitary Landfill. The planning is found in the *Master Plan of Probolinggo City Landfill Development* where a sanitary landfill is planned on a 6 hectare site. Once the Ministry of Public Work and Housing Settlement makes the financial allocation for the new landfill, the detailed design, procurement and construction can go ahead. The first four cells will cover an area of 2.7 Ha on a 6 Ha site and are designed to accept all waste from Probolinggo City over a 20 year period. In all likelihood, the new landfill will be built just east of the existing Sanitary Landfill.

Obviously, the city's top SWM priority now is to obtain a grant for this new landfill from the Ministry of Public Work and Housing Settlement. This was determined as it was understood that international donors would be reluctant to fund such a small project while a PPP option would simply be too complex and beyond the institutional abilities of a mid-sized city in a developing country such as Probolinggo. At the same time, the City should apply for funding for the other *Recommended Actions* described in section 8 of this report, which will strengthen the overall solid waste management system.

It is expected that this re-packaged proposal of recommended actions will greatly increase the chances of the central government providing a grant to Probolinggo City for its SWM needs. This package, which consists of proposals for landfill construction, improved SWM activities and capacity building as well as acquisition of new equipment, includes:

- a new sanitary landfill to serve Probolinggo over the next 20 years;
- new containers and trucks to help process and transport waste;
- the collection of waste from local enterprises;

- the closure of informal recycling sites to better streamline and manage waste;
- institutional strengthening through capacity building, institutional reform and community development programs;
- improved cost recovery of SWM service fee from the private secto;
- improved hazardous waste management
- closure of the existing landfill which is already behind schedule and;
- improved performance of the leachate treatment plant to ensure the sustainability of the existing and future landfill sites

Table 23 provides an overview of the costs for these recommended improvements.

The conclusions drawn from this PFS will support Probolinggo City to further improve its basically well-functioning SWM system in the future and enable the city to continue thriving economically and environmentally.

1 Project Background

Probolinggo is a city located on the north coast of East Java with 220,000 inhabitants. The city features clean tree lined streets and serves as the commercial hub for a hinterland of several million people. The city prides itself on its cleanliness and is a frequent award winner in Indonesia's annual competitions seeking the country's "cleanest cities." Waste minimisation and recycling is prioritized through awareness raising in schools, Recycling Banks, source separation and composting facilities for various waste fractions. Furthermore, the city has a well-managed sanitary landfill, though this landfill will soon be filled to capacity.

In February 2014, CDIA received an application from the City Government of Probolinggo to support improved sustainable solid waste management capability based on the development of a new sanitary landfill that would be linked to community-based solid waste collection management at village[3] level. The city requested CDIA to help conceptualize investments for the short-term extension of the existing landfill site including financial and environmental management capacity development but, more importantly, to propose a long-term and more sustainable approach that potentially would require inter-governmental coordination for a regional sanitary landfill.

In February 2014, the city application was endorsed by the Ministry of National Development Planning (BAPPENAS) and, subsequently, in March 2014 CDIA approved the application for assistance for a Pre-Feasibility Study (PFS) on Sustainable Solid Waste Management. Following the approval of the city application, CDIA worked with the city to prepare the Terms of Reference (TOR) for the PFS with a particular focus on producing options for a regional sanitary landfill site for the city and one or more adjoining districts (for example Kabupaten[4] Probolinggo, Kota[5] and Kabupaten Pasuruan, and Kabupaten Lumajang) in cooperation with the provincial government of East Java.[6]

Besides, a Feasibility Study of Regional Landfill Construction, commissioned by Probolinggo Regency, had been undertaken in 2014 by a local consultancy firm in which a regional landfill located in Tongas District of Probolinggo Regency was proposed. One of the initial tasks of the PFS was therefore to undertake a detailed review of this feasibility study and assess the validity of its findings.

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[3] Probolinggo City is divided into 5 Sub-Districts and 29 "kelurahan," the latter is often translated as "village" though a more appropriately translation is "ward", which therefore is used from here on in this report. The term "village" in this report therefore refers to the small built-up areas in the rural regencies (see further in the following notes).

[4] A "Kabupaten" is a "Regency"

[5] A "Kota" is a "City".

[6] From here on in this report, the English terms City and Regency are used to signify Kota and Kapupaten, respectively. City and Regency constitute the third tier of government in Indonesia. They are at the same level and equally subordinate to a Province (Timur), which is second tier. The term "municipality" could also be used to signify Kota, but the term City is preferred to indicate the urban character of this type of local public entity, as opposed to the predominantly rural regencies.

Central government as the first tier of government issues regulations, which apply equally to City/Regency and Province, and these are often translated into English as local regulations. In order to avoid confusion, this report applies the term "local" for matters regarding City and Regency and the term "provincial" for matters regarding Province. City/Regency and Province also issue local regulations applicable to their own competence areas.

Furthermore, the term "regional" is applied in this report to signify matters regarding two or more local government entities.

2 Introduction to the Final Report

This final report is the culmination of 4 months of work by the Consultant. Throughout the course of this PFS, several Technical Notes were published and submitted to the client as part of our scope of work. These TNs have informed the conclusions drawn in this report.

The Interim Period was used to determine that the pursuit of a regional landfill site to dispose waste from Probolinggo City and other neighbouring regencies would be more expensive that pursuing a the local landfill option. This assessment result was obtained following detailed review of the existing feasibility study, and preparation of detailed cost estimates for both scenarios. Costs aside, it was also found that there was little political will from most of the neighbouring local authorities to pursue a regional landfill option. A mix of costs and inability to control operational outcomes was a strong factor behind this. Other key technical risks were identified which further support this assessment result.

Having concluded that the regional landfill was no longer a viable option, the PFS pushed forward with the examination of a local landfill which would exclusively serve Probolinggo City. A local landfill option had in fact already been designed by Probolinggo City as part of its SWM Masterplan and had been submitted to the central government to receive a grant. However, that request was denied.

Therefore, the PFS focussed its attention on how to improve the existing SWM system and thereby enhance the chances for securing funding for a well-functioning future SWM system including a new local landfill.

On this background, this Final Report starts in Section 3 with a summary of the feasibility assessment of the Regional Vs City landfill site.

Section 4 then covers the existing baseline situation for waste management in Probolinggo City covering waste collection, waste minimisation and waste recycling. As a part of these assessments, deficiencies in Probolinggo City's SWM system were identified.

Section 5 covers waste disposal and includes initial designs and cost estimates for:

- the existing landfill which is currently full, focussing on closure and costs of operation;
- the second landfill currently under construction (a smaller landfill whose aim is to ease SWM in the city while a new larger landfill is designed and planned) and;
- the new local landfill which will serve Probolinggo for the next 20 years

Section 6 outlines the recommended financing option for the new City Landfill. To increase the chances of a grant being accepted by the central government, Probolinggo City would have to 'package' its request to bring several improvements across its SWM system. These recommendations have also been put forward in Section 6 and cover a mix of both operational and institutional improvements including the costs of these. The costs of the required capacity building are shown separately in appendix 1.

A comparison of the risks for regional vs local landfill development for Probolinggo is provided in appendix 2.

Additional information on waste collection and management is surrounding local authorities is provided in Annex 1.

During the course of preparing this Draft Final Report a number of other technical studies have also been finalised and submitted for initial review, which also provided relevant supporting information to reach the conclusions in this report.

3 Feasibility of a Regional Landfill Site Vs a Local Landfill Site

Most of this information was presented in the Interim Report, however some of the data has been updated as the project has progressed.

The primary objective of the Pre-feasibility study is to initially determine the technical and financial feasibility of a regional landfill site involving cooperation between Probolinggo Regency, Probolinggo City and potentially Pasuruan City and Regency to the west. A feasibility study for this project already exists.

This section includes an evaluation of the existing feasibility study and cost estimates of the regional and local landfill options to determine whether it is financially feasible for the City to pursue the regional landfill project, or whether a local solution is the least cost option moving forwards.

3.1 Review of the feasibility study for the proposed Regional Landfill

In 2014 a *Feasibility Study of Regional Landfill Construction* was made for Probolinggo Regency that proposed a landfill serving a larger area. The feasibility study was undertaken by Asta Tiga, but the proposed plans were never discussed with the Pasuruan Regency or Probolinggo City; the two other parties to the proposed future regional landfill. Part of the motivation for the study was Law No. 18 of the year 2008 Paragraph 26 about Solid Waste Management that encourages local Governments to cooperate in performing solid waste management activities. With reference to the law, the Government of Probolinggo Regency decided to initiate a possible cooperation with neighbours to construct a regional landfill for the joint management of solid waste.

3.1.1 *Contents of the Landfill Feasibility Study*

The Asta Tiga *Feasibility Study of Regional Landfill Construction* was issued in December 2014; the main features of the study are summarised in the following:

Technical Aspects of the Landfill:

- It is to serve two Regencies (Probolinggo and Pasuruan) and Probolinggo City.
- The sanitary landfill located on a 25.17 hectares site;
- The landfill is to be located in Tongas sub-district or Lumbang sub-district at the western edge of the regency;
- The proposed sites (all four located in Tongas sub-district) are only identified by village names. The proposed sites are described as “vacant land” though it is actually cultivated land;
- The expected life span of the landfill is 20 years.
- The study only plans for a 6 m high layer of waste in the landfill; though the thickness of waste could easily be 12 or 18 metres high;
- The expected daily volume of received waste is 2,777 m3 at the beginning of operations; a very large amount considering that the Probolinggo City landfill currently receives a little over 100 m^3 per day; and
- There will be a leachate treatment plant, a gas collection & flare system, and composting facilities.

Financial Aspects:

- The investment is to be financed by the East Java Province;
- The land acquisition would be funded by Budget and Expenditure Department (APBD) of Probolinggo Regency;

- The total investment is estimated to be IDR 12,000,000,000 (a little under USD 1,000,000); resulting in a tipping fee of IDR 5,000 / m^3 of waste for Probolinggo City and Pasuruan Regency; and
- According to the study, Probolinggo Regency is expected to use the landfill for free, as it has provided the land.

Foreseen step in the implementation:

The Feasibility Study sets out a four step plan to implement the regional landfill.

1. The Government of Probolinggo Regency conducts the Feasibility Study (the document being reviewed in this sub-section);
2. The mayors establish coordinating teams for inter-regional cooperation between the districts;
3. An inter-regional agreement is signed by the Head of each Regency/ City; and
4. The implementation of the Regional Landfill is carried out by the Local Technical Operation Unit (UPTD) under the Provincial Public Works Department (PU Provinsi). The landfill is to serve parts of two Regencies (Probolinggo and Pasuruan) and Probolinggo City.

Issues with the Solid Waste Management System in Probolinggo Regency

The Feasibility Study assesses the waste management system within the Regency and points out a number of shortcomings. These are summarised below:

Waste Collection Issues:

- The sorting process between wet and dry solid waste is not done well; both at the source and at collection points. This results in difficulty in waste separation at the transfer stations;
- Most of community use permanent containers (made of cement or concrete), making it difficult to transfer the waste into the collection carts;
- Lack of proper garbage containers;
- Not all waste generators are served every day. This leads to nuisance due to smell and accumulation of waste; and
- There is low awareness among residents regarding the handling and composting of household waste.

Collection Point Issues:

- More collection points are needed and several collection points lack containers;
- The coordination of waste transport is not optimal, so waste accumulates at collection points and transfer stations;
- The collection points store waste in a concrete enclosure; so a lot of work is required to manually load the waste from the ground and onto a garbage truck;
- There is waste accumulation/ dumping at some transfer stations. Other transfer stations are located far from residences and therefore not used; and
- In the Tongas Market the waste is burnt on-site by market management.

Waste transport system:

- The waste transport routes are poorly organised; and
- The long distances and steep roads results in high transportation costs.

Environment conditions:

- The quality of river water near the Seboro Landfill does not meet the water quality standard based on Government Regulation No. 82 from the year 2001.

Financial and cost recovery aspect:

- Waste management services are invoiced as part of the water supply company (PDAM) bill. Many residents are not connected to a water supply system, so they do not pay for waste collection services. This leaves an unfair financial burden on those connected to the water mains.

Community participation aspects;

- Lack of understanding regarding waste management and technology;
- Lack of responsibility regarding waste management; and
- Lack of education regarding solid waste management.

3.1.2 ***Weaknesses in the Landfill Feasibility Study***

The *Feasibility Study of Regional Landfill Construction* is in many respects very thorough. The report covers the current situation for waste management in Probolinggo Regency very well, likewise the summaries for the adjacent districts are good, as is the regulatory review. Unfortunately, there are some serious shortcomings in the Feasibility Study, some of which can be considered fatal flaws. These are discussed in the following:

1. The Feasibility Study was commissioned by Probolinggo Regency for a landfill serving the western part of the Regency, as well as Probolinggo City and the eastern parts of Pasuruan Regency. Surprisingly, there was a complete failure to discuss a possible collaboration over a regional landfill with the intended partners! This means that the study was made without any form of consultation or information being provided to the two other stakeholders!
2. The plan assumes that the landfill will receive 2,777 m^3 of waste during its initial operating period. This is close to 1,000 tonnes per day, a huge amount when compared to the 43 tonnes currently received at the Probolinggo City landfill. The study assumes that the majority of the waste received at the regional site will come from the western part of the Probolinggo Regency and the eastern part of the Pasuruan Regency. It seems very unlikely that poor rural areas, though heavily populated, will provide almost all of the waste received at a regional landfill. It would be unusual if villages and rural settlements could afford the cost of collecting waste, transporting this waste 20 km and furthermore pay a gate fee at a landfill. So, in reality, the majority of the waste received at a regional landfill would presumably be received from Probolinggo City, with only a smaller contribution from the Sub-Districts within the Regencies. Hence the study vastly overestimates the quantities of waste to be received at the site.
3. The Feasibility Study assumes very high waste quantities per inhabitant per day, using 2.75 litres per person per day, corresponding to about 1 kg/ person/ day; whereas - as a comparison - 0.2 kg/ person/ day is the quantity of waste received at the Probolinggo City landfill. Various estimates set the waste generation rates for Probolinggo City between 0.4 and 0.6 kg/ person/ day; where the balance of generated waste is recycled. Experience indicates that the quantity of waste generated per person is far lower in rural areas that in urban areas, as these people are poorer than city dwellers and furthermore, part of their waste stream is often used to feed livestock. This is again an indication that the study has most likely greatly overestimated the quantities of waste to be received at the regional landfill site.
4. It is not taken into consideration that there will be additional transportation costs when the waste has to be conveyed to a regional disposal facility. Transporting waste an additional 20 or 50 kilometres substantially adds to the overall waste management costs. The distance between the

cities of Pasuruan and Probolinggo is 40 kilometres, so the minimum average distance to a shared landfill would be 20 kilometres. Calculations made in 2014 for a city in Kyrgyzstan found that transporting waste an additional 20 kilometres to a landfill increase the overall costs of waste collection and transport by 25-30%, depending on the capacity of the vehicle.

The *Feasibility Study of Regional Landfill Construction* concludes that the calculated tipping fee is excessive. By international standards, a tipping fee of 5,000 IDR per m^3 (or about $1 per tonne) is exceedingly low. Malaysia has some of the lowest tipping fees in the world, and there large landfills (2,500 - 3,000 tonnes per day) charge around USD 7.50 per tonne.[7] The referenced article mentions tipping fees per tonne of USD 16 for China and USD 50 for Australia. So the 2014 Study, despite very optimistic estimates regarding waste quantities, which in turn dramatically lower the tipping fee per tonne, still somehow concludes that the calculated waste disposal costs per tonne is excessive!

Whilst the above is interesting and provides some background, affordability, or financial feasibility, of a regional landfill site comes down to, not the absolute value of the tipping fee, but the relative costs of this tipping fee (and any other additional costs) against their existing and projected costs for operating a local solution.

It is however assumed that a USD 1.00 tipping fee per tonne probably would be a very affordable rate and attractive to Probolinggo City, but the assumptions made and financial calculations within the feasibility study do not produce an accurate estimate of the potential tipping fees which would need to be applied to operate a regional landfill site.

While at this stage there are a great number of variables that would affect the operational cost (and tipping fee) of a regional landfill site, it seems important to make a more accurate estimate of both capital and operational costs of the regional solution as well as the local solution for Probolinggo City to enable this comparison and comment on financial feasibility. To do this, below we have made some simple (but much more realistic than the previous feasibility study) assumptions to evaluate the financial feasibility of a regional landfill site. Many of the assumptions made lean towards proving the financial feasibility of the regional landfill site by increasing the economies of scale which may be available because at this stage we are looking to assist Probolinggo City with the decision of whether or not to pursue regional landfill option (in collaboration with Probolinggo Regency and other stakeholders) in the near future.

3.2 Cost Assessment for a Regional versus a Local Landfill

Whilst a feasibility study has already been undertaken, the flaws outlined above mean that the progress with the future regional landfill project has stalled and this work still constitutes early project development (from Probolinggo City's perspective). To generate outline costs a number of assumptions have been made to estimate the financials for both regional and local landfill projects to initially evaluate financial feasibility of the proposed regional solution. These assumptions are generally applied consistently (for both projects) and will enable least-cost analysis to be performed to assist decision making as outlined above.

[7] http://www.thestar.com.my/News/Community/2014/01/08/The-favoured-option-Waste-management-experts-believe-landfills-most-viable-method-for-future/

3.2.1 *Assumptions*

The assumptions made in estimating preparatory, capital, and operational costs are outlined below.

Waste Quantities to a Regional Facility

Annex A provides a summary of waste collection practices in neighbouring authorities.

The *Feasibility Study of Regional Landfill Construction* only includes waste from Probolinggo City and two Regencies. To maximise the economies of scale (to the extent possible), it would be sensible to also receive waste from Pasuruan City (as cities provide a more reliable waste stream). The majority of waste would then come from these two cities, with a smaller contribution from the two rural regencies. In 2014 the waste deliveries to landfill in each of these four districts is as follows:

Probolinggo City:	42.7 tonnes/day
Pasuruan City:	40.1 tonnes/day
Probolinggo Regency:	14.7 tonnes/day
Pasuruan Regency:	30 tonnes/day[8]

If Probolinggo Regency was to deliver waste to a regional landfill in the western part of the Regency, it is likely that all waste from the eastern section of the Regency would still be sent to the Seboro Landfill to minimise transportation costs, but on the other hand larger quantities of waste could be collected in parts of the regency that are closer to a regional landfill.

In this analysis it is assumed that 160 tonnes per day are received at a regional landfill; this figure is higher than what could be expected from the above figures (≈125 tonnes per day). The reason for using a higher figure in the financial calculation, is to minimise the per tonne costs for the regional landfill, so that the calculation is in reality a little biased toward the regional solution. This was done, as it could be envisaged that more waste is collected within the regencies and it is desirable to make as favourable a case as possible for the regional landfill. So in the financial comparison, the costs savings of operating 160 tonne per day landfill against the costs of a 43 tonne per day landfill (based on similar design and construction principles) in Probolinggo City are weighed against the cost of transporting the waste an additional 30 kilometres.

It can be noted here that generally the minimum desired size for a sanitary landfill would normally match the waste handling capacity of the smallest appropriately sized landfill equipment. Thus landfills with a minimum of 300 tonnes/day are desired for full utilization of the bulldozer and a minimum of 1,000 tonnes/day are desired for full utilization of the loader/ excavator. Here it must be understood that in an eight hour day of operation, a bulldozer can handle 300 tonnes of waste; that is to say the waste is pushed into place, compacted and covered with soil. For small landfills, such as the one in Probolinggo City, heavy equipment such as a bulldozer is in operation for less than two hours per day, meaning that a costly piece of equipment is heavily underutilised. To minimise operational costs per tonne, landfills should receive at least 300 tonnes of waste per day or, even better, 1,000 tonnes per day.

[8] There is no weighbridge at this landfill, so the number is estimated based on the daily number of truck arrivals. Head of Probolinggo Regency Environmental Agency, 5 August 2015.

Landfill operational lifetime

In this analysis, to enable comparison, both the regional and municipal landfill sites have been sized (and costed) to accept waste for 20 years. The economic lifetime of a landfill depends on a number of factors including waste supply (tonnes), waste density and compaction, landfill volume (footprint, depth, side-slope). These variables will be kept consistent when developing the outline designs used for generating costs, to enable closer comparison.

Landfill construction

Relatively high specification sanitary landfill construction has been assumed to develop construction costs, as there is an assumption (at least for the regional site) that international partners may be involved, necessitating best practices in feasibility study, design, monitoring and environmental protection.

Landfill sites will comprise 4 No. cells of 5 years capacity. Construction of at least the first landfill cell can be undertaken in one year to enable tipping fees (where applicable) to be generated in all years thereafter.

Note that construction of cells simultaneously rather than in sequence is often an issue in donor funded landfill sites. Ideally, the construction of the next cell should start when the previous cell is nearing completion, as long exposure to the elements will cause an empty cell to lose its integrity. The most common problems for cells that remain empty for a longer period are that the gravel layer covering the membrane is washed away by rainfall or that vegetation grows on the unused parts of the landfill cell, so that eventually roots will damage the landfill's liner or the HDPE membrane will be exposed to sunlight or otherwise harmed. As it is costly to build sanitary landfill cells, donors frequently build sanitary landfills designed with a capacity for 15 or 20 years' worth of waste. The rationale is that the recipient cannot afford to build new landfill cells, and therefore the complete sanitary landfill must be completed using the donor's funds. This is not desirable, as after the first five years the landfill will most likely no longer be sound, as the membrane will be damaged. So for sanitary landfills where the recipient cannot afford the capital costs of building new landfill cells, the financing should, if at all possible, be planned in stages over the lifetime of the landfill.

Closure and covering costs have been factored into the operating costs.

Land acquisition and resettlement

Land acquisition is required for the regional landfill site at an assumed rate of IDR 50,000/m^2 (USD 3.7/m^2). It is assumed this will be covered by the province as suggested in the previous feasibility study. Resettlement costs for the regional site have not been included as the site is uncertain but they are unlikely to be significant, although compensation and resettlement will be a key issue to address at the beginning of project implementation.

Given that a 25 Hectare site would be required, the total land acquisition cost for the regional site is estimated as USD 952,500.

Resettlement will be required for approximately 150 households (450 people) who occupy part of the land proposed for the new City landfill. They have been living in this city owned location for many years and have established a strong social community unit. Both RTs are administratively parts of Kelurahan Sukabumi Sub-District of Mayangan.

Law No.1 / 2011 regulates that the government has the authority to perform the control of the affected people, who live in this location. Based on Law No.2 / 2012, people who receive full compensation are those, who own certified land (legally). So affected people who are occupying government land can be relocated, and government is only obliged to provide new housing for them, not ownership. Accordingly,

these affected people will often be relocated to rental apartments in government owned buildings which are available in Probolinggo – at least initially.

In 2010, the City Government offered to the affected people in RT 7 and some of RT 8 to move to Bestari rental apartments (east side of the harbour) with compensation of 10 million rupiahs, but it was only 10 household that were willing to move to that location.

It is assumed that if the fee were doubled (this is a conservative estimate) for compensation, and housing, along with temporary livelihood support is provided, affected people will be willing to move. Table 1, below, provides the resettlement cost estimate for developing a new City Landfill on the proposed site.

Table 1: Estimated resettlement costs for the proposed City landfill

Item	No	Cost per household (IDR)	Total IDR	Total USD
Negotiated compensation fee	150	20,000,000	3,000,000,000	228,000
Relocation cost	150	2,000,000	300,000,000	22,800
Temporary livelihood support	150	2,000,000	300,000,000	22,800
			Total USD	**273,600**

It is assumed the existing site has no opportunity cost as it is marginal swamp with existing squatter settlements.

Climate resilience measures

The regional landfill could be sited to mitigate any future climate impacts.

Based on some conservative assumptions outlined in the Technical Note on Climate Resilience, the local landfill site would require 2.5m of fill to elevate it above worst case future sea level rise impacts. Note that this additional cost may not be necessary as it is recommended that Probolinggo City commissions further technical study of sea level rise impacts on the City to develop a City wide strategy to plan for and mitigate these real impacts. The cost of this has been included in site preparation costs to enable a cost estimate.

3.2.2 *Cost estimates*

Regional landfill

Table 2 below outlines the capital cost estimates for the hypothetical regional landfill site (sized for 60 tonnes/day) in USD. Capital costs total USD 8,418,000, and annual operating costs total USD 185,000.

The limited interest in a regional landfill option has proved a stumbling block for the consulting team to understand in detail how the capital could be obtained. However, it assumed that land acquisition and design costs would be provided by the region, and the capital cost for equipment, site preparation and construction could be covered through a combination of provincial APBD budget, other national funding sources (APBN), or external donor loan.

Therefore the tipping fees collected would only be required to cover operational costs, plus presumably a management overhead.

If the site were to be operated by a Local Technical Operation Unit (UPTD) under the Provincial Public Works Department), or a Special Unit (comprising more than one stakeholder), the tipping fee required to cover operational costs only is USD 3.08 per tonne (based on 160 tonnes/day). For a regional landfill there

would also be some additional management overhead costs that are not included in these calculations. If operated by private sector tipping fees would have to be significantly higher.

Local Landfill

Table 3 below outlines the cost estimates for the hypothetical city landfill site in USD. Capital costs total USD 2,773,000, and annual operating costs total USD 69,000.

Probolinggo City have already prepared their application for a provincial grant to assist as necessary with the capital costs (they already own the site). If this is successful, the operational cost to the City of the landfill site is USD 4.41 per tonne (based on 43 tonnes of waste per day).

Transport Costs

The additional transport costs for Probolinggo City to transport the waste from a transfer depot in the City to the regional landfill site are outlined in Table 4. The total additional cost of transport per tonne of waste is estimated as USD 4.79 per tonne.

Tables 2, and 3 below outline the capital and operation costs of both options and Table 4 provides an estimate of the additional transport cost for the city associated with a regional landfill site.

Table 2: Cost Estimates for a Regional Landfill

Consulting fees					
Feasibility	7.5%		$	6,577,195	$ 493,290
Detailed Design	5.0%		$	6,577,195	$ 328,860
Construction supervision and monitoring	1.0%		$	6,577,195	$ 65,772
Land acquisition costs	250,000	m2	$	3.8	$ 952,500
Resettlement costs					$ -
Equipment and Site Preparation					
Bulldozer TY 165-2 (17 tonnes)	1	unit	$	130,000	$ 130,000
Bulldozer shipping & spare parts	1	unit	$	20,000	$ 20,000
Excavator John Deere 75G	1	unit	$	110,000	$ 110,000
Flatbed Truck (provided by Env. Agency)	1	unit	$	-	$ -
Leachate treatment plant	1	unit	$	300,000	$ 300,000
Pond and gasoline pump	1	unit	$	1,000	$ 1,000
Hose and spreader for leachate recirculation	300	m	$	5	$ 1,500
Groundwater monitoring wells	4	units	$	4,000	$ 16,000
Trees around site	1	lot	$	5,000	$ 5,000
Road Improvements	1000	m	$	50	$ 50,000
Chain-wire galvanized steel	2400	m	$	25	$ 60,000
Fence Gate	1	unit	$	800	$ 800
Weighbridge	1	unit	$	20,000	$ 20,000
Site office with WC and furniture	1	unit	$	30,000	$ 30,000
Diesel Generator	1	unit	$	2,000	$ 2,000
Contingency	15%				$ 111,945
					$ 858,245
Sanitary Landfill Cell for 5 years					
Excavation of soils/rocks	33,750	m3	$	12	$ 405,000
Grading of base to 2%	45,000	m2	$	3	$ 112,500
Excavation of clay liner	22,500	m3	$	6	$ 135,000
Transport (per 100 km)	25	km			$ 117,000
Grading and compacting at 2% slope	22,500	m3	$	7	$ 157,500
Perforated 150 mm pipe	5,625	m	$	18	$ 101,250
Main drain: non perforated 300 mm pipe	320	m	$	70	$ 22,400
Excavation of gravel layer of 0.5 m	22,500	m3	$	6	$ 135,000
Gravel layer of 0.5 m	10	km			$ 57,600
Contingency	15%		$	1,243,250	$ 186,488
Total 1 cell		1			$1,429,738
Total No. of cells		4			**$5,718,950**
Sanitary Landfill Operating Costs					per year
Bulldozer fuel costs	1,557.3		$	10	$ 15,573
Bulldozer maintenance costs	5%		$	130,000	$ 6,500
Excavator fuel costs	519.1		$	5	$ 2,596
Excavator maintenance costs	5%		$	110,000	$ 5,500
Flatbed fuel costs	1,713.3		$	4	$ 6,853
Flatbed maintenance costs	5%		$	10,000	$ 500
Facilities maintenance costs	3%		$	112,800	$ 3,384
Workers	20		$	1,400	$ 28,000
Landfill top cover w. grading and compacting (annualised)					
Excavation of clay liner for top cover	4,500	m3	$	6	$ 27,000
Transport	50	km			$ 46,800
Grading and compacting clay at 2% slope	4,500	m3	$	7	$ 31,500
Bulldozer hours for cell closure	156.00		$	30	$ 4,680
Excavator hours for cell closure	52.0		$	15	$ 780
Contingency	15%				$ 26,950
					$ 179,666

Table 3: Cost Estimates for a City Landfill

Consulting fees					
Feasibility					
Detailed Design	5.0%		$ 2,357,897	$	117,895
Construction supervision and monitoring	1.0%		$ 2,357,897	$	23,579
Land acquisition costs		m2	$ 3.7	$	-
Resettlement costs	150	HH	$ 913	$	273,750
Equipment and Site Preparation					
Bulldozer TY 165-2 (17 tonnes)	1	unit	$ 130,000	$	130,000
Bulldozer shipping & spare parts	1	unit	$ 20,000	$	20,000
Excavator John Deere 75G	1	unit	$ 110,000	$	110,000
Flatbed Truck (provided by Env. Agency)	1	unit	$ -	$	-
Leachate treatment plant	-	unit	$ 200,000	$	-
Pond and gasoline pump	1	unit	$ 1,000	$	1,000
Hose and spreader for leachate recirculati	200	m	$ 5	$	1,000
Groundwater monitoring wells	4	units	$ 4,000	$	16,000
Trees around site	1	lot	$ 5,000	$	5,000
Road Improvements	150	m	$ 50	$	7,500
Fence around landfill	800	m	$ 25	$	20,000
Fence Gate	0	unit	$ 800	$	-
Weighbridge	0	unit	$ 20,000	$	-
Site office with WC and furniture	0	unit	$ 30,000	$	-
Diesel Generator	1	unit	$ 2,000	$	2,000
Contingency	15%		$ 312,500	$	46,875
				$	**359,375**
Sanitary Landfill Cell for 5 years					
Importing fill (2.5m depth)	37,411	m3	$ 4.0	$	149,645
Grading of base to 2%	14,965	m2	$ 3	$	37,411
Excavation of clay liner	7,482	m3	$ 6	$	44,894
Transport (per 100 km)	25	km		$	38,908
Grading and compacting at 2% slope	7,482	m3	$ 7	$	52,376
Perforated 150 mm pipe	1,871	m	$ 18	$	33,670
Main drain: non perforated 300 mm pipe	193	m	$ 70	$	13,510
Excavation of gravel layer of 0.5 m	7,482	m3	$ 6	$	44,894
transport of gravel	10			$	19,155
Contingency	15%		$ 434,461	$	65,169
Total 1 cell				$	499,631
No of cells		4		**$**	**1,998,522**
Sanitary Landfill Operating Costs				per year	
Bulldozer fuel costs	389.3		$ 10	$	3,893
Bulldozer maintenance costs	5%		$ 130,000	$	6,500
Excavator fuel costs	129.8		$ 5	$	649
Excavator maintenance costs	5%		$ 110,000	$	5,500
Flatbed fuel costs	441.2		$ 4	$	1,765
Flatbed maintenance costs	5%		$ 10,000	$	500
Facilities maintenance costs	3%		$ 22,000	$	660
Workers	16		$ 1,400	$	22,400
Landfill top cover w. grading and compacting (annualised)					
Excavation of clay liner for top cover	1,496	m3	$ 6	$	8,979
Transport	20	km		$	6,225
Grading and compacting clay at 2% slope	1,496	m3	$ 7	$	10,475
Bulldozer hours for cell closure	51.88		$ 20	$	1,058
Excavator hours for cell closure	17.3		$ 10	$	176
Contingency	15%		$ 68,781	$	10,317
				$	**68,781**

Table 4: Cost Estimates for Transport of waste from Probolinggo to a Regional Landfill

Waste transported		43	tonnes/day	
Compacted waste density		0.5	tonnes/m3	
Waste volume		86	m3/day	
Truck volume		15	m3	
Round trips		5.7	per day	
Round trips per working day		8.0	per day	2 trucks necessary
Distance (round trip)		60	km	
Fuel consumption		3	km/ltr	
Fuel price	$	0.68	ltr	
Fuel price daily	$	108		
Fuel price annual	$	26,006		
Salaries	$	385	per month	
Annual salaries	$	4,618	per year	
15m3 compactor truck	$	90,000	unit	
Economic life		7	years	
Annualised	$	25,714	straight line	
Vehicle maintenance	$	9,000	5%	
Annual cost of transport	$	65,338		
Contingency	$	9,801	15%	
Total cost per km	$	0.60		
Total cost per tonne	**$**	**4.79**		

3.3 Least Cost Option

To recommend the most appropriate solution for the City to pursue for a future landfill site – for the next 20 years after the small cell (currently under construction) is full – the operational costs of the local landfill site have been evaluated against the minimum feasible tipping fee (equal to the estimated operational costs) of a regional landfill site plus the additional transport costs associated with this option.

The operational costs for a local landfill, USD 4.41 per tonne, are significantly higher than the hypothetical regional landfill site (USD 3.08 per tonne). This is to be expected as machinery is utilised more effectively on a larger site. However, when estimated additional transport costs (USD 4.79 per tonne) are added to the regional landfill operational cost (and therefore minimum tipping fee charges to the City), the cost per tonne increases to USD 7.87 per tonne for the regional landfill site option.

To compare these options in terms of least cost to the City of Probolinggo, only the operational cost per tonne is compared[9]. This assessment of both options clearly shows that the local landfill solution is significantly cheaper for the City, USD 4.41 per tonne Vs USD 7.87 per tonne.

If solid waste generation (and collection and delivery to landfill) increases in Probolinggo Regency in the next 10 to 15 years, the possibility of establishing a regional landfill site may become financially feasible.

[9] It is assumed that the capital cost in both scenarios is externally funded. In the case of the City option this would be national budget, and in the Case of the Regional option this would be provincial, national, or donor funded.

3.4 Stakeholder Interest in a Regional Landfill

As stated the section of Weaknesses in the Landfill Feasibility Study above, the *Feasibility Study of Regional Landfill Construction* was made by Asta Tiga without any form of consultation with the proposed partners. Probolinggo Regency, as well as both the City and Regency of Pasuruan have been informed of the possibility of a regional collaboration over a regional landfill over the past months of this PFS.

The Consultant has identified very little interest in a regional landfill within the two Cities and two Regencies. The responses during meetings from the stakeholders were as follows:

- Probolinggo City already has long-term plans as described in their SWM Masterplan. The City did express some interest in working together with Probolinggo Regency, but it was clear that Pasuruan City and Regency were firmly excluded from any considerations. During the second Workshop, the head of Bappeda, Pak Imanto expressed that the possibility of a regional landfill should be reconsidered 20 or 30 years from now.
- Probolinggo Regency initially expressed interest in operating a regional landfill in the western part of their Regency; as this would lessen waste transportation costs for this part of their district.[10] At this time, the Regency assumed that as the landfill would be on their land, all operating costs would be borne by the other stakeholders. The *2014 Regional Landfill Feasibility Study* was commissioned by the Chairman of the Environment Department who has since been replaced by a new individual "who appears to be far less enthusiastic about the concept." [11] At the first Workshop, Probolinggo Regency stated that they are now seeking a local solution, so that they will have a second landfill serving the western part of their Regency.
- Pasuruan City has a landfill capacity for the next 50 years and had absolutely no interest in a shared landfill.
- Pasuruan Regency expressed interest in a regional landfill, though this attentiveness was probably most due to the fact that the Regency's existing landfill is almost full and at present there are no tangible plans for its successor.

Hence, at the first Workshop on 15 October, none of the three participating stakeholders expressed interest for a regional landfill. There are two concerns that have been repeatedly stated by the potential stakeholders regarding a regional landfill. Firstly, worries over excessive transportation costs. Secondly, fear that the stakeholders will be unable to collaborate smoothly over the shared use of a landfill. This is seen as the primary risk to moving forwards with a regional landfill solution.

3.5 Social Aspects

Legally, and in order to provide a healthy and prosperous living environment for citizens including the poor, City government is obliged to provide proper waste management for society within its jurisdiction. In poorer regions/cities, revenues collected locally are unable to cover the costs of waste management leading city governments, including Probolinggo City, to allocate Local Development Budget (generally comprising that transferred from National/Government Budget) for this activity.

[10] Head of Probolinggo Regency Environmental Agency 5 August 2015.

[11] Minutes of a 29 July 2015 meeting between Asta Tiga, CDIA and CRM.

In understanding of this, the Medium-Term National Development Plan (2015-2019) states that public funding will be prioritized for development in areas of low revenue society, accelerated development priority areas, and for social service programmes. Table 5, below, presents a comparison of poverty nationally, and for the two regencies and two cities in question.

Table 5: Poverty statistics of relevant authorities

% of Population Living Below the Poverty Line	2008	2009	2010	2011	2012
National*)					
• City	11,65	10,72	9,87	9,23	**8,60**
• Village	18,93	17,35	16,56	15,72	***14,70***
• City + Village	15,42	14,15	13,33	12,49	11,66
Probolinggo City**)	23,29	21,06	19,03	17,74	**18,33**
Pasuruan City***)	11,20	9,34	9,00	8,40	7,90
Probolinggo Regency****)	29,23	26,82	25,23	23,48	***22,15***
Pasuruan Regency*****)	NA	NA	NA	12,30	11,50

Sources:

**)* *Central Bureau of Statistics*

***)* *Probolinggo City in figure 2014, Central Bureau of Statistics of Probolinggo City*

****)* *Pasuruan City in figure 2014, Central Bureau of Statistics of Pasuruan City*

*****)* *Probolinggo Regency in figure 2014, Central Bureau of Statistics of Probolinggo Regency*

******)* *Pasuruan Regency in figure 2014, Central Bureau of Statistics of Pasuruan regency*

3.5.1 *Impact on the Poor*

The establishment of a new landfill should have impact on the enhancement of people's prosperity, and especially people around the landfill location, including poor and vulnerable people. Sometimes, infrastructure development projects actually benefit only those groups of people who can afford to pay for the services provided. Therefore, the City Government should guarantee that the construction of the landfill does not increase the service fee to a level beyond which people cannot afford to pay, and thus in turn increase the number of the poor – or those without access basic infrastructure services.

Considering the limited poverty reduction in recent years, it is important (in Probolinggo now) that infrastructure focuses on poverty reduction as low-income communities may slowly form indifference towards development programmes. Whilst this is true, in general, Probolinggo City has a well-functioning SWM system, widely serving the entire population.

Aspects of establishing a new landfill and SWM system which may have positive and negative impact for poor and disadvantaged segments of the urban population are listed below in Table 6. Many of these aspects have already been accommodated as best practice in Probolinggo. The list therefore illustrates the linkages between enhanced SWM and living conditions for poor and disadvantaged people.

Table 6: Impacts of improved Solid Waste Management on Society, including the poor

Beneficiary	Impact	Addressed?
Poor Households	The new landfill project has to ensure that poor households are always serviced. Through the project good habits emerge, for instance in terms of reusing materials and reducing the consumption of single-use household items and thus, poor household expenses will be relatively reduced.	Yes

Beneficiary	Impact	Addressed?
Females	The current approach to solid waste management in Probolinggo positively impacts women. The project will increase the awareness of every household member about waste management not being only the responsibility of female household members but also of the male. Often waste problems belong to the female, due to habits of each household in treating the waste. Including decision making regarding fee payment, responsibility of waste management education to other household members, waste collection and segregation. The project may lead to positive mind-set change of each member of the household.	Could be improved under the Project
Female head of households	In Probolinggo female heads of households rarely participate in meetings regarding sanitation improvements. They tend to 'follow' decisions made in the community/kelurahan. In order for them to be more active, starting from planning, implementing and monitoring, it is required representatives of the authority in question approach the community through activities that female households head often participate in, such as local women's organization and religious activity. Or the representatives can also personally visit them with information and guidance.	Could be improved under the Project
Children	The project representatives also need to approach this group. These groups tend to be less concerned about the cleanliness of the environment. Approach through schools is one way to give an early understanding on the importance of good waste management. So that in the future the good aspects of waste management will become basic needs just like the need for food.	Could be improved under the Project
Public Health	The impact of good waste management activities will lead to a cleaner residential neighbourhood with reduced risk of diseases caused by poor hygiene, environmental pollution, and accumulation of inorganic waste. Low-income people are generally less concerned about the health of their environment. They are more concentrated on the fulfilment of basic needs such as meeting food needs, school fee, etc.	Yes
Employment	The implementation of these activities may lead to new job opportunities for the affected people especially the poor such as scavengers, waste collectors and street sweeper.	Yes
Law enforcement	The improved SWM will have to ensure that the regulations are applied universally and consistently against any party that does not adhere to proper waste management regulations and fee payments, and thus in general support social justice and the rule of law.	Could be improved under the Project
Affected people	The project to establish a new landfill must ensure that the resettlement and compensation costs for the loss of assets and jobs are done in line with current regulations.	Under any project

If suitably implemented, either landfill option, coupled with outreach campaigns (discussed in Section 6), proper land acquisition and resettlement and an awareness of job / loss creation will have a positive impact on the poor by improving solid waste management and maintaining service provision for waste collection and disposal.

3.5.2 *Job Creation*

In terms of job loss/creation, communities within Probolinggo that are identified as directly affected by establishment of a new landfill (either a city landfill or a regional landfill) include scavengers on the existing site and existing employees of Probolinggo EA involved in landfill operations – approximately 25 staff.

A local landfill project will have limited impact in terms of loss or creation of these directly related jobs, though temporary construction work will be available. Improved collection, segregation, transport and community recycling (throughout the City SWM system) may create jobs, entrepreneurship, and additional revenues across the City.

A regional landfill project may cause loss of local jobs directly related to landfill operations and scavenging, and therefore a scheme to transfer jobs to a regional project should be established during any discussions on collaboration and implementation and should be agreed by the institutional stakeholders and the implementing authority. Additional jobs will however be created in transportation of waste to any landfill site located outside of the City. Again, improved collection, segregation, transport and community recycling (throughout the City SWM system) may create jobs, entrepreneurship, and additional revenues across the City.

Table 7, below, summarises these job creation issues from the perspective of Probolinggo City.

Table 7: Potential job creation opportunities of local and regional landfill options

Regional Landfill Opportunities	City Landfill
1. Involvement in the infrastructure construction job	Increased locally
2. Community involvement in waste management activities	Similar locally
3. Recycling and waste bank business opportunities through the City solid waste management system.	Similar locally
4. Landfill related formal jobs: technical and operations.	Less locally
5. Establishment of schemes for transferring technical staff presently working at the existing city landfill to the regional landfill.	
6. Employment of additional truck drivers for transporting city waste to the regional landfill.	

Essentially, in summary, the regional landfill solution offers additional job opportunities for truck drivers but also the challenges of transferring present city landfill technical staff to the regional landfill.

3.5.3 *Affected People*

The people that would be affected by a local landfill project are those that occupy the government land allocated for the proposed new City landfill site. The people affected by the regional landfill option would be the owners of the land who may lose productive land and thus a portion of their livelihood (compensation will be paid for this).

Under the City landfill project, it is important to take proactive measures to protect affected people beyond compensation and resettlement. Schemes including skill development and employment opportunities should be considered and the affected people should be consulted throughout the process, for example by:

a) Giving access for affected people as scavenger on landfill location;
b) Giving skill trainings like carpentry, machinery, husbandry package, farmland business package such as food processing package from cassava, banana, and nursery package, grocery store package for affected head of household whether it is male / female head of household;
c) Facilitation of the government in creating 'recycle' business community especially for females affected household including skills training and helping them in marketing the products so that they may have additional income;
d) Facilitation of other skills (sewing, cake making, etc.) for productive female of affected household;

e) Giving guarantee for the affected male/female head of household to capital access; and,
f) Affected household prioritized and integrated to government program like small enterprises development program and farm enterprises credit.

Resettlement and Land Acquisition

The plan of establishing a new city landfill or a regional landfill requires careful planning and land area acquisition, as well as participation of people. Many issues can arise during land acquisition such as land owner rights, compensation, and land ownership controversy. If necessary, land acquisition is followed by resettlement of any occupants residing on the land. As well as loss of land, assets have to be attended to, and affected people given fair compensation.

Furthermore, social impact such as loss of kinship ties, social ties and livelihoods must also be mitigated. It means that the resettlement plans has to be planned well and should consider the social and economic aspects of the people affected.

Both legal and illegal occupants must be given fair compensation for loss of employment and / or assets. Essentially, affected people should have life as before or better when the project starts at the new location.

<u>New sanitary landfill in Kota Probolinggo</u>

The development of a new city sanitary landfill is planned on the 6ha area belonging to the City of Probolinggo, so land acquisition is not necessary. This choice of location is in accordance with the Spatial Planning of Probolinggo City. The location was originally a vacant land. However, currently, the proposed area is used by people as a residential location, as well as for small businesses, fish ponds, recycled waste collection stalls, and public facilities such as mosque.

The population affected indirectly for this project covers the majority of RT 8 RW 7, RT 8 and RT 9 of RW 1 Kelurahan Sukabumi, Sub-District of Mayangan in the form of (limited) increased traffic density during construction.

The number of people who occupy this land area owned by the City is approximately 150 households (450 people)[12] in two RTs, namely RT 7 and RT 8. They have been living in this city owned location for many years and have established a strong social community unit. Both RTs are administratively parts of Kelurahan Sukabumi Sub-District of Mayangan.

Law No.1 / 2011 regulates that the residents settlement area must be in accordance with the spatial plan and the government has authority on its control. This means that the government has the authority to perform the control of the affected people, who live in this location. Based on Law No.2 / 2012, people who receive full compensation are those, who own certified land (legally). So affected people who are occupying government land can be relocated, and government is only obliged to provide new housing for them, not ownership. Accordingly, these affected people will often be relocated to rental apartments in government owned buildings which are available in Probolinggo – at least initially.

Although the existing regulations only cover land and/or building replacement or relocation, international financing institutions (IFIs)will have policies about guarantees to affected people includes compensation to

[12] These numbers are based on information provided by representatives of the households in the area.

cover the loss of income or livelihood sources, and this will need to be considered by the city government, particularly if the project were to be financed by an IFI. Such policies prevent increases in the number of the poor as an effect of the project, which is the principle which underpins their financing programmes. City Government in this case may refer to the above Section 6.3 about job opportunities. Conducting public consultation and approaching the key persons of communities can also be done to accommodate the differences of interest between the government and affected people to negotiate a fair solution for the loss of shelter and livelihoods.

In 2010, the City Government offered to the affected people in RT 7 and some of RT 8 to move to Bestari rental apartments (east side of the harbour) with compensation of 10 million rupiahs, but it was only 10 household that were willing to move to that location. Cost estimates are discussed in the Section on Assumptions above.

As the landfill site should be developed in sequential cells, there is time to undertake detailed consultation with the affected peoples currently residing on the site, and come to a fair solution for both parties, and find suitable land or housing for relocation. However this process should commence as soon as possible.

Regional Landfill

The plan for a regional landfill has identified an area in Tongas District of Probolinggo Regency. The planned land area is 25 ha, unoccupied and subject to property rights of individual people. Undertaking negotiations and establishing property ownership presents a risk which could cause delays to the project, this is a common problem in Indonesia.

Land acquisition has not yet started, but if it were to go ahead, it would have to be in accordance with a Land Acquisition and Resettlement Action Plan (LARAP). In addition, the government also has regulations that regulate aspects of land acquisition for the implementation of development for public interest through Law No.2/2012. In this regulation, the process of land acquisition for public purposes may be preceded by an agreement with the land owners including pre-set time limit. But if such an agreement fails, the acquisition process shall be resolved by the applicable law. Land acquisition processes can take quite a long time, often at least 3 years.

This location would present limited resettlement issues, only concerning aspects of land acquisition. President Regulation No. 65/2006 has been set up on land acquisition for development implementation in the public interest. Land acquisition is done based on principles of humanity, fairness, usefulness, certainty, transparency, agreement, participation, welfare, sustainability and harmony.

If establishment of the regional landfill will be through IFI loans, the process of land acquisition will have to accommodate donor policies in addition to the existing rules in Indonesia.

3.6 Risk Assessment for a Regional versus a Local Landfill

As can be seen in the above sections, a regional landfill does not present Probolinggo City with a financially better waste disposal option and it can also be noted that the potential users of such a landfill have shown almost no interest for a regional solution. Appendix 2 the risks and benefits of the two options, providing a useful summary of this Section of the Report Chapter. The key risks for Probolinggo City pursuing a regional landfill option in the near future are institutional and waste generation (which are both linked to the financial sustainability). These risks are linked, in terms of both collaborating (to some degree) to implement and operate the project, and delivering waste in the quantities predicted and agreed and therefore ensure the project is financially sustainable, thus helping to avoid disputes. Experience in other developing countries reinforces some of these concerns, as can be seen in the following bullet points

covering the (sometimes adverse) impacts of transportation distances, tipping fees and collaboration agreements:

- For a municipal waste management company, the two biggest expenses are generally fuel costs followed by salaries. Therefore, landfills (or dumpsites) are generally within 10 km of the city.[13] For cities where there are private waste transporters, for example for industrial waste, these can be tempted to dump their collected waste illegally elsewhere; simply to save fuel. For administrations with weak institutions, actually catching and punishing such perpetrators can be very difficult.
- Landfill tipping fees can also easily lead to illegal dumping as independent waste transporters seek to minimise their costs. When the first PPP landfills opened in Malaysia about 15 years ago, very large quantities of collected waste never reached the sanitary landfills but were instead dumped along the access roads.
- For both regional landfills and commercial (for example PPP) landfills, the tipping fee frequently causes the waste collectors not to deliver waste to the landfill. The root problem is financial: The (usually municipally owned) waste management company has cash flow problems and cannot pay the tipping fee. So appropriate excuse will be invented and the waste will be transported elsewhere, usually to the town's/ city's old dumpsite or landfill. The regional or commercial landfill's lack of revenues means that it in turn cannot meet its license conditions (for example covering the received waste with soil or operating their leachate treatment plant to meet effluent standards); thereby offering further excuses to those who do not wish to pay a tipping fee. In these situations, the contractual agreements generally have no authority whatsoever.

The cost of operating a sanitary landfill is often forgotten by donors. Large cities such as Jakarta, Bangkok or Ho Chi Minh City have no major problems operating sanitary landfills; firstly they benefit from an economy of scale [14] and secondly big cities have far higher living standards than surrounding towns. In Vietnam cities similar in population to Probolinggo City have substantial problems operating their sanitary landfills properly. These are landfills built with grants, where all the recipient must pay is salaries, maintenance and operating costs. For some, the cost of fuel for the bulldozer is excessive, so the waste is not covered by soil on the landfill. Likewise, chemicals and electricity (as is the case at Probolinggo City's leachate treatment plant) can be considered unaffordable, so leachate is discharged without treatment. The end result is waste being placed in a $5 million sanitary landfill that has absolutely no environmental (or other benefits) over the dumpsite it replaced.

[13] In developed countries where the waste management costs are higher by a factor of 10 or more, the transportation costs become insignificant. There the cost of high salaries, waste-to energy-plants and expensive recycling dwarfs transportation costs.

[14] Bangkok generates over 8,000 tonnes of MSW per day; considerably more than Probolinggo City's 43 tonnes per day!

4 Institutional Aspects of Waste Management in Probolinggo City

4.1 Background on the City

Probolinggo City is one of the 38 regencies and cities in East Java Province, located on the north coast of Java at the Madura Straight. The bay is bounded on its north side by the Madura Island, and the city is thus to some extent sheltered from typhoons coming from the Java Sea.

Probolinggo City includes 5 sub-districts (kecamatan) and 29 wards (kelurahan) and has 220,000 inhabitants. The built-up area of the city consists mostly of 1-3 story buildings, and except for the main streets, it is characterized by detached buildings in an open, not densely built-up urban landscape. The street pattern of the sub-districts in the northern part is rectangular, and besides a railroad, a national highway passes through the city from west to east on the way from Surabaya toward Bali.

The total area of the city is 56.67 km^2. The wards in the southern parts include agricultural land and are sparsely built-on, except construction along the main roads. The terrain shelves from approximately 50 meter above normal sea level at the southern border of the city to 0 metres by the coast.

The city appears clean and green and with a well-functioning and effective solid waste management system. The soil is fertile and the groundwater clean. Located as it is at a low-lying coastal area, the city is at the receiving end of rivers and water streams coming from the surrounding Probolinggo Regency and the steep volcanic slopes in the southern part of the Regency.

4.2 Institutional Framework

Table 8 describes the distribution of authority between the Central, Provincial, and City/Regency Governments on waste management:

Table 8: Distribution of waste management responsibilities

Central Government	Provincial Government	City/Regency Government
1. Determine national policy and strategy of waste management.	1. Determine policy and strategy in managing the waste according to capital government.	1. Determine policy and strategy in managing the waste according to capital and province government.
2. Determine the norm, procedure and criteria of waste management.	2. Facilitate the cooperation between regions in certain province, partnership, and network in waste management.	2. Implement city/regency waste management in accordance with norm, standard, procedure, and criteria determined by government.
3. Facilitate and develop the cooperation inter-partnership areas and network in waste management.	3. Implement coordination, founding, and monitoring the performance of city/regency government in waste management.	3. Implement performance guidance and monitoring of waste management by third parties.
4. Implement coordination, guidance, and monitoring the performance of province government in waste management.	4. Facilitate conflict solution between city/regency in a province about waste management.	4. Determine the location of temporary dumpsite, integrated waste management site, and/or landfill.
5. Determine inter-regions conflict solution policy in waste management.		5. Implement monitoring and evaluation once every 6 month for 20 years of the closed landfill.

Central Government	Provincial Government	City/Regency Government
		6. Plan and implement emergency response system of waste management based on the authority.

Source: Law of Republic of Indonesia Number 18 Year 2008 about Waste Management

In every city/regency, different institutions are given authority to manage the waste in their area. In some cities/regencies, the authority is under the public work department, the sanitation and gardens department or under the sanitation, gardens and funeral department. In other cities/regencies, it is under the Environmental Agency, as it is in Probolinggo, which is effective relative to other Cities in Indonesia. Much is decided by the Mayor's policy in each city/regency, based on their autonomous authority.

According to Local Regulation of Probolinggo City No. 4 year 2012, the Mitigation and Management division, under the Environmental Agency, handles waste management in Probolinggo City. This division monitors, controls, evaluates and reports on waste management and is fully responsible to ensure that Probolinggo City remains clean and free of waste.

Waste management is not the sole responsibility of the government but also requires active citizen participation – without citizen participation, the programs are bound to fail. Local Regulation of Probolinggo City No 5/2010 organizes this role distribution. Article 22 regulates that the citizens can participate in waste management activities which is organized by the Local Government, in the form of:

a) Provide suggestions to the local government on waste management activity;
b) Provide suggestions and/or advice in formulating waste management policies; and,
c) Provide suggestions and/or advice in waste related dispute settlement.

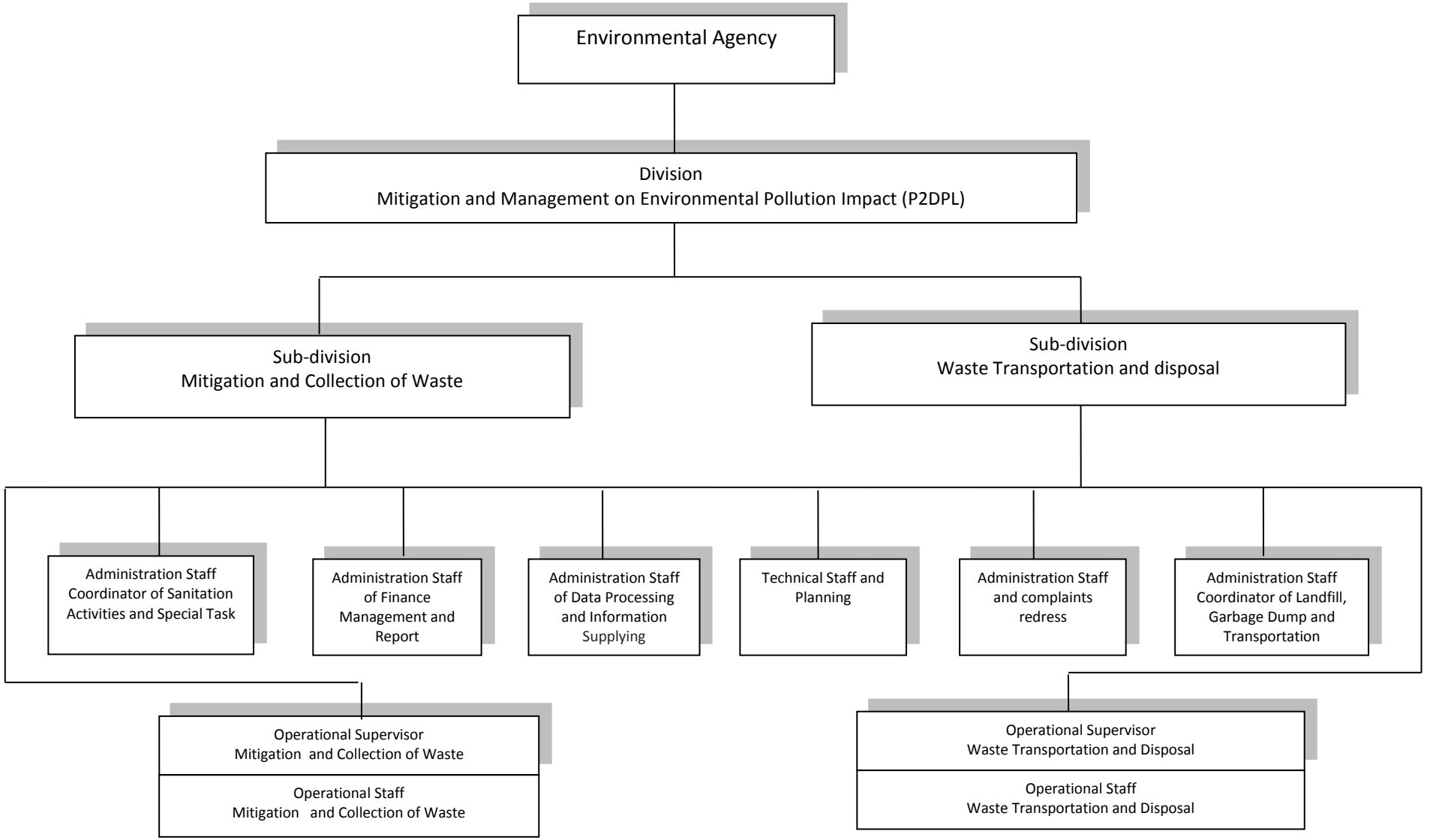
4.2.1 *Responsibilities*

The Mitigation and Management of Environmental Pollution Impact Division (P2DPL) is a Division of the local Environment Agency. It has responsibility for mitigation (or minimisation), monitoring & controlling, collection, transportation, and disposal of waste, and has the overall functions of:

a) Formulating work schedules;
b) Planning and formulating technical implementation;
c) Implementing coordination of facilities, and task guidance;
d) Monitoring, controlling, evaluating and reporting activities; and,
e) Implementing other official duties given by the head of the Agency.

The structure of P2PDPL is described in Figure 1, below.

Figure 1: Organizational structure of P2DPL



The subdivision of Waste Mitigation and Collection is responsible for mitigation and management of environmental pollution and has the functions of:

a) Accumulation and research of laws and regulation, technical guidance, implementation guidance and other orientations related to waste management;
b) Structuring program and activity plans;
c) Job distribution, guidance and evaluation of work ;
d) Monitoring, advising, evaluating and reporting in the field of waste management;
e) Monitoring and implementing emergency response systems as a result of pollution and/or corruption related to forest fires and/or natural disasters;
f) Planning, supplying, and preserving facilities related to waste management including waste containers and collection facilities;
g) Planning and implementing socialization to actualize society awareness and participation in the field of waste management;
h) Coordinating and managing partnerships between related institutions, societal elements, and the private sector;
i) Implementing, monitoring and managing the leachate treatment system;
j) Structuring program and activity implementation reports including financial management of its programs; and,
k) Implementing other official duties given by the head of the agency suited with the task and function.

The Waste Transportation and Disposal Sub-division is responsible for the prevention and treatment of pollution in waste transportation and has the functions of:

a) Accumulation and research of the laws and regulation, technical guidance, implementation guidance and other orientation relate to waste transportation and disposal;
b) Structuring program and activity plan also the implementation on rubbish and waste transportation and disposal sub-division;
c) Job distribution, guidance, also evaluation of work result of the subordinates in the work implementation;
d) Implementation of monitoring, advising, evaluating and reporting in the field of waste management mobilization including operational monitoring on waste transportation, landfill and garbage dump operational, also reporting the waste transportation and disposal condition;
e) Implementation of planning, supplying, and preserving facilities and infrastructure of waste transportation and disposal including waste container and collection, landfill, and decomposing;
f) Implementing coordination and partnership between related institutions, society elements, and private sector in waste transportation and disposal ;
g) Structuring program and activity implementation report and finance realization of waste transportation and disposal sub-division; and,
h) Implementing other official duties given by the head of the agency suited with the task and function.

4.2.2 *Waste collection*

Waste management and collection in Probolinggo is generally very effective and is reliant on good community outreach and empowerment.

Cost recovery is however currently poor, as described in the Financial Technical Note (2), while this is a social and institutional issue, it has been summarised in that note (2) for completeness, including proposed recommendations for improvement have been proposed.

There are two types of waste which the city has a responsibility to manage:

a) Household waste produced by daily household activities, not including liquid waste; and,
b) Waste originating from commercial and industrial activities, social facilities and public facilities.

Waste from Household Communities

Probolinggo City implements a 3R system at the community level in an effort to reduce the amount of waste arriving at the landfill.

Organizing waste management at the community level involves community level stakeholders from the ward (Kelurahan), and hamlet (RW), and neighbourhood (RT).

Rukun Tetangga (RT) is the smallest organization in the governance structure in Indonesia, consisting of a number of households, whose functions is to manage the interests of the surrounding community and to manage the community services set by the Kelurahan (Village). It also functions as a representative arm of, and working with, local government.

Rukun Warga (RW) is an organization within the governance structure in Indonesia, which serves to coordinate the management of RT and manage the interests of its surrounding community in Indonesia under Kelurahan (ward). It is formed based on the local community meetings in the framework of community services set by the Kelurahan.

P2DPL works with, and educates RW/RT when there is a need to socialize, and disseminate the importance of, behavior in solid waste management at the community (RW/RT) level.

The head of the Kelurahan, RW/RT holds a role as a facilitator of 3R activities. The head of RW/RT facilitates the availability of waste management employee, whose duty is to transport household waste to the transfer station. The employee is paid by citizens in each neighbourhood.

Household fees for this service vary depending on the agreement between the waste management employee and the household, but from field observations it was found that this is approximately Rp. 10.000/month. The payment is coordinated by the local RW/RT. Cost recovery, including institutional aspects related to cost recovery are covered in the Technical Note (2) on Finance.

At the kelurahan level (and at schools), Waste Bank Communities and Group Societies (POKMAS) are active and crucial to waste management at the community level. Based on the 2013 data from the Environmental Agency, there were 26 Waste Bank Communities and 96 POKMAS. The existence of these community level organisations helps to reduce the amount of waste which arrives in the transfer station/landfill, therefore contributing to both financial and operational performance.

The sorted waste consists of recyclable materials which can be made into various marketable products. Alternatively, they also serve the needs of the members themselves while 'useful' waste can be sold to the waste collector or Technical Operations Unit-Waste Management. Primarily, this consists of collecting organic waste (for compost) from the environment of which 30% is then sold to the Technical Operations Unit Waste Management. This waste usually serves in the making of compost.

Sources of waste from commercial and industrial areas, social and public facilities

Waste from these sources is organized by Environment Agency Officers. The responsibility of waste mobilization from the source of waste and/or from transfer station is taken by the Environmental Agency officer under the coordination of Waste Management Mobilization. The organization of fee payments in these areas is done by the Environmental Agency officer.

4.3 Assessment of Institutional Capacity

Table 9, below, provides an overview of staffing numbers in P2DPL:

Table 9: Staffing breakdown of P2DPL

Division/Department	Staff numbers
Total Environmental Agency Staff	454
P2DPL Staff	180
Sub-division Mitigation and Collection of Waste	115
Sub-division Waste Transportation and Disposal	47
Administration Staff	15
Technical Staff and Planning	3
Operational Supervisor Mitigation and Collection of Waste	3
Operational Staff Mitigation and Collection of Waste	112
Operational Supervisor Waste Transportation and Disposal	2
Operational Staff Waste Transportation and Disposal	45

The overall capacity of the Environmental Agency is good and staffing and technical capacity within sub-divisions is reasonable relative to other Indonesian Cities.

With respect to solid waste management and awareness raising the technical capacity is very good. That is why they have one of the best waste management systems in Indonesia, resulting in a very clean city, a well-managed sanitary landfill and high levels of waste minimisation, reuse and recycling. In terms of this best practice, the Environment Agency has facilitated the establishment, or has encourage waste management initiatives, with various society groups in Probolinggo City such as pedi-cab (tricycle taxi) association, association of the handicapped, scavenger association, Islamic student association, cart operator association, market society association, street vendors association. This has led to improved society awareness of solid waste management issues and contributes to the clean city goals of Probolinggo.

The Environmental Agency is weaker within areas such as monitoring of polluters and enforcing regulations. The main reason for this is political - the enforcement of environmental regulations is not a high priority for local government relative to health (for example) or commercial/industrial development and job creation. For example, the Agency cites the main hospital for poor healthcare waste management or an industry for water or air pollution, the "guilty" party will appeal and local

government may accept the appeal (as the hospital does not have the necessary funds for proper waste management and the industry will threaten loss of jobs).

4.4 Recommendations for institutional capacity development

The Environment Agency is currently responsible for both waste management operations in Probolinggo City, covering awareness raising, recycling activities, waste collection and waste disposal, as well as the monitoring and enforcement of these activities. Hence, this department is both responsible for the waste management operations, as well as the enforcement activities to ensure that these operations are in compliance with their licenses. Such a situation can easily crease conflicts of interest for the department, for example: The department has insufficient funds to operate the city landfill in accordance with the issued license; therefore the department does not enforce the license requirements when inspecting the landfill.

It is proposed that this is re-structured to a three branch structure where:

- One branch is responsible for the legislative/ regulatory the side of SWM (already the case with the City Hall)
- One branch is responsible for waste management operations (at present the EA, but it is recommended that an entity such as a Local Public Service Entity is established)
- One branch is responsible for monitoring and enforcement operations (at present the EA and it is envisaged this should be their sole responsibility in the long term.

Through consultation, the City of Probolinggo has agreed that this is a sensible approach and is now tentatively planning to separate out the waste management operations from the Department of Environment and create a public utility providing this service.

This could be in the form of a new agency, e.g. a Local Public Service Agency (BLUD - Badan Layanan Umum Daerah), and let operation be done by a technical operations unit responsible to the head of this new agency as a Local Government Unit (SKPD - Satuan Kerja Perangkat Daerah). This would place responsibilities for operations at same level as the Environmental Agency, which then only would be responsible for SWM supervision as regulator and monitor.

Another option for consideration could be transferring the SWM operations function to the existing Public Works Agency. A SWM operations unit here would then be responsible to the head of Public Works Agency. SWM operations are handled by entities under public works or similar agencies in many other countries.

A number of cities in Indonesia have implemented similar organizational changes, and it is recommended that before finalising this institutional restructuring, training is delivered to relavent staff (EA, City Hall and Public Works) by City government organizations within Indonesia that have already experienced implementing such organizational restructuring. The purpose, duration, provider, number of participants, venue and a rough cost estimate are indicated for this training event are provided in Appendix 1.

5 Financial Aspects of Waste Management in Probolinggo City

5.1 Review of the City budget

This section covers background information of Probolinggo City's financial situation. The aim of this is to help establish a baseline to understand financing options for improvements to the city's SWM system.

Table 10 below shows actual budget of revenue and expenditure of the city of Probolinggo for the last 5 years.

Table 10: Actual Budget of the City of Probolinggo (IDR, Billions)

	2010	2011	2012	2013	2014	Growth	Share
a. Revenue	517.2	565.2	614.2	682.4	872.8	13.97%	100.00%
i. Own Revenue	45.7	57.5	69.3	78.4	135.1	31.10%	11.87%
ii. Transferred	438.9	491.2	535.6	596.9	683.4	11.70%	84.45%
iii. Other Income	32.6	16.5	9.3	7.1	54.4		3.69%
b. Expenditure	498.6	578.4	612.7	656.2	778.6	11.78%	100.00%
i. Operating Expense	393.1	471.1	525.9	586.9	670.3	14.27%	84.73%
1. Personnel	257.9	293.4	338.2	366.9	422.6	13.14%	53.74%
2. Non-personnel	135.2	177.8	187.8	220	247.7	16.34%	31.00%
ii. Capital Expense	105.5	107	84.7	68.2	106.9		15.12%
1. Land	1.1	6.4	5.3	0.4	10.2		
2. Equipment & Machinery	27.8	32.8	30.2	22.5	36.2		
3. Construction	37.1	15.8	30.7	25.6	27.6		
4. Road irrigation and drainage	39.2	45.7	18.1	18.3	31.4		
5. Other	0.3	6.4	0.4	1.4	1.7		
iii. Contingencies	0	0.3	2	1.1	1.3	189.56%	0.15%
c. Surplus/deficit	18.6	-13.2	1.5	26.2	94.2	50.02%	4.08%
d. Net Financing	43.6	58.8	43	48.5	74.2	14.20%	8.58%
i. Financing income	44.9	61.4	45.2	48.5	74.9	13.67%	8.80%
ii. Financing expense	1.3	2.7	2.3	0	0.8	-12.34%	0.22%
f. Net surplus/deficit	62.2	45.6	44.5	74.7	168.4	28.27%	12.65%

Source: Actual budget report of Probolinggo City 2010-2014

Revenue

The table above shows that the total revenue has increased by around 14% on average for the last five years which supported by growth in 'own revenue' by 31%, followed by growth in 'transfer' (from Central and Provincial Government) by 11.7%. Note that though the own revenue has high growth rate it just made up of 11.9% of the total, whilst the transfer made up 84.5% of the total.

This illustrates the Cities dependence on government transfers and limited ability to raise revenue locally. This is common in Indonesia and illustrates that the City is far from operating as an autonomous authority.

The lack of financial independence of local governments is a common phenomenon throughout Indonesia. Many local governments are still heavily dependent on the transfer of funds (from Central and Prvincial Government) as the main source of funds for development.

Own Revenue

According to the city's financial report, local tax contributes the highest proportion to 'own revenue'. The major local revenues are local taxes comprised of streetlight taxes, taxes on land and building transfers, and restaurant taxes.

Capital Expenditures

An indicator of the development of public sector infrastructure can be inferred from capital expenditure. Capital expenditure is low relative to personnel and other operational costs and this is unlikely to change in the near future as 85% of the budget is utilised for operational costs (over 50% on staffing). This is not promising for the development of infrastructure, such as funding new landfill projects. However, Capital Expenditure has not grown relative to revenues over the last 5 years as the City has limited capacity to plan develop and implement capital projects. From the budget data it is clear that budget for capital projects is available as a result of continued growth in transferred revenue, and is often under-utilised.

Whilst infrastructure development should consider options beyond 'normal' City budget – i.e. National Government Infrastructure funding (ABPN) – as it is available, there is a possibility for the City to prioritise SWM projects and utilise their own budget for funding a new City Landfill site. For example, in 2014, IDR 27.6 Billion (around $2 Million) was utilised for construction projects, and there was a IDR 94 Billion surplus ($7 million) in the budget.

Finance

Over the last five years, Probolinggo City only ran a deficit in 2011. Which illustrates they are managing their budget reasonably well but, again, as is common in Indonesia, local governments struggle to utilise capital budgets, due to limited project development, procurement, and implementation capacity.

In 2011 the city financed its deficit by allocating excess funds from its previous budget. Probolinggo City has never obtained a domestic loan from any party, sold assets, or obtained receivables for its financing.

5.2 Review of the Environment Agency and SWM budget

Table 11, below summarises the Environment Agency budget with a breakdown of Solid Waste Management expenditures as well and revenues.

Table 11: Environmental Agency Own Revenue and Expenditure 2011 -15 (IDR millions)

	2011	2012	2013	2014	Av. annual growth	Share (2014)
Revenue	**444**	**617**	**669**	**692**	**17%**	
SWM service Fee	82	101	127	132		19%
Other fees	362	516	542	561		81%
Total Expenditure	**19,375**	**17,690**	**21,018**	**23,818**	**8%**	
Operating expenses	17,191	15,513	18,040	21,285		89%
Personnel	*7,854*	*7,038*	*7,897*	*9,718*		*46%*
Goods and services	*9,336*	*8,475*	*10,143*	*11,567*		*54%*
Capital expenses	2,184	2,177	2,978	2,532		11%
SWM Expenditure	**7,289**	**6,533**	**7,129**	**9,469**	**11%**	**40%**
Operating expenses	6,392	5,715	5,932	8,595		91%
Personnel	*4,182*	*3,742*	*3,513*	*5,759*		*67%*
Transportation	366	328	378	452		
Landfill	310	277	188	514		
Other	3,506	3,137	2,947	4,793		
Goods and services	*2,210*	*1,973*	*2,418*	*2,836*		*33%*
Transportation	379	338	358	621		
Landfill	352	314	318	499		
Other	1,480	1,321	1,742	1,715		
Capital expenses	897	818	1,197	874		9%
Transportation	504	460	671	492		
Landfill	52	47	3	117		
Other	341	312	523	265		

Other expenditure: Administration, Outreach, Monitoring, Regulation and other projects

It is clear that the Environment Agency rely on budget allocations from City Government to operate as the revenues they collect only amount to 3% (in 2014) of total expenditure. Revenues consist of SWM tariff collection and other fees comprising parks, septic tank desludging, and composting. Revenues are growing relative to expenditure, but clearly not at a sufficient rate to deliver financial sustainability.

In 2014, the total expenditure on waste collection and transportation was IDR1,565 Million, and the total expenditure on landfill was IDR1,130 Million. The majority of the SWM, 'Other' SWM expenses, amounted to IDR 6,774, which is primarily made up of staffing, expenses, services and capital projects related to administration, regulation, monitoring, outreach and other related projects.

In 2014, SWM related expenditure constitutes 40% of the EA budget, with 91% of that spent on operational expenses and 9% on capital expenses. Total operational expenditure was IDR 9,469 Million (67% on staffing, and 33% on goods and services). Total capital expenditure was IDR 874 Million; 117 million (less than USD 9,000) of that spent on landfill development.

5.3 Operational costs

This section focuses on improvements which could be made in terms of financing SWM management operational costs. Proposals for which will add value to the above proposal to National Government to fund a City landfill site.

5.3.1 *Operational Cost of the Existing SWM System*

Table 12 below, is based on Table 6, summarizing annual revenues generated by the SWM service fee as well as the direct costs of SWM in Probolinggo (removing capital costs as well as 'other' expenses – administration, outreach, monitoring, regulation and other projects). This represents a reasonable target cost recover for the City as a target.

Table 12: SWM revenues and direct SWM operating costs 2011-2014 (IDR millions)

	2011	2012	2013	2014	Av. annual growth
Revenue	**82**	**101**	**127**	**132**	**17%**
SWM service Fee	82	101	127	132	
Direct SWM operational expenditure	**1,407**	**1,257**	**1,242**	**2,086**	**19%**
Operating expenses	1,407	1,257	1,242	2,086	
Personnel	*676*	*605*	*566*	*966*	
Transportation	366	328	378	452	
Landfill	310	277	188	514	
Goods and services	*730*	*652*	*676*	*1,121*	
Transportation	379	338	358	621	
Landfill	352	314	318	499	**Av. cost recovery:**
Cost recovery	**6%**	**8%**	**10%**	**6%**	**8%**

On average, over the last 4 years, revenues generated through SWM service fees cover only 8% of these direct SWM costs, which implies there is scope for improvement.

5.3.2 *Cost recovery of Solid Waste Management services*

Cost recovery is understood as the recovery of costs by service fee collection from the serviced communities, industry and commerce. Additional revenue generated through selling reuse materials, processed organic waste materials, etc. is not considered here, however should be promoted as best practice.

Cost recovery through fee collection is the responsibility of Mitigation and Management on Environmental Pollution Impact Division (P2DPL) of the Environment Agency according to Local Regulation No.3/2011.

Cost recovery of waste management services should adhere to Local Regulation No.3/2011. This regulation defines that *public service is a service provided or granted by the local government for the purpose of the interest and benefit for the general public.* Furthermore, *that public service charges are to be levied against an individual or entity that uses public services provided or granted by the Government.* Among many types of Public Services Cost Recovery is the *Management of Solid Waste/Sanitation Services, including collection, transportation and disposal of household, industrial and commercial waste; excluding public janitorial services, parks and public indoor places.*

Cost recovery is addressed in clauses 1 and 3.

- Clause 1 mentions that the principle and purpose in determining cost recovery for public services is determined by the cost of service, ability of society to pay, and effectiveness of the services.

- Clause 3 mentions that while cost of service delivery should be fully considered in setting tariff levels, it may not always be achieved if the cost of providing service is too great (i.e. unaffordable). In this situation Local Government will make up the deficit through Local Development Budget.

5.3.3 *Tariffs and collection*

Household tariffs

Probolinggo City implements a 3R system at the community level in an effort to reduce the amount of waste arriving at the landfill.

Organizing waste management at the community level involves community level stakeholders from the ward (Kelurahan), and hamlet (RW), and neighbourhood (RT).

Rukun Tetangga (RT) is the smallest organization in the governance structure in Indonesia, consisting of a number of households, whose functions is to manage the interests of the surrounding community and to manage the community services set by the Kelurahan (Village). It also functions as a representative arm of, and working with, local government.

Rukun Warga (RW) is an organization within the governance structure in Indonesia, which serves to coordinate the management of RT and manage the interests of its surrounding community in Indonesia under Kelurahan (ward). It is formed based on the local community meetings in the framework of community services set by the Kelurahan.

P2DPL works with, and educates RW/RT when there is a need to socialize, and disseminate the importance of, behaviour in solid waste management at the community (RW/RT) level.

The head of the Kelurahan, RW/RT holds a role as a facilitator of 3R activities. The head of RW/RT facilitates the availability of waste management employee, whose duty is to transport household waste to the transfer station, and assist community level recycling of waste. The employee is paid by citizens in each neighbourhood.

Household fees for this service vary depending on the agreement between the waste management employee and the household, but from field observations it was found that this is approximately IDR 10,000/month. The payment is coordinated by the local RW/RT.

<u>Affordability</u>

Household income is calculated using the Minimum Local Revenue (minimum wage) of Probolinggo City, IDR 1,437,500 (according to Governor of East Java Regulation No. 72/2014). Therefore, the minimum cost recovery per household is calculated as IDR 14,375 (1% of household income). The tariff level of each locality is agreed and set by RW/RT to manage the costs of collection and transfer to the transfer station. This will vary based on income levels, the quantity of waste generated (generally higher in more affluent areas) and the recycling responsibility of the community waste management employee.

The waste ‘collection’ (to transfer stations) is therefore funded and managed by communities. This system works effectively and provides a useful community structure to socialise and improve solid waste management at the household level.

Whilst there may be scope for increasing tariffs to cover more of the costs associated with waste transfer and disposal, this is a highly political issue which will also be difficult to implement as there is currently no structure in place to collect tariffs from households. Furthermore, the tariff (around IDR 10,000 per month) seems reasonable based on minimum household revenue, and is currently being well managed through the existing community framework. Any strategic decisions on residential tariff intensification should be undertaken based on the findings of a comprehensive Willingness to Pay (WTP) survey. The Consultant is also concerned that a poorly implemented tariff increase could disproportionately harm the poorest households in Probolinggo City.

Industry and commerce

The different tariffs which should be applied to different types of consumers in Probolinggo City according to Local Regulation No. 30, 2011, are outlined below in Table 13.

Table 13: City SWM Tariff Level for Different Consumers

No	Consumer Community Structure	Fees / Month (IDR)
1.	Trading	
	a. Street vendors	1, 000
	b. Stand or stall	7,500
	c. Large store/supermarket/wholesaler	75,000
2.	Hotel	
	a. One star hotel	150.000
	b. Hostel	125,000
	c. Inn/lodging	50,000
3.	Restaurant	
	a. Restaurant	100,000
	b. Cafe	75,000
	c. Stall / depot	50,000
4.	Public places, recreation and sports and other entertainment	
	a. Movie theatre	50,000
	b. Billiard house	50,000
	c. Beauty salon	50,000
	d. Barbershop	15,000
	e. Train station	100,000
	f. Bus station	200,000
5.	Other business place	
	a. Workshop company	75,000
	b. Traditional workshop company	15,000
	c. Car showroom	75,000
	d. Warehouse, goods storage	100,000
	e. Grinding/drying company	15,000
	Public transportation/travel agency garage	
	• Bus	150,000
	• Truck	100,000
	• Travel transportation	50,000
6.	Office	
	a. Government institution	150,000
	b. BUMN, BUMD and Bank	200,000
7.	Company	
	a. Small company	50,000
	b. Medium company	100,000
	c. Large company	150,000

Source: Local Regulation of Probolinggo City No 3/ 2011 about cost recovery

P2DPL manages collection of SWM tariffs from these users of the service but collection rate is poor.

5.3.4 *Cost Recovery*

If P2DPL were able to collect SWM service fees from non-residential consumers, the potential revenue is IDR 2,274 Million, as outlined in Table 14 – based on the consumer profile of the local public electricity provider (PLN). This would more than cover the direct SWM expenditure, IDR 2,086 Million in 2014 (Table 12).

Table 14: Potential SWM tariff from industry, commerce and public buildings/offices

Electricity Office consumer profile	No. of consumers	Potential monthly SWM tariff (IDR)	Total tariff per year (IDR millions)
Households			
R1	44,953	1,000	539.44
R2	369	1,500	6.64
R3	92	3,000	3.31
Business			
B1	1,920	50,000	1,152.00
B2	319	100,000	382.80
B3	2	150,000	3.60
Industry			
I1	18	100,000	21.60
I2	23	100,000	27.60
I3	15	150,000	27.00
Bulding/Office			
P1	273	200,000	655.20
Public Transport			
Train Station	1	150,000	1.80
Bus Station	1	200,000	2.40
		TOTAL*	2,274.00

*Not including residential customers

Combining a Solid Waste Bill to the Electricity Bill (PLN) or water bill (PDAM)

Due to the huge potential in improving cost recovery, and the poor performance of P2DPL in terms of tariff collection % from non-residential customers, it is suggested here that consideration be given to combine a SWM charge to the electricity company's (PLN) bill for private sector consumers, or to the Water provider's (PDAM) bill.

The electricity company consumer profile, summarised in Table 14, is comprehensive, enabling fees to be collected from almost offices, businesses and industry buildings. Only street vendors and stands/stalls are unaccounted. This is expected to be similar for the Water Company.

In embarking on this strategy it is important that there is the political will to enforce private sector payment of services, and raise awareness with the private sector regarding waste management fees and the benefit for their business that this service provides.

It would be a huge benefit for SWM fees to be collected that would cover all direct costs of collecting and disposing of waste, and would contribute significantly to any proposal for a national infrastructure grant for developing a new City Landfill site.

It is therefore recommended that an assessment is made on the possibility of combining a SWM bill to either of these bills. A consulting firm specialising in Public Finance Management would be required to undertake the assessment. The firm should be based in Indonesia, with a strong understanding of local government finance/function in Indonesia, but should also have expertise of International best practice. Such firms are available in Jakarta, their rates may not be cheap but the potential annual revenue of IDR 2.27 trillion is a significant incentive for procuring this study.

The consult fees would be in the region of IDR 390 million (see Table 15). The Consultancy should cover:

i. A detailed review of P2DPL tariff setting and fee collection from private sector consumers;
ii. A review of both PLN and PDAM tariff collection process and recommendations in terms of compatibility;
iii. Discussions with both PLN and PDAM in terms of capacity to implement combined fee and collection services;
iv. Discussion of key practical, technical and institutional issues for implementing a project to combine SWM tariffs;
v. Recommendations, including legal, to PLN and PDAM in terms of setting a fee for the service of tariff collection;
vi. Recommendations to P2DPL and other relevant City Administrations in terms of auditing the service;
vii. An implementation plan and cost estimate for a project to combine SWM tariffs with another service; and,
viii. Recommended training required to develop capacity to implement the project and manage the SWM tariff collection process in future.

Table 15: Budget estimate of Public Financial management study to improve SWM tariff collection

Fees	**Months**	**Rate**		**Subtotal**	
Senior consultant	1	IDR	140,000,000	IDR	140,000,000
Junior consultant	2	IDR	70,000,000	IDR	140,000,000
Expenses				IDR	60,000,000
Contingency				IDR	50,000,000
Total				**IDR**	**390,000,000**
USD estimate				$	29,534

5.3.5 *Other Sources of Revenue*

There are other sources of revenue available to the Environment Agency to improve cost recover. One example is the ongoing sale of compost.

Composting is carried out on approximately 17% of the total waste which enters the landfill site, representing 7.5 tons/month. The compost sold from this source has an extremely low selling price of IDR 1,000/kg. This is in stark comparison to average market prices where vendors will sell compost at a minimum of Rp 5,000/kg and if only a small amount is bought, the price can rise to IDR 10,000/kg.

The revenue earned from composting is currently not optimised. While the city has an excellent composting plant, operating costs currently exceed revenues from composting! The lack of transparency with respect to official production and sales figures has constrained this study from

calculating detailed current and potential revenue from composting. It is however clear that cost could be increased to generate increased revenue.

5.3.6 *Awareness Raising*

Whilst it is not recommended to make wholesale changes to the tariff collection system from households, to sustain the current process effectively it is important that P2DPL support community waste management in ensuring that households contribute to the community waste management scheme in each RW/RT. As such it is proposed that the Environment Agency implement two awareness raising campaigns annually, these campaigns should focus on improving citizens' understanding of SWM and willingness to pay the fees for solid waste collection. These should be delivered to residents as well as the private sector.

The scope, including cost estimates, for these two awareness raising campaigns is described in the table in Appendix 1.

Training is required for P2DPL to implement these campaigns effectively. The scope, including cost estimates of this training is provided in Appendix 1.

5.4 External Financing Options for Probolinggo City for Establishing a New Landfill

Due to the size of the capital investment, around $2 million for 4 landfill cells to be constructed over 20 years, international financing institutions and donor options for financing the landfill site are limited. Central government infrastructure funding options are however available for Probolinggo City, note that the existing landfill was funded through such Central government budgets. Probolinggo City is also financially capable of investing in the Solid Waste sub-sector to realize its vision of becoming a green city – defined as following sustainable development concepts including the implementation of best solid waste management practices and increasing renewable energy sources – although as can be seen by City budget analysis, the capacity to implementing capital projects is limited.

5.4.1 *Central Government Budget (APBN)*

Development of a landfill requires high investment costs, thus it would fall under the domain of the central government, i.e. Ministry of Public Work and Housing Settlement (MPWHS). The possibility of the city to obtain funds for the development of a new landfill from central government is open for Probolinggo City.

MPWHS requires specific conditions to be met in order for the city to access central government funds. In general, the requirements issued by MPWHS regard several conditions:

i. The Mayor should issue Letter of Intent regarding the infrastructure to be developed and the tentative amount of the project.

ii. Supporting studies, such as master plan of solid waste and RPIJM[15], that are still valid as these two documents are only considered applicable for a 5 year period following their publication. Other documents include the City Sanitation Strategy, Memorandum Program document as a further proof of the CSS, and other technical documents, e.g. engineering design of new landfill (if any).

iii. An approval letter signed by the Mayor, indicating local government readiness to implement the development of a landfill. This should demonstrate that funds have been allocated to the project in the financial budget.

iv. An update of the Directorate General of Human Settlement Readiness Criteria[16] requirements of MPWHS, which include:

- Detailed activities regarding landfill development
- Performance indicators of the city in general and the candidate operator of new landfill
- Allocation of funds by the city in its budget to complement funds from MPWHS
- A Feasibility Study of new landfill
- A Detail Engineering Design of new landfill
- Land ownership in which new landfill located (should be free and clear of legal aspects)
- Preparation of operation units and institutional requirements which must be met

Once all the required documents have been prepared, there are also some strategic considerations the city should address:

i. The city should monitor MPWHS budget availability as the city will be forced to compete with other local governments across the country for funding.

ii. As a new landfill has several cells, they should not all be developed simultaneously but rather in 2 or 3 stages.

iii. The packaging of the proposal. For example, the city should not focus on obtaining funds uniquely for a new landfill but should also include development planning for SWM. This could include planning to improve transfer depots, composting installations, other related activities (3Rs, waste to energy, etc.), and capacity development programmes to improve operational efficiency.

5.4.2 *Recommended approach*

The recommended approach is to pursue national ABPN funding for a City landfill site.

The least cost analysis of regional Vs local landfill suggest that the best course of action would be for Probolinggo city to pursue a local landfill site run and managed by the city itself. This is consistent with both the institutional and technical outputs of this PFS.

[15] *RPIJM stands for Rencana Investasi Jangka Menengah or Middle Term Investment Planning, document that local government must possess, that required by MPWHS, directorate general of Human Settlement (Cipta Karya)*

[16] *Readiness Criteria is a requirement to obtain MPWHS funds*

As international financial institutions are more inclined to finance large projects (Regional landfill), it is most likely that Probolinggo city will have to seek financing for a new local landfill site through the central government budget which was detailed in 6.1.1.

The City has previously submitted an application for a new Sanitary Landfill to the central government and the provincial government and thus, the *Master Plan of Probolinggo City Landfill Development* was made for a submission that was rejected as all the necessary information was not provided. Therefore, the City is presently preparing another request that is expected to be successful. The City is in discussion with the MPWHS and with the provincial government, it is confident that their request will be granted, though, as noted below, there is no guarantee that this will be the case, as local governments compete with each other for grants.

After Probolinggo City has prepared all the requirements, the city will have some strategic considerations:

- The *first strategic consideration* is monitoring the MPWHS budget availability, as the city will be competing for funds with other local governments across the country.
- The *second strategic consideration* pertains to the development plans for the new landfill, as the new landfill will include several cells that do not need to be developed at once. Thus the city should plan to develop the landfill in 2 or 3 stages.
- The *third strategic consideration* is a packaging strategy; i.e. the city should not focus on obtaining funds solely for a new landfill, the development planning should include other proposed improvements regarding solid waste. For instance, planning to improve transfer stations, improving composting facilities, 3R activities, and capacity development programmes to improve operational efficiency.

The most important aspect of this new submission should be the third strategic consideration detailed above. Therefore, this PFS will develop recommendations for further improvements (TN #8) which can be submitted to the central government as part of a whole package which will improve Probolinggo's SWM system across the board, thus making the grant more effective and therefore more likely to be approved. This also acts a lever for Probolinggo to make its application as competitive and as possible while it competes against other applications by local governments.

6 Existing Waste Collection and 3R system

Probolinggo City's approach to urban environmental management is very thorough. The city appears to being determined to handle all environmental challenges and are also well on the way to enhancing environmental awareness in public. The city places a high priority on waste minimisation, recycling and urban cleanliness; the Environmental Agency Profile for 2014 mentions over 50 groups/programmes concerned with environment, waste and cleanliness. The following sub-sections describe the waste collection and disposal system in Probolinggo City, as well as some of the 3R (Reduce, Reuse, Recycle) programmes that are in place.

6.1.1 *Division for Mitigation and Management of Environmental Pollution Impact*

The Division for Mitigation and Management of Environmental Pollution Impact is the division within the Environmental Agency that provides waste management services. The total number of staff is 180 people, of which 74 are government staff.

Residential areas are served by waste collectors (that are not part of the Division for Mitigation and Management of Environmental Pollution Impact staff), who collect and transport the generated waste to collection points or transfer stations by carts. Motorised waste collection bikes and waste collection bikes are used to empty waste bins in main streets. At some of the transfer stations organic waste is composted, and everywhere recyclable materials are recovered and sold to the waste shops. The Technical Operations Unit for Waste Management transports all waste from collection points and transfer stations to the city's sanitary landfill.

An overview of the Environmental Agency's waste management equipment is shown in the table below. Some of vehicles are old but the machinery of the trucks is still in good condition. Maintenance of vehicles is provided for by Environmental Agency budget within the APBD (local government budget).

Table 16: Inventory of Waste Vehicles and Containers

No	Vehicles	Units	Capacity
1	Tipper Truck	5	6 m^3
2	Truck	2	6 m^3
3	Hook lift Truck	5	6 m^3
4	Septic sludge Truck	1	4 m^3
5	Container	35	6 – 10 m3
6	Pick- Up Cars	2	3 m^3
7	Motorised Waste Collection Bike	3	1,5 m^3
8	Waste Collection Bike	16	1 m^3
9	Carts	61	0,7 m^3
10	Rubber Bins	215	20-50 litre
11	Sidewalk Bins	300	50-80 litre

Figure 2: Waste Collection Truck and Hook Lift Truck

6.1.2 *Waste Management System*

Street Sweeping

A street sweeping service is undertaken every day and performed by 114 street sweepers, who serve 40 different segments of roads. The sweeping locations include 37 roads and sidewalks, as well as 3 public facilities (Square, Market and Government Offices). Roads that are well-travelled and/or visited by many people and can therefore potentially generate a high volume of waste are cleaned three times a day. Waste collected from the street sweeping is transported by cart to a nearby container. The equipment used is a broom, a basket, as well as the cart. The salary for street sweeping activities is paid through the Environmental Agency.

Figure 3: Street Sweepers

Waste collection

The primary waste collection from houses and shops towards the collection points is done by waste collectors belonging to the wards, and done manually using a cart with a capacity of 0.7 m^3. The frequency of waste collection in residential areas is two times a day. The waste collectors will recover whatever recyclable materials they see as a means to augment their income.

Figure 4: Typical Collection Points

Depending on the type of collection point, the waste is either stored on the ground or accumulated in a container. The waste that is gathered at a collection point is then transported to the Sanitary Landfill by vehicles belonging to the Technical Operations Unit for Waste Management. Containers are picked up by a hook lift truck for transport, and waste stored on the ground is shovelled into a tipper truck (sometimes using baskets).

There are a total of 212 waste collectors in the city.[17] Usually, one cart is operated by two waste collectors and these are paid by the community. Each household pays IDR 10,000 per month or, in some cases, each cart is paid IDR 250,000 per month by the community.

Garbage from the manufacturing and industry is often handled by the enterprise itself. Manufacturing waste such as waste paper, plastic, leather and sacks is usually handled internally through a recycling system and the recovered materials sold directly to entrepreneurs as scrap materials. Many larger enterprises carry out their waste disposal independently of the city's waste management system, often using their own vehicles and in some cases the waste does not reach the Sanitary Landfill.

Waste separation is generally not performed in the trade and commercial areas, so mixed waste will be deposited directly in street garbage bins or in the larger garbage container where these are available. Street garbage bins are emptied daily by waste collectors in the side streets and by trucks in the main streets. Containers are emptied at the landfill using the Environmental Agency's hook lift trucks.

There are 4 transfer stations in Probolinggo City and 81 collection points ranging from containers, over roofed waste storage areas to "mini" collection points. The transfer stations are located in Ungup-ungup, Jati, Mangunharjo and Wiroborang. Of the four transfer stations, only Ungup-ungup is conducting waste separation and recycling activities. A complete listing of the transfer station and collection point can be found in the table below.

Table 17: The Number of Transfer Station and Collection Point

Type	Units
Transfer Stations	4
Collection Points	18
Mini Collection Points	59
Total	**81**

[17] Source: Environmental Agency, 2014

Figure 5: Ungup-ungup Transfer Station

The transport process is determined by the pattern of transport and the means of transport. The waste transportation in the city includes taking waste from the four Transfer Stations and the numerous Collection Points and disposing it in the Sanitary Landfill. The transport is done using tipping trucks, flatbed trucks and hook lift trucks. Waste transportation is carried out by 25 Transport Officers (driver and assistant driver belonging to the Division for Mitigation and Management of Environmental Pollution Impact) from 05:30 until 11:00 and from 12:00 until 15:00 every day. The pattern of solid waste management can be found in the figure below.

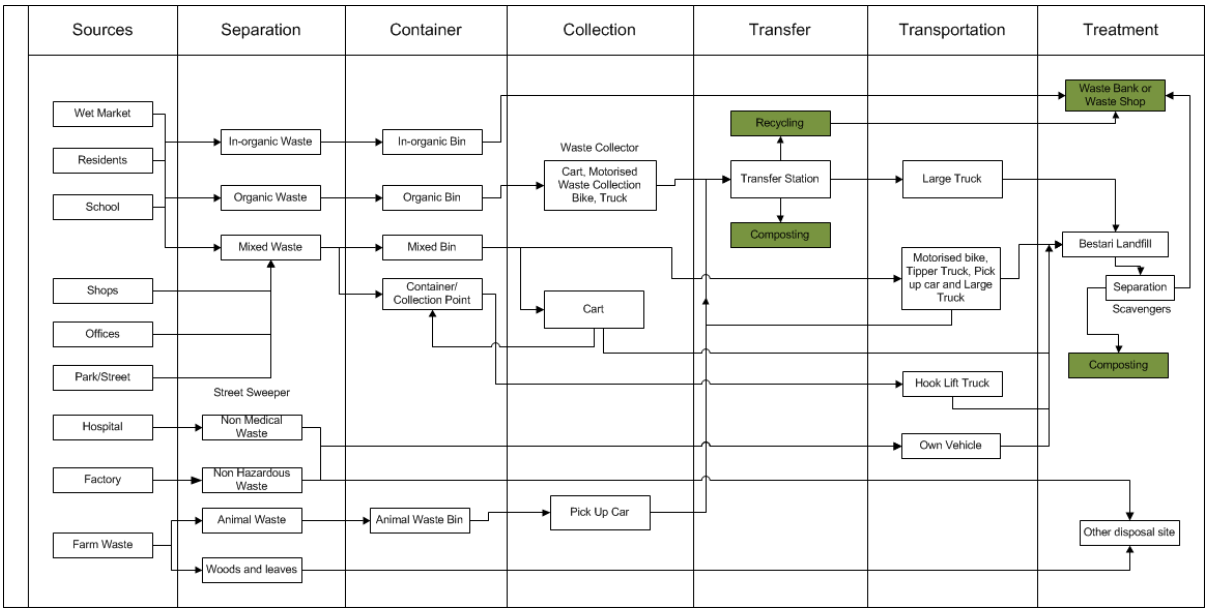


Figure 6: The Existing Pattern of Solid Waste Management in Probolinggo City

Incoming waste is weighed and recorded by the weighbridge staff. The largest monthly quantity of waste received at the Sanitary Landfill in 2014 was 1,470 tonnes in December and the lowest quantity was 1,177 tonnes for the month of on August. The quantities of waste collected in 2014 are given in the figure below.

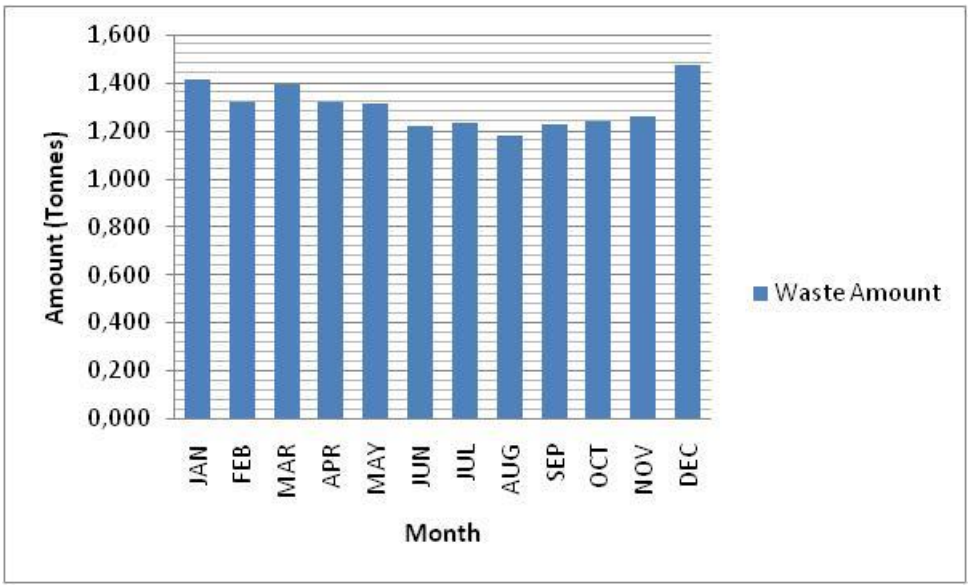


Figure 7: Amount of Waste received at Sanitary Landfill in 2014

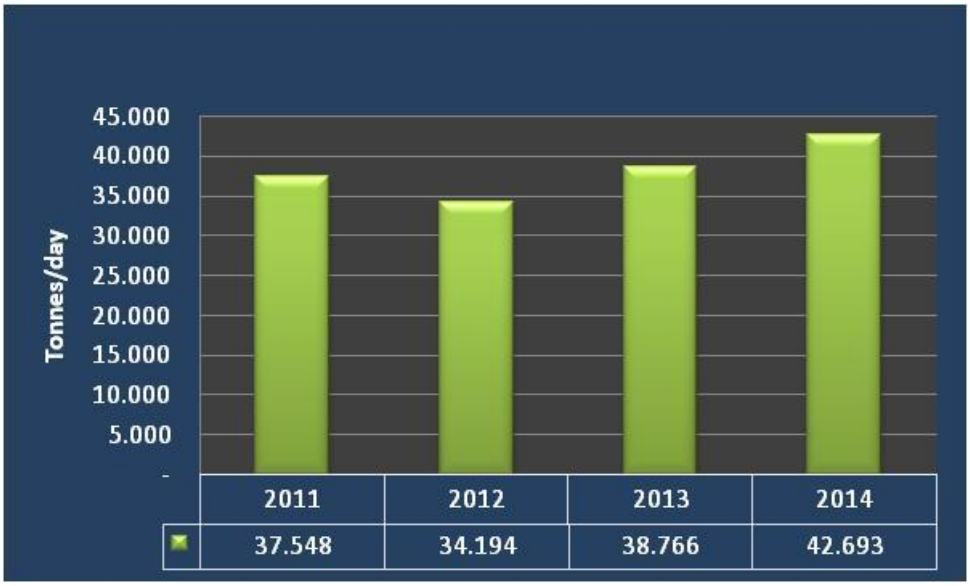


Figure 8: Average of waste received at Sanitary Landfill in 2011 - 2014

The average of waste that went to the landfill increased from 2011 to 2014, though there was a decrease in 2012. This decrease in 2012 of the quantity of waste transported per day was due to the local government having started the development of recycling activities. The average of waste per day that went to the landfill 2011-14 can be seen in the figure above.

6.1.3 *Recycling Activities*

Recycling activities in Probolinggo City are commonly called 3R, i.e. Reduce, Reuse, Recycle. 3R on a city scale enables the reduction of organic and inorganic waste delivery and can be done by the government or managed independently by the community. The 3R system provides benefits to society, to the environment and reduces the quantity of waste that needs to be landfilled.

3R is undertaken actively on a city scale in Probolinggo, sustained by socialization (raising and building awareness in the public). This further stimulates environmentally friendly waste

management at the smaller scale in the form of composting facilities, shredders for plastic waste and promotion of recycling at the city's school, amongst others in the form of aerobic composters.

Figure 9: Aerobic Composter

The goals of the city-wide 3R scheme are:

a. To change the society behaviour in managing of waste.
b. To improve the societal economy.
c. To reduce the waste load burden on the landfill.
d. To reduce the operation expenses of waste transport.

Larger scale 3R implementation is the responsibility of Technical Operations Unit for Waste Management, while 3R activities in smaller scope (for around 20-50 households) is managed by the communities themselves. In addition, there are several farmers' groups, who mix leaves and wood waste with animal waste in order to facilitate composting of the waste.

Recovery and recycling

Recovery of the waste that still has economic value is done at community level. Some households are sorting some types of waste such as plastic bottles and paper. Then the waste is taken to the waste bank or waste shop. Mixed waste is usually sorted by the scavengers, and plastic bottles, paper, metal, and glass bottles are recovered for recycling.

A small number of "freelance" scavengers work on the landfill, the average number is probably around 30 persons. They collect recyclable materials, mostly paper, metal, glass and plastic bottles.

There is no accurate data on how many waste shops there are in the Probolinggo City. They are present in most wards and larger waste shops can be found along the main roads. Close to the Sanitary Landfill are approximately 4 waste shops buying the waste from scavengers and the communities.

Figure 10: Waste Shops

Composting Systems

The management of composting systems is undertaken by the Technical Operations Unit for Waste Management Unit located at the Ungup-ungup Transfer Station and at the Sanitary Landfill. Additional composting systems managed by communities are located in Asabri, Bromo, Kopian Barat, Sumber Taman Indah, UPT, IPLH, TPS Sumber Taman, TPS Prasaja Mulya, TPS Jrebeng Lor, TPS Kedungasem, TPS Kedung Galeng and TPS Wonoasih.

Figure 11: Composting System at the Ungup-ungup Transfer Station

Figure 12: Composting System at the Sanitary Landfill

Total amount of waste processed in the various composting systems is not well documented, especially for the composting systems managed by communities, schools and farmer groups. Only the composting system managed by the Technical Operations Unit for Waste Management records quantities and has available information. The recorded amount of processed waste is a combination of the amount of waste processed in Ungup-ungup Transfer Station and in Sanitary Landfill. The amount of waste that was processed to become compost in 2014 amounted to 143.24 tonnes. The highest amount of waste was processed in January, amounting to 16.928 tonnes, and the smallest in August to 8.035 tonnes.

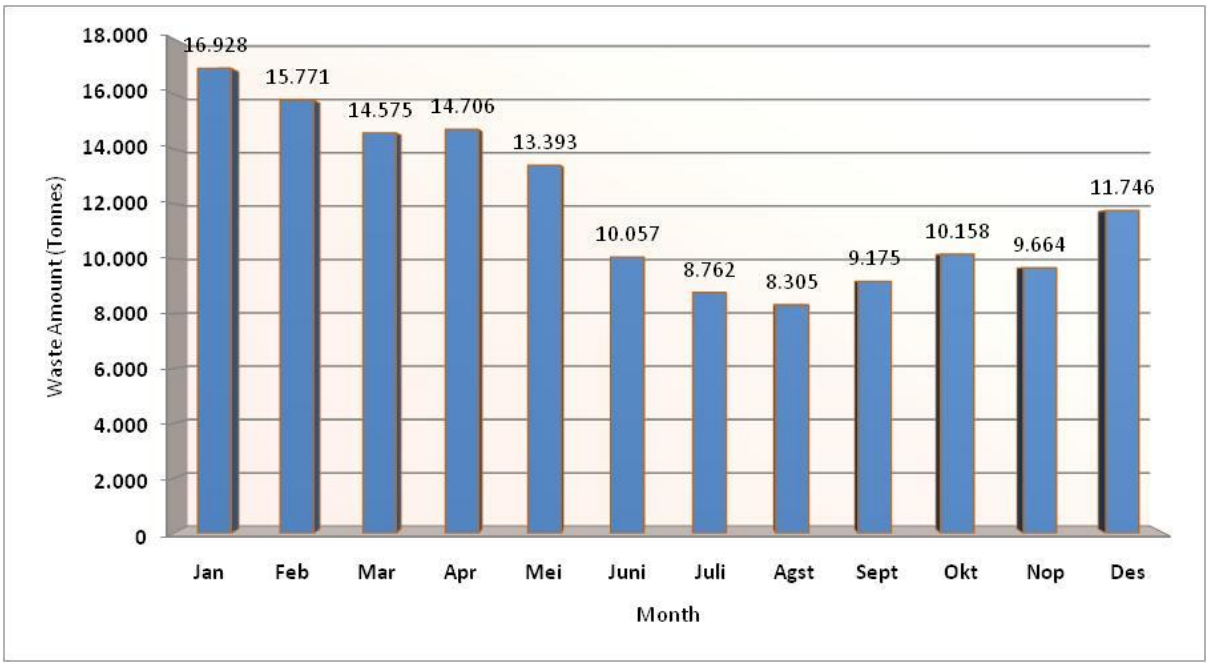


Figure 13: The amount of waste which is processed into compost in 2014[18]

Waste Banks

The system of Waste Banks is based on communities collecting various types of waste (recyclables) that still have economic value and depositing in a local "bank". The financial value of these deposits is recorded and can be withdrawn by the resident in the form of money.

The establishment of Waste Banks in the City of Probolinggo began in 2010 and was officially launched and began operations in January 2012, when the Government of Probolinggo City in cooperation with the Danamon Peduli Foundation facilitated the establishment of waste banks and ensured these were managed independently by the merchants, who are members of the Pasar Baru Traders Association of Probolinggo City.

Figure 14: Maspro Mesra Waste Bank

[18] Source: UPT-PSL, 2014

Waste Bank branches in Probolinggo City are found in most areas, and the Technical Operations Unit for Waste Management regularly provides assistance and guidance to the operators. Waste Banks in the City of Probolinggo include among other: Bunda Peduli, Melati Berseri, Indah, Spanex Mandiri, Makmur Sejahtera, SMPN II, SMPN X, SMKN III, SMAN II, SMKN I, SD Mangunharjo VI, SD Sukabumi VI, Pasar Baru, Kenanga, Melati, Brantas, Pakistaji, SMPN III, Anugerah, Insan Peduli, Abadi Mulia, Pakistaji 1, Zakinah Waste Bank. The number of Waste Banks in Probolinggo City had expanded to 30 units by the first quarter of 2013.

Figure 15: BundaPeduli Waste Bank and Composting System in Asabri Community

Recycling in Schools

Several schools also conduct composting system and Waste Bank activities, which is the principal's responsibility. Those activities in schools are done in Senior High School 1, Senior High School 2, Senior High School 3, Senior High School 4, Vocational High School 1, Vocational High School 2, Vocational High School 3, Junior High School 4, Junior High School 10, Elementary School Ketapang 3, Elementary School Mangunharjo 6 and Elementary School Sumber Wetan 2.

Other Initiatives

Concern for environment is the responsible of any society at all educational and social levels, including social and religious organizations, non-government organizations and other societal elements, and can also be seen as an effort of giving opportunities for active participation in environmental management. In order to synergize all potentialities of the stakeholders, the Environmental Agency of Probolinggo City has facilitated assistance and training, starting from establishment of a partnership to start-up of the environmental activity in question.

Facilitation on establishment of environmental partnership includes:

1. Management of Free Environmental Pollution
   a. Sustainable Development Council
   b. Informal Meeting Forum
2. Management of Public Waste Cleaning
   a. Waste Management Network Forum (Forjamansa)
   b. Social Groups (Pokmas)
   c. Eco Pesantren Community
   d. Environmental Awareness Community (Papesa)
   e. Environmental Novice Community (Pakerling)
   f. Waste Collector Community

g. Bikes Community
h. Traditional Market Community for Environmental Awareness
i. Scavengers Community for Environmental Awareness
j. Street Vendors Community for Environmental Awareness

3. Management of Sublimity and Green City
   a. Miss of Environmental Community
   b. Biodiversity Community (Komtari Kehati)
   c. Disabilities Community for Environmental Awareness (Pecel Koprol)

6.2 Observed Weaknesses in the Waste Management System

The overall waste management system in Probolinggo City is one of the very best in Indonesia. But given that this is not an affluent city, there are not surprisingly some weaknesses in the system; these are briefly discussed in the following.

6.2.1 *Insufficient Capital and Operating Funds*

Though waste is collected throughout the city on a consistent basis; the reliability is not always perfect due to old equipment and similar issues. This leads to waste occasionally being burned next to a Collection Point, as it has accumulated over several days without a collection vehicle showing up. Likewise, some equipment should already have been replaced; this applies - amongst others - to many of the waste containers, as these are severely corroded. With a higher level of funding, particularly for repair and maintenance of equipment, services would obviously be improved, but the current service provisions are of a high standard given the available resources. It is recommended that new waste containers are purchased.

6.2.2 *Informal Recycling Sites*

The Environmental Agency is the only waste management institution in the city, and it is estimated that only a small percentage of city population manages waste disposal on their own. The Consultant identified four sites close to the harbour in Mayangan District that receives waste from households and that operate as informal recycling areas. [19]

These four sites along the harbour front road are used as recycling sites by scavengers. Waste collectors are paid IDR 50,000 per month to empty their carts at these sites and then anything that can be sold is recovered by these hard-core poor people and their goats also feed on the waste. The residues are left in situ, meaning that the recycling sites double as dumpsites.

These sites cover a total area of roughly 5.000 m^2 and at least one has been in operation for about 30 years according to information by one of the persons working there. The sites are located at the edge of the mangrove groves and close to the coastline at normal high tide.

[19] One of these informal sites is described in detail in TN#1: Waste Collection and 3R in 29 Kelurahan (Wards) of Integrated SWM System

Figure 16: Informal Recycling

Although these sites are informal, they seem to be operating relatively well with recyclable materials being sorted out and sold for reuse. As informed at the site, there are no complaints about smell from the people living close by. Although the waste does not spread to the surroundings, these dumpsites are still a potential source of sea pollution because of their location so close to the coast. A heavy storm at high tide could damage the wall along the ponds and cause severe damage to a dumpsite, leading to waste spreading both inland and to the sea.

The quantity of waste collected and dumped at these sites is relatively small; less than 15% of the quantity received at the Sanitary Landfill. Therefore, this irregular waste dumping does not constitute a major deficiency in Probolinggo City's otherwise effective solid waste management. The City should aim to stop this practice in the near future by enhancing public waste collection from the area in question.

6.2.3 *Collection of waste from Enterprises*

As mentioned in section 6.1.2, some manufacturers and industries manage their own waste. The authorities do not have full control over how this waste is managed. It occurs that enterprise waste is dumped within the city limits, in which case scavengers will recover recyclable materials and (as the consultant observed once), they may set fire to the waste, presumably to recover metals.

6.3 Waste Quantities 2015 - 2040

It is generally assumed that the quantity of waste generated is proportional with the size of the population and with economic growth. So when the size of the population increases, or the average income increases, the amount of waste generated will increase correspondingly. Therefore, it is important to know the number of inhabitants up to the year 2040, so that the quantities of waste generated each year can be estimated.

6.3.1 *Population growth 2015 – 2040*

The total population of Probolinggo City at year end 2014 amounted to 220,636 people. Based on the calculations at the time projected, the population of Probolinggo City at the end of 2015 will be 221,490 people and increasing up to 244,307 people by the end of the year 2040; given that the rate of population growth is 0.38% per year.

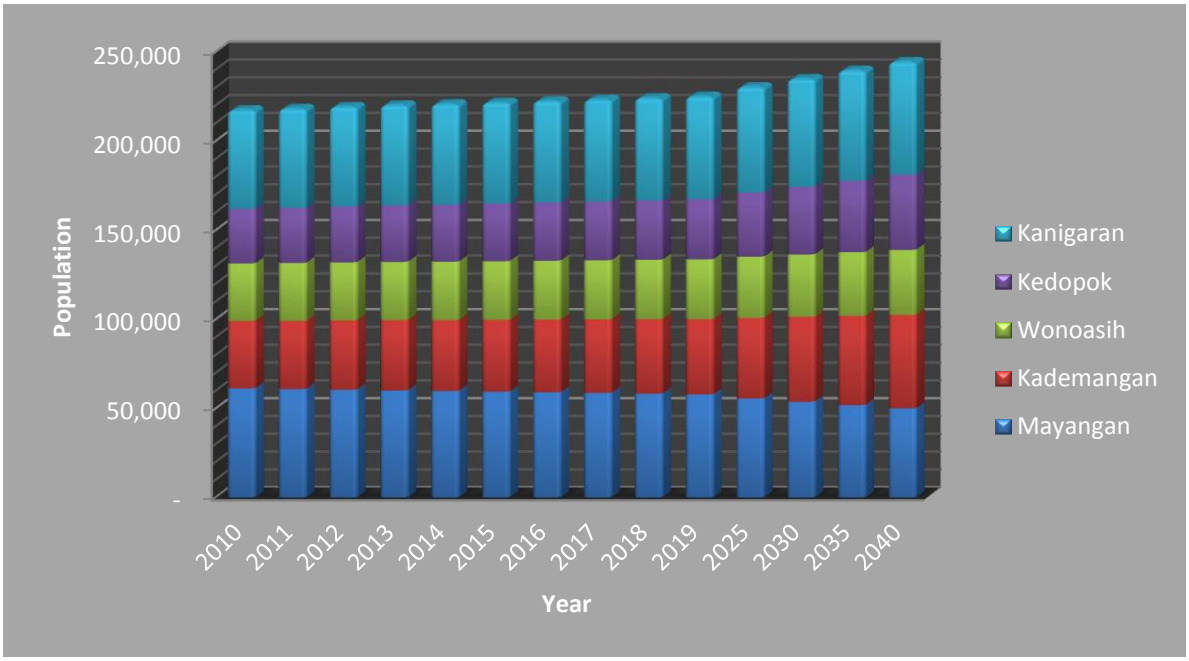


Figure 17: The total population of the city of Probolinggo (2010 – 2040)

6.3.2 *Waste Quantity per person & growth*

The waste forecasts are based on the present estimated waste quantities and these are then projected using the expected population growth. It is assumed that the quantity of waste generated is directly proportional to the population size.

Generally, the quantity of waste will also increase as living standards improve. As a very high priority is given in Probolinggo City to waste minimisation, reuse and recycling, it is anticipated that any increase in waste generation rates due to economic growth will be offset by increased funding for green programmes; so that the quantity of waste generated per citizen will effectively remain constant at the 2014 level.

6.3.3 *Waste quantities 2015 – 2040*

Not all generated waste is collected in Probolinggo City. Though the consultant has not identified any, there must be a few remote areas that are not served and where the inhabitants burn and/ or bury their waste. The quantity of waste that is not collected is low and it is not expected that these isolated homes/farms will obtain waste collection services before the year 2040. Therefore, the serviced area will not increase during the planning period from 2015 to 2040 and impact the waste quantities.

Data from the Environmental Agency states that waste generation in Probolinggo City is 0.6 kg/person/day. If the population of the city in 2014 was 220.636 person, the amount of waste generated is 132.38 tonnes/day or 48,319.28 tonnes/year. [20] The total amount of waste received at

[20] Source: Environmental Agency, 2014

the city's landfill in 2014 was 15,583.06 tonnes or approximately 0.1935 kg/person/day. The City assumes that two thirds of the generated "waste" is reused or recycled through one of the many waste minimisation programmes. Hence only 15,500 tonnes of waste need to be placed in a landfill every year; corresponding to 42.7 tonnes per day, as the balance of "waste" is recycled through Waste Banks, recovered by scavengers and sold to waste shops, composted and so forth.

It would be very impressive if two thirds of the generated waste (or 0.4 kg out of 0.6 kg generated per person per day) is somehow recycled into recovered materials, compost or otherwise reused. This number may be excessive, on the other hand if construction and demolition waste (which is generally recycled as fill material for construction or land reclamation) is included in the total of waste generated, the number could be correct. If solely solid waste from the city is considered, it is probably a third to half the waste stream that does not reach the landfill, as it is reused or recycled; i.e. that 0.3 to 0.4 kg of waste is generated per person per day.

Based on the above, the amount of waste received at the Sanitary Landfill was 15,583 tonnes/ year in 2014 and by 2040 this quantity will have increased to 17,255 tonnes/year.

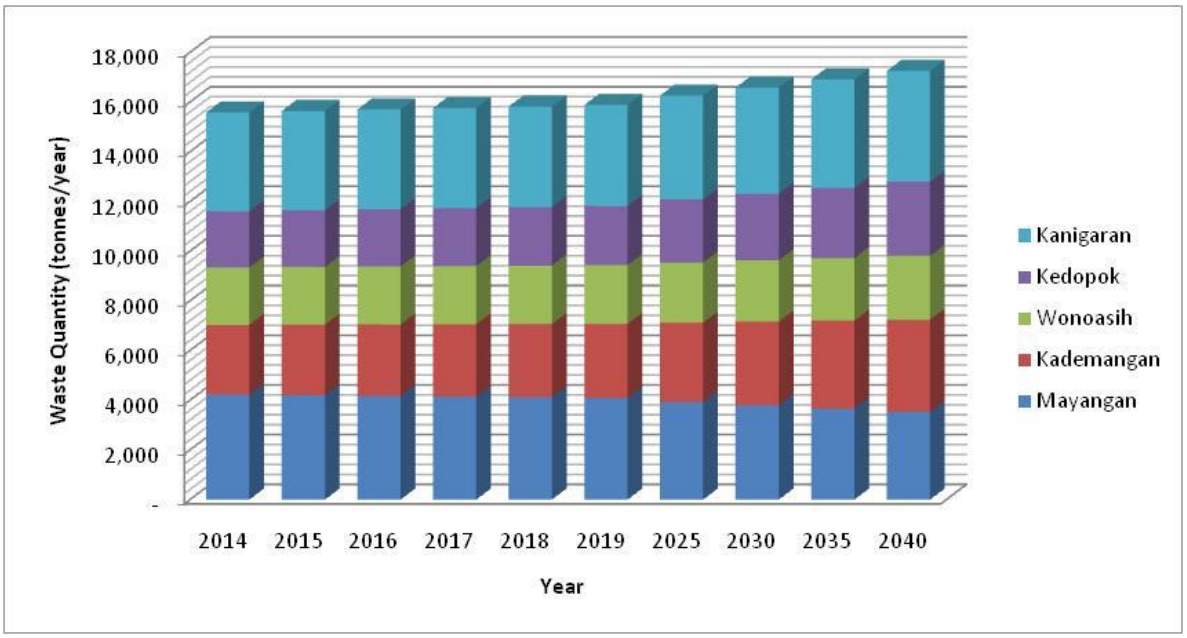


Figure 18: Waste Quantities to Landfill 2015 – 2040

6.3.4 *Waste Composition*

Determination of the waste composition was done at the landfill in 2014. It was found that the largest composition of the waste stream is organic material at 52.4%; followed by 20.8% plastic; and 13.2% paper. The complete composition is given in figure 19 below.

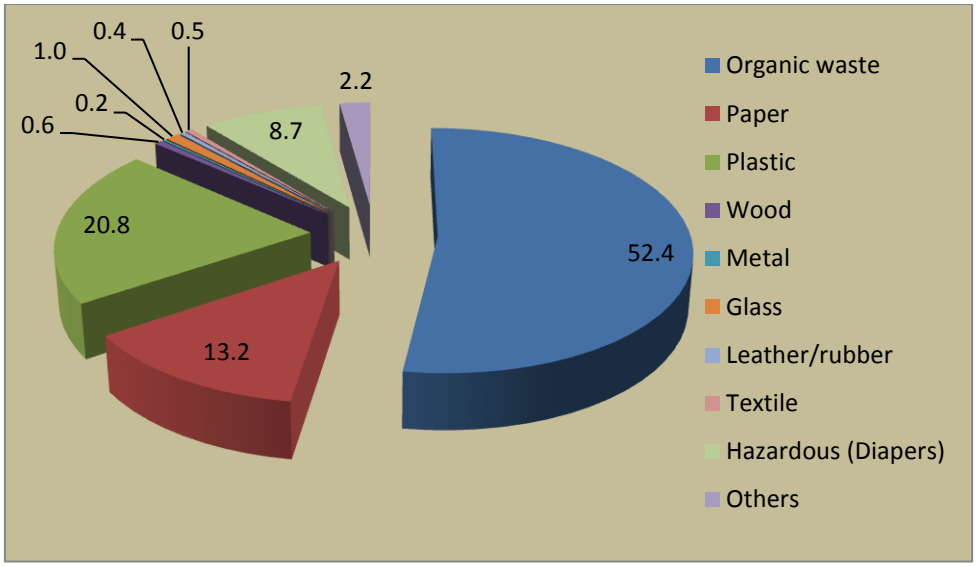


Figure 19: Waste Composition[21]

6.4 Hazardous Waste Management in Probolinggo City

Technical Note # 3A covers hazardous waste management in Probolinggo City. During the kick-off meetings, the scope of the PFS was expanded to cover both hazardous waste and healthcare risk waste and this Technical Note covers the management of these two waste streams in Probolinggo City. It was found that there are 30 larger industries that operate in Probolinggo City; these consist of plywood, food, adhesive and asbestos industries. The quantity of hazardous waste generated in Probolinggo, though unknown, is relatively modest and does not cause any obvious or alarming environmental impact. Hence, there is no basis for a major project addressing hazardous waste management in Probolinggo City. It is advised that the City should ensure that:

a. All industries, manufacturers and enterprises are licensed to manage any hazardous waste they may generate; and
b. The Environmental Agency conducts regular inspections to ensure that hazardous waste generators meet their permit conditions.

Through licensing and regular inspections (both announced and unannounced), Probolinggo City can ensure that the hazardous waste generated by enterprises and manufacturing processes is managed in an environmentally responsible manner.

The total amount of healthcare risk waste from 5 hospitals, 2 community health centres and a clinic is estimated to be 217.5 kg/day. It was found that this waste is separated at source in accordance with the applicable regulations and transported to a regional treatment centre PT. Putra Restu Ibu Abadi (PRIA) in Mojokerto where it is incinerated. It is recommended that Probolinggo City, through their Department of Health (first three points) and through the Environmental Agency (last point) should:

[21] Source: Environmental Agency of Probolinggo City, 2014

a. Ensure that all hospitals and clinics are licensed to handle infectious waste;
b. Conduct regular inspections to make sure these institutions meet their permit requirements;
c. Ensure that all infectious waste generated within the city is sent to the PT. PRIA in Mojokerto; and
d. Make certain that the existing unlicensed incinerator at the Mohamed Saleh Hospital is not operated.

In conclusion, it can be noted that industrial and hazardous wastes are managed as well as can be expected for a city of Probolinggo's size and prosperity. With a functioning regional treatment facility for healthcare risk waste, it means that the infectious waste generated by the city's larger hospitals is managed in accordance with national regulations and international standards. The Department of Health should strive to ensure that smaller healthcare risk waste generators also make use of the regional PRIA treatment facility in Mojokerto.

6.5 Summary on Waste Management

The general condition of waste management in Probolinggo City is good; this can be seen from the successful transportation of waste from the source to the landfill and the absence of garbage in the streets. Besides, recycling activities both by the Environmental Agency and the community are of high standard, in terms of both quantity and quality. It is the Environmental Agency's assessment that two-thirds of the generated waste within the city is recycled and never reaches the sanitary landfill. There is no doubt that the level of waste minimisation, reuse and recycling is very high in Probolinggo City.

The public campaign activities undertaken by the city government in raising public awareness have been running well. These need to be maintained and could be developed further.

In some locations, there are still cases of waste dumped in the river and the canals and of waste burning activity, but the quantities of waste involved is relatively small. Likewise, some equipment is worn or owned in insufficient quantity, so were it possible the city should purchase new equipment.

In comparison to other cities in Indonesia, Probolinggo generally manages its finances quite well, having only run a deficit in 2011 due to strong capital expenditures.

7 Probolinggo City Waste Disposal (Landfill)

The TOR for this Pre-Feasibility Study, developed by CDIA in cooperation with the city, requests the Consultant to focus on producing options for a regional sanitary landfill site for the city and one or more adjoining districts, with a particular focus on Probolinggo Regency, Pasuruan City and Regency, and Lumajang Regency. The Consultant quickly eliminated Lumajang Regency, as the transportation distances and times associated with bringing waste from this regency to a regional landfill are simply far too great.

Environmentally a regional landfill could be beneficial, as a single regional sanitary landfill would allow for the closure of several active landfills.[22] The financial calculations (see the Annex) indicate that the economies of scale (a lower the tipping fee per tonne) do not outweigh the increased transportation costs. Hence, to transport Probolinggo's waste to a regional landfill 30 km away would increase the city's overall waste disposal costs. This means that there is no compelling financial incentive for Probolinggo City to push for a regional solution. Furthermore, the stakeholders were found to be unenthusiastic about a regional landfill.

It was concluded that the primary risk to a regional landfill project is institutional, and that there must be support from all parties to collaborate and follow through on agreements. The combination of increased transport costs, mistrust of neighbouring local authorities, tipping fees, and weak collaboration agreements present a significant risk to a regional landfill project in Probolinggo, particularly when the financial incentive is non-existent.

Probolinggo City can just manage to afford to operate their sanitary landfill at present, though it is clearly limited how much money can be spent on necessary tasks. This means that the soil cover is minimal and that the leachate treatment plant is not operated fully as it should be. It goes without saying that a city like Probolinggo cannot afford to borrow money to build a new sanitary landfill, as paying back the loan would be well beyond their financial resources. Therefore, Probolinggo City is best served by building on their existing waste disposal plans.

The detailed evaluation of the possibility of a regional landfill can be found in the Annex.

At present the plans of Probolinggo City for waste disposal are as follows: The first cell of the Sanitary Landfill that is currently in use will be closed by the end of the year. A second landfill cell is presently under construction and is expected to be completed by the end of the year. This cell no. 2 will serve the city for the coming two to three years. During this period the new Sanitary Landfill will be developed on an adjacent 6 hectare plot of land belonging to the city; this landfill is expected to serve the city for at least 20 years. These different units and their operation are described in this section.

[22] Although carbon emissions would increase as waste is transported further.

7.1 Sanitary Landfill Cell no. 1

7.1.1 *Description and Operation of Cell no. 1*

The Sanitary Landfill is located in Probolinggo City and the site has been used since 1973 as an open dumping area. The sanitary landfill was established there in 2008. Based on information from the Environmental Agency of Probolinggo City, the average amount of solid waste received at the landfill was 42.69 tonnes /day in 2013.

The Landfill is located on Jalan Anggrek, Sukabumi Ward, Mayangan sub-District. The total area is 4 Ha, of which 1 Ha is used for the current landfill cell. The land is owned by the Probolinggo City Government. The distance between landfill and the centre of the city is about 1.5 km. The boundaries of the landfill are as follows:

North : Pond area
South : Jl. Anggrek
East : Residential area and old fish ponds
West : River

Figure 20: Sanitary Landfill Location

7.1.2 *Leachate Treatment Plant*

The Sanitary Landfill's leachate treatment plant uses an anaerobic pond, facultative maturation ponds, and a bio-filter combined with sludge drying beds, sedimentation, and aeration in an aerobic pond. By using these processes, the effluent should meet the effluent quality standards. The Environmental Laboratory of Probolinggo City has sampled the inlet and outlet of the landfill leachate treatment plant every six months to monitor its performance. The data for the leachate quality test results are given below:

Table 18: Leachate Quality in the Probolinggo Landfill [23]

No.	PARAMETER	UNIT	QUALITY STANDARDS [24]	ANALYSIS RESULT					
				February 2012		June 2012		February 2013	
				Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
1.	pH	-	6-9	7.6	8.0	7.9	8.1	8.1	8.4
2.	BOD	mg/l	150	936.8	40.6	556.9	39.4	1,477	204.4
3.	COD	mg/l	3000	3,170.0	70.3	1,620.0	121.3	5,910	500.4
4.	TSS	mg/l	200	340.7	37.4	56.1	172.4	166.6	6.7
5.	Oil Fatty	mg/l	15	3.3	< 2.5	8.2	5,0	5.0	7.3

From the above table, it can be seen that the effluent occasionally exceeds the requirements of quality standards. Therefore, it can be concluded that the performance of the leachate treatment plant does not fully meet Indonesian performance standards. This can be visually observed in that the colour of the influent and effluent water is the same. Therefore, improvements are required to some of the operating units; the needed improvements are discussed in section **Error! Reference source not found.**

7.2 Second Landfill Cell under Construction

The *Detail Engineering Design for the Bestari Sanitary Landfill* [25]made by *Pusat Pelayanan Teknoligi* (Technology Service Center) and BPPT Enjiniring does not provide a design basis; the document offers a basic design for the new cell and generic detailed designs of various features of a sanitary landfill that the contractor will have to follow. It is known that the new cell is expected to last to two to three years, it is expected to receive approximately 40 tonnes per day; meaning that between 29,200 tonnes (the amount that would be received over 2 years) and 43,800 tonnes (amount over three years) will be the quantity of waste stored in the new cell when it is full. The new cell is expected to have an area of 4,469 m^2.

[23] Analysis Results of environmental impacts of the landfill, Probolinggo City 2013

[24] Quality Standards in accordance with Governor Decree No. 45/2002 about Quality Standards of Liquid Waste for Industry or Other Enterprises in East Java Attachment II Class III. Analysis Site: Water Quality Laboratory PJT I Malang

[25] Penyusunan (Detail Engineering Design) DED sel Sanitary Landfill TPA Bestari, Kota Probolinggo

7.2.1 *Environmental Impact of the New Landfill Cell*

An Environmental Impact Assessment for the second cell of the landfill was made by Mitra Hijau Environmental Consultants in 2013.[26] The EIA is a thorough document covering all aspects of the new landfill cell.

Air Quality and Noise

The air quality and noise levels were monitored on the existing landfill, as well as up wind and downwind from the disposal site. It was found that all limits were met with the exception of dust levels on the landfill itself, where a dust concentration of 0.300 mg/m3 was measured, exceeding the limit of 0.260 mg/m3 set in the *Quality Standard* issued by the Governor of East Java as Regulation no. 10/2009.

Water Quality

Examinations of water quality in upstream and downstream areas were carried out to determine the initial condition of the river quality. Water quality inspection was conducted on 28 parameters according to local regulations No. 02 year of 2008 for class III. Based on the results obtained in laboratory analysis of the 28 parameters examined, only the parameters TDS (Total Dissolved Solid) and sulphate were in excess of the required quality standard, while the rest were below the limits of the quality standards required.

Groundwater Sampling

Ground water sampling was conducted at six monitoring wells, as well as in piping close to the landfill and in a well on the BLH landfill site. The analytical results were compared to the *Quality Standards of Surface Water Quality* found in Local Regulation no. 02 from the year 2008 Class III. For many of the samples, the values for total dissolved solids, hardness and chloride were exceeded, which is not surprising for a site located within 500 metres of the ocean. High concentrations of nitrate were found in the six samples from the monitoring wells, presumably due to the use of fertilizers on the surrounding fields. Some of the monitoring wells also do not meet the water quality parameters for turbidity, taste, colour, iron, manganese, sulphates, organic substances and detergent.

7.2.2 *Layout and Cross Section Drawings*

To offer an understanding of the configuration of the new cell, a layout drawing and a cross section drawing can be found below:

[26] Alalisis Dampak Lingkungan Amdal Tempat Pemrosesan Akhir Kota Probolinggo

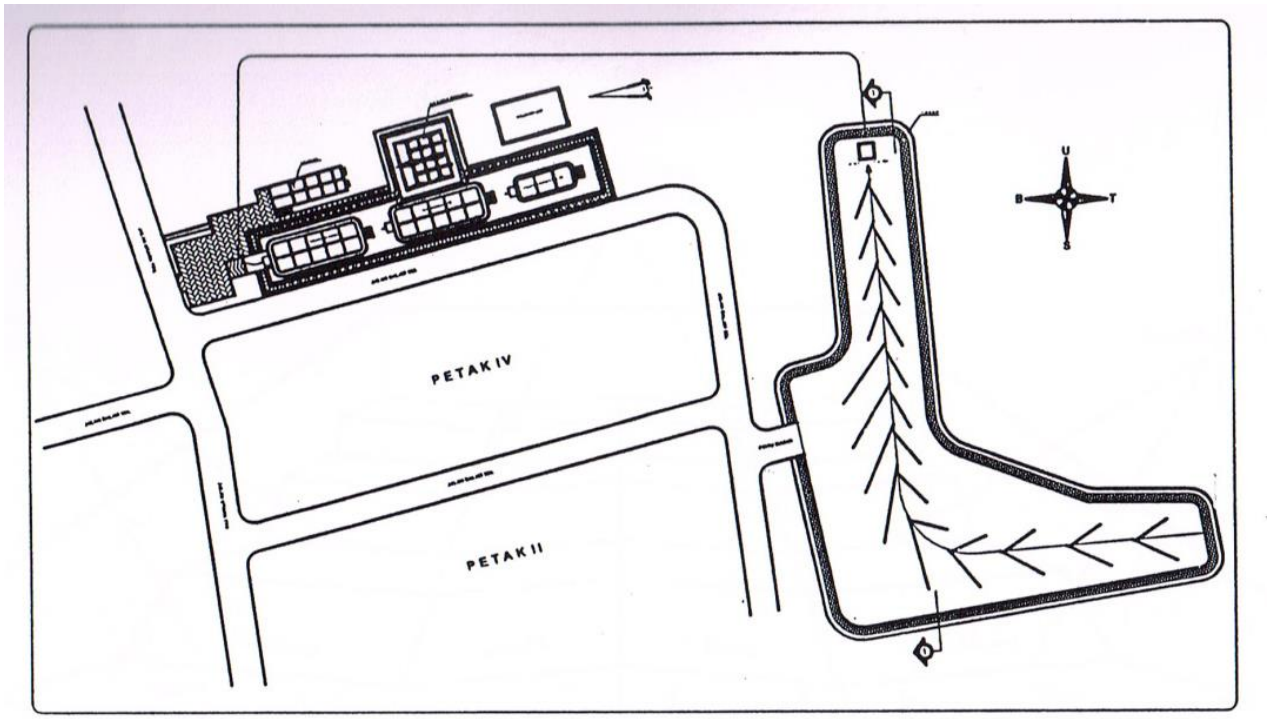


Figure 21: The new landfill cell right and the existing leachate treatment plant top left.

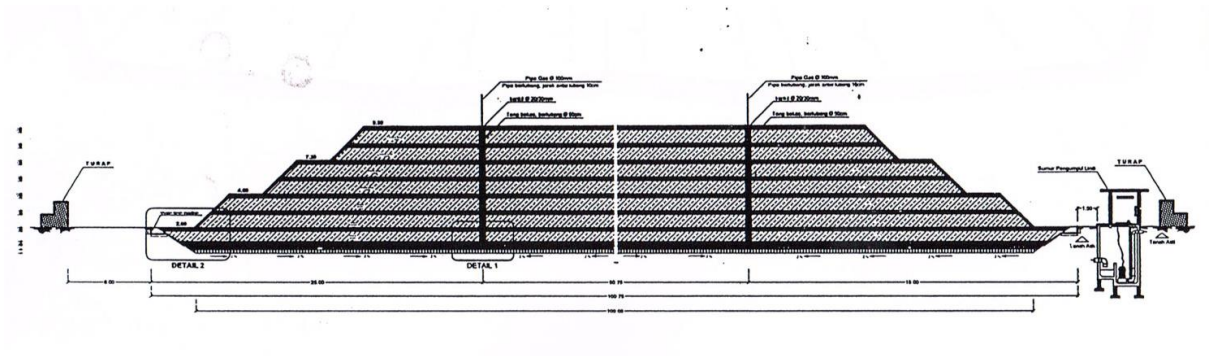


Figure 22: Cross section (S-N) of the new landfill cell

7.2.3 *Description of the Second Cell*

The new cell will be accessed from the western side using existing roads within the Sanitary Landfill site. This means that the existing infrastructure, including gate, weighbridge, leachate treatment plant, roads and recycling facilities will still serve for the new cell.

Leachate collection system

The landfill is designed with a HDPE liner enclosed on both sides by a geotextile protection layer and laid over a 300 mm clay layer. The bottom of the landfill cell is sloped at 2% toward the drainage system that uses 100 and 150 mm perforated pipes; these pipes are protected from the waste by a layer of gravel The collected leachate is lead to a sump at the north end of the cell, from where the polluted water will be pumped to the existing leachate treatment facility.

The layout of the second cell

Waste will be placed in the cell in 1 metre thick layers; each layer will be compacted and covered firstly by a layer of gravel (see the next section - to allow for the collection of gas) and then by a 15 cm thick layer of soil.

The *Detail Engineering Design for the Bestari Sanitary Landfill* foresees that the sides of the landfill will have a 1:1 slope; i.e. that for every horizontal metre, the slope gains one metre in height. This corresponds to a slope of 45^0. The choice to design these very steep side slopes is certainly due to the fact that the landfill is quite small and very narrow in places, so if "normally" angled side slopes were used, the waste storage capacity of the landfill would be very low.

Landfill side slopes are usually designed with a 1:3slope, so that for every three horizontal metres, the slope gains one metre in height. This angle is based on experience and the desire that there is no movement of the side slopes. The very steep side slopes on this landfill cell means that great care will have to be taken to ensure that the slopes do not erode or slide down, exposing the stored waste to the elements (or depositing the waste on the ground next to the landfill).

Landfill Gas collection system

The landfill is designed with horizontal gravel layers between each 1 metre layer of waste. These layers will lead all generated gas toward the vertical 100 mm diameter gas collection pipes. The collected gas will be led to a flare with a continuous pilot flame, where the gas can be burned. This means that the landfill gas (methane gas) will be converted to carbon dioxide gas and water vapour. Environmentally, this is a very good solution as methane is a greenhouse gas that is 20 times more harmful than carbon dioxide.

Capping

The landfill will be capped using a layer of gravel to allow for gas collection; followed by a 200 mm clay layer to prevent waste infiltration into the cell; above this there is a drainage layer and the a 600 mm layer of topsoil wherein protective vegetation can grow.

Current Status

A contract for 3,847,000,000 Rupiah has been awarded to PT Ganesha Jaya for the construction of the second landfill cell and this cell is expected to be completed by the end of the year.

Figure 23: The area for cell no. 2 in August 2015

Figure 24: Progress of the construction on 16 September 2015

7.3 Closure of Sanitary Landfill Cell no. 1

After receiving waste from the Probolinggo City for 8 years, the landfill cell no. 1 is almost full and it is estimated that the cell will reach its maximum capacity by the end of 2015. Once this cell ceases to operate and waste is disposed in cell no. 2; this cell must be closed.

7.3.1 *Cell Closure Requirements*

Closure and rehabilitation of landfills in Indonesia must be arranged in accordance with Regulation No. 3 (2014) from the Minister of Public Works. This stipulates that a range of criteria must be met in order to fulfil the requirements of landfill closure:

- The landfill must be full while expansion of the site is deemed unsuitable.
- The condition of the landfill must be assessed including the availability of land and the operational procedures relevant to the site.
- Prior to the landfill's closure, a proper landfill design must have been prepared at least on year in advance.
- The main components that need to be considered for landfill closure include the stability of the solid waste, availability of soil for final cover, drainage systems, leachate control, gas control, water pollution control, fire and odour control, illegal dumping prevention, revegetation (greening) and buffer area.

It must be noted that the Sanitary Landfill site being evaluated is not being closed. The Sanitary Landfill site is made up of two separate cells: cell no. 2 will start accepting waste once cell no. 1 is full and ready for closure. Hence, it is the closure of a landfill cell, rather than the closure of a whole landfill site, that is dealt with in this section of the report.

There are three stages of landfill closure related to the regulation that can apply to the landfill cell: landfill pre-closure, landfill closure implementation, and landfill post-closure. These stages are explained below:

1. Landfill pre-closure

   Prior to landfill closure, location data of the landfill must be collected. These data are:

   a. Physical data of the land condition (i.e. Land boundaries; the height of solid waste layer; location of waste water treatment plant, drainage system, gas control, buffer zones, etc.)
   b. Climatology, hydrogeological, and geotechnical data (i.e. soil, quality of ground water in the landfill, quality of water bodies near landfill, etc.)
   c. Assessment of the potential quantities of gas and leachate that are generated in the waste.
   d. Socialization the landfill closure plan through bulletin boards around landfill site and/or local mass media.

2. Landfill closure implementation

   The following matters must be considered during the implementation of landfill closure:

   a. The stability of the solid waste, slope, contour slope, etc.
   b. Capping system

      The final capping system in sanitary landfill can consist of several layers of different materials that are listed below from bottom to top:

      - Daily cover soil on top of the solid waste. If the cells have not been used for more than a year, a 30 cm thick cover of compacted soil is necessary.
      - Gravel with a diameter of 30 – 50 mm as a horizontal gas catchment layer with a thickness of 20 cm, which is connected to the vertical landfill gas pipe.
      - 20 cm thickness of clay layers with maximum permeability of 1x10 -7 cm/sec
      - A drainage gravel layer to lead away water in filtration composed of a 20 cm thick gravel layer with diameters of 30-50 mm that is sloped towards the drainage system. If needed, a geotextile layer is installed on the top of the gravel layer to prevent descending into the gravel layer.
      - Soil humus (top soil) with minimum thickness of 60 cm.
      - Examination of the existing landfill surface condition needs to be done at least once a month or every several days after heavy rain. In addition, the area of the final closure has to be planted with crops or trees which are suited to the local conditions.
      - If the city government does not have the funds carry out capping using the soil layer as described above, the landfill can be closed using a 40 cm thick clay layer with a permeability of 1x10-7 cm/sec with a thickness of 40 cm. Figure 24 shows the landfill closure using a single clay layer.

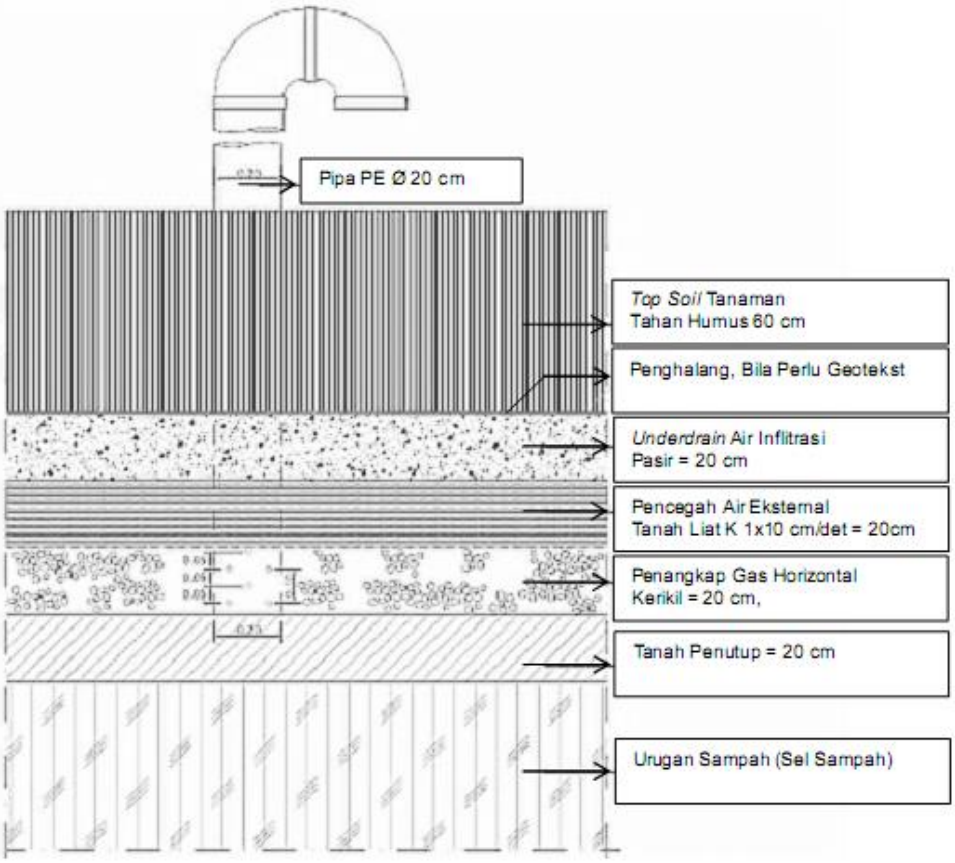


Figure 25: Final capping system with multiple layers

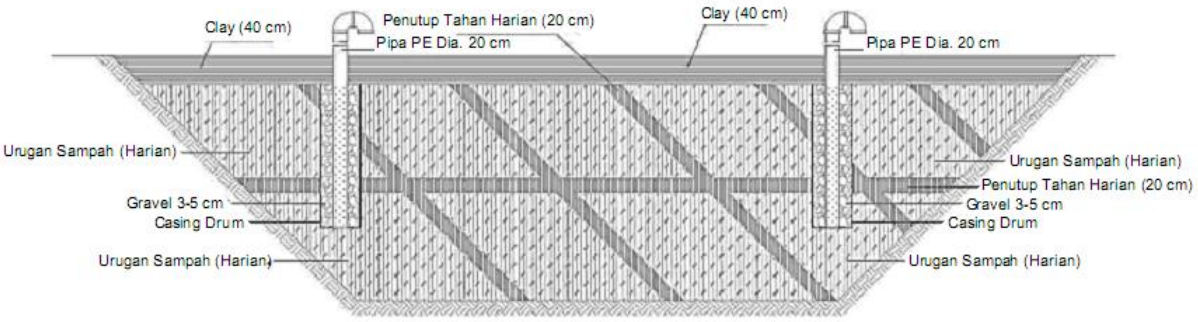


Figure 26: Simple capping system

c. Drainage System

The drainage system must be regularly inspected every week, especially during the rainy season to prevent serious damage to it. Canals and drains should also be monitored to ensure that no grass or bushes grow on it.

d. Leachate Control

When it is not raining, some of the leachate is collected and recirculated to the waste so that it can evaporate. The effective depth of the leachate collection pond also needs to be observed and mud sediments that accumulate in the leachate treatment plant unit must be removed immediately. Regular measurements of leachate effluent quality must also be regularly taken.

e. Gas Control

Excess gas must be burnt using the centralized gas flare (not to be stored). Gas generation must be regularly monitored and controlled.

f. Water Pollution Control

Regular checks on ground water quality in monitoring wells, community wells around the landfill, as well as river water within 200 meters of the outer limit of existing landfill must be carried out. Water quality must be monitored for colour, pH levels, odour, electrical conductivity, chloride, BOD, COD, $KMnO_4$, and N-NH according to the government's environmental standards.

3. Landfill Post-Closure
   a. Implementation of a revegetation program.
   b. Monitoring and maintenance of leachate and gas systems.
   c. Leachate cleaning and treatment, landfill drainage system and leachate treatment plant maintenance.
   d. Monitoring of the solid waste and the slope stability.

7.3.2 *Sanitary Landfill Closure Costs*

It was found (see Technical Note # 4) that a single layer capping system was best suited for this landfill; meaning that the cell is simply topped with a layer of clay.

Measurements of the existing landfill: Land area: 145.2 m x 82.14 m

Based on the design calculation, the costs of capping the cell are calculated below. It is assumed that a large (16 tonnes) bulldozer can move and compact about 300 tonnes of materials in an eight hour shift and that for every three hours of bulldozer operation, one hour of excavator operations are required.

Table 19: The cost of landfill capping using a single clay layer

No	Job Description	Quantity	Unit	Price per unit	Total Price
1	Re-measurement (landfill site) and preparation	454	m	48,800	22,155,200
2	Clay	660	m3	100,200	66,091,920
3	Soil	1,975	m3	65,000	128,342,500
4	Revegetation	1	Ha	70,000,000	70,000,000
5	Fence installation (wooden)	454	m	3,000	1,362,000
6	Equipment operating hours to spread soil layer				
7	Bulldozer	19	tonnes/hr	140,000	2,604,000
8	Excavator	6	tonnes/hr	70,000	434,000
9	Equipment operating hours to spread clay layer				
10	Bulldozer	23	hr	140,000	3,220,000
11	Excavator	8	hr	70,000	560,000
12	Clay procurement (excavation in mining)				55,406,400
13	Transportation (assumed distance 50 km)				96,037,760

No	Job Description	Quantity	Unit	Price per unit	Total Price
14	Drainage system	40	surface drain	1,400,000 IDR/unit	56,000,000
Cost					502,213,780
Tax 10%					50,221,378
Total inclusive of Tax					**552,435,158**

The total cost of landfill closure using single layer clay system is 552 million IDR.

7.3.3 *Post Closure Monitoring*

For the first twenty years after the cell closure, the following monitoring must take place:

- Regular checks on the landfill's surrounding area (fence and monitoring wells)
- Vegetation preservation including watering, especially during the dry season, pruning every 3 months for dry branches and fertilizing the plants once every 3 months using non-organic fertilizer.
- Quarterly gas monitoring in ambient air above the waste and adjacent to the landfill site.
- The leachate treatment system must be monitored in the inlet, and outlet units must be checked at least 4 times a year. The system must also be checked after periods of heavy rain.
- Visual monitoring of the solid waste and the landfill slope stability with a parameter of land settlement over time; original soil condition, types and capacity supports; final soil condition, total area, and the layer's thickness.

The post closure phase must be undertaken for at least 20 years following the landfill's closure.

7.4 New Sanitary Landfill

Based on the least cost, risk and feasibility analysis of Regional Vs Local landfill sites as future waste disposal options for Probolinggo, it has been recommended that The City pursue the Local solution, as described below.

The city is already in the process of planning for a future landfill to replace the existing Sanitary Landfill. The planning is found in the *Master Plan of Probolinggo City Landfill Development* from 2011, as well as in two Land Use Certificates for sanitary landfill. The City's intention is to implement these plans once the Ministry of Public Work and Housing Settlement makes the financial allocation for the new landfill.

This will be a six hectare sanitary landfill located in what are currently abandoned fishponds and a residential area. The city rented land out and approximately 150 households now live on the area that is designated for the future landfill. This will require relocation of the affected citizens, and it may take a long time and be a challenge for Probolinggo City. But existing Indonesian regulations do provide protection of the rights of the affected people.

7.4.1 *Design and Location*

The Master Plan for the New Sanitary Landfill calls for four waste cells to be built on top of a two metre layer of soil infill; this is in order to raise the base of the landfill above some old fishponds. The four cells will cover an area of 2.7 Ha on a 6 Ha site and are designed to accept all waste from

Probolinggo City over a 20 year period. In all likelihood, the new landfill will be built just east of the existing Sanitary Landfill.

Figure 27: The most likely location of the new Sanitary Landfill

The construction of the New Sanitary Landfill was planned for 2011, but due to lack of financing from the Ministry of Public Work and Housing Settlement, the construction of the landfill has been delayed till a future date when the funding is allocated.

The rest of the 6 Ha land area of the land will be used for a Materials Recovery Facility and as a buffer zone. The detail of the landfill can be seen in Figure 28.

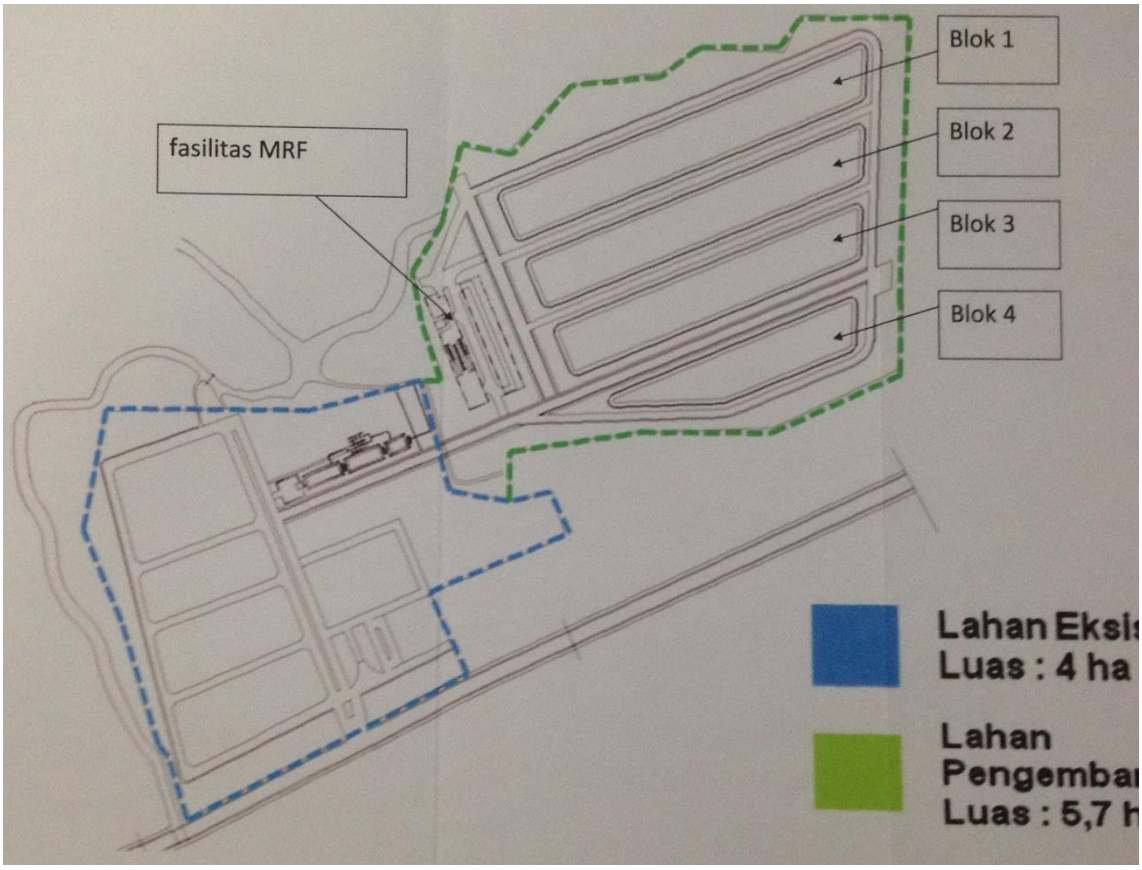


Figure 28: Layout of the new Sanitary Landfill [27]

It can be seen in the figure above that the landfill will be adjacent to landfill cell no. 2 and as also anticipated in the Master Plan, the leachate from the new landfill will be treated in the existing leachate treatment plant. This can be considered a wise solution that minimises the investment for the new landfill. Likewise, it is clear that the new landfill will make use of the entire infrastructure that is already in place for the current landfill, such as weighbridge, offices and existing recycling facilities.

One of the requirements for landfill site selection is that the groundwater surface level must be at least 3 meters below the landfill. In the case of the new Sanitary Landfill, that requirement could be waivered (as it has been for Cells No. 1 and 2), as the site is probably sited on top of salt or brackish water.

The table below provides an initial estimate for the cost of this new landfill.

[27] From the *Master Plan of Probolinggo City Landfill Development*

Table 20: Cost Estimates for New Landfill

Item	Cost USD
Consulting	$ 141,474
LARP costs	$ 273,750
Equipment and site preparation	$ 359,375
Sanitary landfill Cells (4 No)	$ 1,998,522
Total CAPITAL cost	$ 2,773,121.21
Operational Cost (annual)	$ 69,238

7.4.2 *Materials Recovery Facility*

The inclusion of a Materials Recovery Facility (MRF) in the design seems difficult to justify. In Probolinggo City most waste sorting and treatment (such as composting) takes place at the source, or at the collection points or transfer stations. So the inclusion of a MRF that would presumably consist of a sorting area for recyclables, a windrow compost plant and a baler for recyclables (or something along those lines) seems superfluous. The objective to recover recyclable materials and to produce compost is commendable, as this saves natural resources and reduces the quantity of waste going to the landfill.

From a practical point of view, these activities already take place at source and, furthermore, the Probolinggo City landfill site already has plastic recycling facilities and a composting plant installed, so it would seem wasteful to build a second recycling facility on the landfill site. Secondly, as most recycling takes place in the home, in the streets, in the collection points and transfer stations, there are few recoverable materials in the waste that arrives at the landfill. Thirdly, compost made from mixed city solid waste is often of so low quality that it cannot be sold and must instead be, for example, spread in city's green areas. Therefore, the operation of a sorting facility and a composting plant will cost more in salaries, utilities and maintenance, than can be recovered through the sale of products. Therefore, it is recommended that a MRF is not included in the planning of the new landfill.

7.4.3 *Climate resilience*

Technical Note 3 on climate change resilience focused on assessing sea level rise vulnerability for this landfill. This is summarised below.

1. Using conservative estimates SLR to 2050 will be 0.25m.
2. Large scale subsistence is not expected as it would be for a heavily populated and heavily urbanized area; the site lies on the urban fringe and clearly groundwater levels are not depressed as the water table is visible in ponds on the proposed site, furthermore heavy urbanisation out towards the proposed site will not occur as it is marginal coastal land. The inclusion of 0.09m for subsidence is conservative.
3. Temporary tidal extremes during La Nina are predicted to increase MSL by 0.1-0.2m. This has been accounted for, again conservatively using 0.2m.
4. This therefore represents a 2050 SLR estimate of 0.5m.
5. When high tide and extreme weather are added to this estimate, it is suggested that the base of the landfill should be raised 1.25m above predicted future MSL. Given that accurate topographic information is not available it has been assumed that the site is currently 1.25m above current MSL (this is considered conservative based on site assessment). As the current

proposal includes 2m of fill to prepare the site, after compaction, will easily provide this 0.5 increase in elevation, to ensure the site is raised to 1.75m above current MSL to allow for SLR.

6. As it is difficult to estimate the effects of extreme wave height on this specific site, the problem was also considered from another perspective: There is no record of sea water inundation from extreme weather events at the existing site or within the surrounding area. It is therefore assumed that there has been no inundation of the site during high tides (coupled with extreme weather) at the existing site. We can therefore take this as a benchmark elevation which is currently 'safe' from current extreme wave height. To account for future sea level rise, relative to this 'safe' benchmark, the new landfill should be constructed at an elevation of 0.5m above the existing site to account for SLR (0.25m) tidal extremes (0.2m) and subsidence (0.09m). The additional cost for this was included in the least cost analysis of the Regional Vs Local landfill solution.
7. This a conservative, and pragmatic, way forward at pre-feasibility level, but this should be validated by a detailed topographic survey (referenced against Surabaya's tide gauge) as part of a wider study which could inform a new coastal and SLR management plan for the City (as there may be many vulnerable areas in the north of the City). If this study was conducted, it would be likely that the proposed 2m of fill would be unlikely, and the landfill can be constructed at the same elevation as the existing landfill site.
8. By locating the landfill on this site and providing a managed coastal area for mangrove growth in the surrounding area and to the north it would provide additional protection to the northwest of Surabaya in the future (beyond 2050) and thus have wider benefits and tie nicely into a SLR management plan (climate resilience) for the city. It is suggested this project is therefore included in a SLR management plan for the City, which is recommended.

8 Recommended Actions to be taken by Probolinggo City

This section covers measures that are recommended to be undertaken to strengthen solid and (to a lesser degree hazardous) waste management in Probolinggo City over the coming years. It is envisaged that all the measures outlined in the section form part of Probolinggo City's next application for funding for the new Sanitary Landfill to the central government and the provincial government. Other than the new landfill that will serve the city for 20 years, the measures cover capacity building, procurement of new equipment and the recommendation that all hazardous waste generators, such as industries and hospitals, be licensed and inspected on a regular basis.

8.1 New Sanitary Landfill

Section 5.4 provides the recommended approach to financing a new Local Sanitary Landfill site, and provides detail on the approach to applying for ABPN (Central Government) duning for a new landfill site.

The request for funding of the new Sanitary Landfill will be at the heart of the application to the central government. However, the city should not focus on obtaining funds solely for a new landfill, the development planning should include other proposed improvements regarding solid waste. For instance, planning to improve transfer stations, improving composting facilities, 3R activities, waste to energy and so forth. This 'package' will improve Probolinggo's SWM system across the board, thus making the grant more effective and therefore more likely to be approved. This also acts a lever for Probolinggo to make its application as competitive and as possible while it competes against other applications by local governments.

Other than the new landfill that will serve the city for 20 years, other measures will cover capacity building, procurement of new equipment and the recommendation that all hazardous waste generators, such as industries and hospitals, be licensed and inspected on a regular basis.

The *Master Plan of Probolinggo City Landfill Development* would have to be updated to include the recommended actions, and an update on resettlement issues and climate resilience measures should be provided in the application.

Land acquisition and resettlement

Resettlement will be required for approximately 150 households (450 people) who occupy part of the land proposed for the new City landfill. They have been living in this city owned location for many years and have established a strong social community unit. Both RTs are administratively parts of Kelurahan Sukabumi Sub-District of Mayangan.

Law No.1 / 2011 regulates that the government has the authority to perform the control of the affected people, who live in this location. Based on Law No.2 / 2012, people who receive full compensation are those, who own certified land (legally). So affected people who are occupying government land can be relocated, and government is only obliged to provide new housing for them, not ownership. Accordingly, these affected people will often be relocated to rental apartments in government owned buildings which are available in Probolinggo – at least initially.

Table 21, below, provides the resettlement cost estimate for developing a new City Landfill on the proposed site.

Table 21: Estimated resettlement costs for the proposed City landfill

Item	No	Cost per household (IDR)	Total IDR	Total USD
Negotiated compensation fee	150	20,000,000	3,000,000,000	228,000
Relocation cost	150	2,000,000	300,000,000	22,800
Temporary livelihood support	150	2,000,000	300,000,000	22,800
			Total USD	**273,600**

Climate resilience measures

Based on some conservative assumptions outlined in the Technical Note on Climate Resilience, the local landfill site would require 2.5m of fill to elevate it above worst case future sea level rise impacts. Note that this additional cost may not be necessary as it is recommended that Probolinggo City commissions further technical study of sea level rise impacts on the City to develop a City wide strategy to plan for and mitigate these real impacts. The cost of this has been included in site preparation costs to enable a cost estimate.

8.2 New Containers and Trucks for Collection Points

Some collection points use 6 m3 containers as the means of waste collection. The Environmental Agency owns 35 containers but only 28 containers are still in operation in 23 different locations. The last 7 containers are broken and beyond repair. According to Regulation No. 3 from the year 2013 from the Ministry of Public Works, a city with the total population is 220,636 people should have 38 containers. So the Environmental Agency can obtain another 10 containers.

Ten of the existing containers are in poor condition and also need to be replaced. So in total the Environmental Agency would benefit by the acquisition of 20 new containers. The price of one new 6 m3 container is IDR 25,000,000 (including tax), so the total cost for twenty new containers is IDR 500,000,000.

These containers are transported with hook lift trucks. Ideally, to have sufficient capacity, the Environmental Agency should have three more hook lift trucks. The price of one new hook lift truck around IDR 350,000,000 (including tax), so the total budget required for three vehicles is IDR 1,050,000,000.

8.3 Collection of waste from Enterprises

Some manufacturers and industries manage their own waste. Especially many larger enterprises carry out their waste disposal independently of the city's waste management system, often using their own vehicles (or contracting a vehicle). In some cases the transported waste does not reach the Bestari Landfill. The authorities should have full control over how this waste is managed. To this end, the Environmental Agency must ensure that all manufacturers and industries are properly licensed; the license for each enterprise should state how their different waste streams are handled ("sold to waste shop"; "transported to the Bestari Landfill"; etc.). Then during the regular inspections, officers from the Environmental Agency can check that these waste streams are correctly handled, for

example though viewing waste delivery receipts from the Bestari Landfill. Such monitoring, when properly implemented, will make it very difficult for an enterprise to dump its waste illegally.

The primary reason for poor management of industrial waste in Indonesia, and Probolinggo, is political will. To manage and monitor industrial waste and environmental pollution requires prioritisation from both national policy makers and local government. There is currently not a desire for rigorous enforcement of environmental regulations with regard to industry, as industry is unwilling to comply with regulations (to reduce their overheads) and City Hall want to attract industry to the City to provide jobs, local revenues and other benefits. If the enforcement of regulations relating to industrial waste became an issue of national and local priority, and regulations were enforced and prioritised like household waste management, 3R policies and community awareness raising, the problem would be resolved relatively quickly. Locally, the Environment Agency have the skills and capacity to undertake this work but the control is with City Hall, to allocate budgets reject appeals and assist at a higher level in enforcing payment of fines and undertaking restorative work. This need a shift in national policy making which is difficult to achieve in developing economies that have high international industrial investment.

This is rather a philosophic debate about the advantage of integrated urban environmental planning and regulation, and understanding that green/clean cities can improve competitiveness, health, education etc and therefore providing an attractive place for industry to locate. The Ministry of Public Works as well as Bappenas (Planning) are both pushing Green City programmes, but they have significant limitations, relative to the scale of the urban problem in Indonesia.

8.4 Closure of Informal Recycling Sites

Four sites along the harbour front road are used as recycling sites by scavengers. Waste collectors are paid IDR 50,000 per month to empty their carts at these sites and then anything that can be sold is recovered by these hard-core poor people and their goats also feed on the waste. The residues are left in situ, meaning that the recycling sites double as dumpsites. [28]

The Environmental Agency should stop this practice and close these four sites. It is suggested that five 6 m^3 containers be located along the harbour front road, providing the local residents and businesses with a waste disposal option. Practically all waste generators along the road would be within 100 metres of a container. Awareness raising should be undertaken throughout the local community to stop all dumping and ensure that the new containers are used.

Once the on-site waste dumping and sorting is definitively stopped, the four sites totalling 5,000 m^2 can be closed by covering them with 50 cm of soil. The soil should be levelled and compacted with a bulldozer. A cost estimate for the required awareness raising and for the soil cover is found in Section 3 Overall Budget for Improvements.

[28] One of these informal sites is described in detail in TN#1: Waste Collection and 3R in 29 Kelurahan (Wards) of Integrated SWM System

8.5 Institutional and Financial Strengthening

8.5.1 *Improving SWM Tariff Collection*

Due to the huge potential in improving cost recovery, and the poor performance of P2DPL in terms of tariff collection % from non-residential customers, it is suggested here that consideration be given to combine a SWM charge to the electricity company's (PLN) bill for private sector consumers, or to the Water provider's (PDAM) bill.

The electricity company consumer profile, summarised in Table 9, is comprehensive, enabling fees to be collected from almost offices, businesses and industry buildings. Only street vendors and stands/stalls are unaccounted. This is expected to be similar for the Water Company.

In embarking on this strategy it is important that there is the political will to enforce private sector payment of services, and raise awareness with the private sector regarding waste management fees and the benefit for their business that this service provides.

It would be a huge benefit for SWM fees to be collected that would cover all direct costs of collecting and disposing of waste, and would contribute significantly to any proposal for a national infrastructure grant for developing a new City Landfill site.

It is therefore recommended that an assessment is made on the possibility of combining a SWM bill to either of these bills. A consulting firm specialising in Public Finance Management would be required to undertake the assessment. The firm should be based in Indonesia, with a strong understanding of local government finance/function in Indonesia, but should also have expertise of International best practice. Such firms are available in Jakarta, their rates may not be cheap but the potential annual revenue of IDR 2.27 trillion is a significant incentive for procuring this study.

The consult fees would be in the region of IDR 390 million (see Table 21). The Consultancy should cover:

ix. A detailed review of P2DPL tariff setting and fee collection from private sector consumers;
x. A review of both PLN and PDAM tariff collection process and recommendations in terms of compatibility;
xi. Discussions with both PLN and PDAM in terms of capacity to implement combined fee and collection services;
xii. Discussion of key practical, technical and institutional issues for implementing a project to combine SWM tariffs;
xiii. Recommendations, including legal, to PLN and PDAM in terms of setting a fee for the service of tariff collection;
xiv. Recommendations to P2DPL and other relevant City Administrations in terms of auditing the service;
xv. An implementation plan and cost estimate for a project to combine SWM tariffs with another service; and,
xvi. Recommended training required to develop capacity to implement the project and manage the SWM tariff collection process in future.

Table 22: Budget estimate of Public Financial management study to improve SWM tariff collection

Fees	Months	Rate		Subtotal	
Senior consultant	1	IDR	140,000,000	IDR	140,000,000
Junior consultant	2	IDR	70,000,000	IDR	140,000,000
Expenses				IDR	60,000,000
Contingency				IDR	50,000,000
Total				**IDR**	**390,000,000**
USD estimate				$	29,534

8.5.2 *Awareness raising and capacity development*

Whilst it is not recommended to make wholesale changes to the tariff collection system from households, to sustain the current process effectively it is important that P2DPL support community waste management in ensuring that households contribute to the community waste management scheme in each RW/RT. As such it is proposed that the Environment Agency implement two awareness raising campaigns annually, these campaigns should focus on improving citizens' understanding of SWM and willingness to pay the fees for solid waste collection. These should be delivered to residents as well as the private sector.

The scope, including cost estimates, for these two awareness raising campaigns is described in the table in Appendix 1.

Training is required for P2DPL to implement these campaigns effectively. The scope, including cost estimates of this training is provided in Appendix 1.

8.5.3 *Options for Organizational Structure Change*

As mentioned in TN 3B on Institutional and Social Aspects, there is a need to separate SWM operational functions from the regulator and monitor functions in order to establish more autonomous space for the operator to focus on planning, implementing and controlling the waste management activities. Three options for such a separation were identified:

- Organizational changes within the Environmental Agency so that the SWM regulating, implementing and monitoring functions are placed in each their separate division, each equally responsible to the head of the Environmental Agency
- Establishment of a new agency, e.g. a Local Public Service Agency (BLUD - Badan Layanan Umum Daerah), with a technical operations unit (SKPD - Satuan Kerja Perangkat Daerah) responsible to the head of this new agency
- Transfer of the SWM operations function to the existing Public Works Agency

A number of cities in Indonesia have implemented similar organizational changes, and the organizational change training presented in Appendix 1 utilize this by suggesting training courses delivered at and by city government organizations that already have the experience of implementing these kinds of organizational restructuring.

In Appendix 1 the purpose, duration and number of participants, provider, venue and a rough cost estimate are indicated for each awareness raising and retraining event. The grand total costs of all the proposed training are 862 million IDR, not including the awareness campaigns, which can be financed by the city's own budget.

8.6 Hazardous Waste Management

There are no major issues with hazardous waste management in Probolinggo City, principally because there are few polluting industries within the city. The Environmental Agency City should make sure that all the industries, manufactures and enterprises are licensed to manage any hazardous waste they generate. The Environmental Agency should also conduct regular inspections to ensure that hazardous waste generators meet their permit conditions. This will decrease or stop any illegal hazardous waste disposal that may be taking place at the moment. This can be undertaken under the Environment Agency's existing responsibility as regulator and managed through their existing budget. Once again, this issue requires political will and prioritization by local and national government.

Healthcare risk waste is relatively well managed. The authorities should make sure that all hospitals, clinics and other practices that generate infectious waste are licensed to handle this waste stream. The authorities should conduct regular inspections to confirm that these institutions meet their permit requirements and ensure that all infectious waste is sent to the PT. PRIA facility in Mojokerto Regency in East Java. Finally, if the information contained in the Bromo Radar newspaper article is correct, the Environmental Agency should make sure that the existing incinerator at the Mohamed Saleh Public Regional Hospital is no longer used to treat infectious (or other) waste.

Enforcing management

8.7 Closure of the existing landfill

In Technical Note # 4 it is recommended that the less costly and more reliable capping system using a single clay layer should be installed once landfill cell no. 1 has received its last delivery of waste. This would allow for a sound closure of the cell in accordance with Indonesian regulations. The cost of such a closure would be approximately 550,000,000 IDR.

8.8 Improved Performance of the Leachate Treatment Plant

The recommended improvements to the Leachate Treatment Plant serving the Bestari Sanitary Landfill are given in the revised Technical Note # 4; and two additional pumps are required for the leachate treatment plant. The total required investment, including installation, is 6,000,000 IDR.

Furthermore, the same Technical Note recommends that the Environmental Agency spends an additional 500,000 IDR per month on electricity to ensure that the pumps in the leachate treatment plant are operated as intended, as this will allow the plant to meet its discharge limits.

8.9 Overall Budget for Improvements

The recommended improvements that require investments are summarised in Table 2 below.

Table 23: Cost of Recommended Measures

#	Item	Number of Units	Cost per Unit	Cost in IDR
1	6 m^3 Containers	20	25,000,000	500,000,000
2	Hook lift trucks for 6 m^3 containers	3	350,000,000	1,050,000,000
3	Closure of Informal Dumpsites:			

	• Soil cover for 5,000 m2 • Awareness raising by ward & BLH	2,500 m3 1	50,000 20,000,000	125,000,000 20,000,000
4	Study to combine tariff billing and collection with PLN/PDAM	1	390,000,000	390,000,000
5	Institutional and Financial Strengthening	1	862,000,000	862,000,000
6	Closure of Existing Landfill Cell	1	550,000,000	550,000,000
7	Pumps for the leachate treatment plant	2	3,000,000	6,000,000
8	**Total**			**3,503,000,000**

If all improvements are implemented, the total cost will be around 3.5 billion IDR or a little under $265,000.

9 Concluding Remarks

For Probolinggo City to maintain its position as the city in Indonesia with one of best the solid waste management system, it is important that the city administration continues to pay attention to this activity and that it is ensured that these services are adequately funded.

Pertaining to the waste management system in Probolinggo City, where the Consultant was requested to firstly address the waste collection system, it was envisaged that the outcome could be a system of "intermediate treatment facilities" and "supporting facilities."

It was found that Probolinggo City already has an extensive network of such facilities, consisting of recycling stands, composting facilities, transfer stations and collection points. So the requirement that the Consultant "Study options [...] (such as sorting and composting plants, landfill gas to energy/flaring plant, refuse derived fuels (RDF), methane gas, waste briquettes, incinerator and or other options as appropriate) as well as collection and transfer stations"[29] is a request to propose options for something that is already in place. Here it should be stressed that Probolinggo City has for a number of years focussed on establishing an efficient waste collection system that maximises waste minimisation, reuse and recycling; as well as environmentally sustainable waste disposal. Regarding the options listed above to be studied, the present status is:

- There are numerous waste sorting facilities throughout the city, as well as other initiatives to encourage waste sorting at source, such as 122 Waste Banks;
- The City has over 10 composting plants;
- The existing landfill has a gas collection system that is both used for cooking in some adjacent houses, as well as flare;
- Refuse derived fuel and waste briquettes are not made, this would probably not be a rewarding venture, given the small quantities of waste and the fact that there is not large energy user - such as a cement kiln - close by;
- Waste incineration if far more costly than landfill as a route for waste treatment, so that should not be considered for Probolinggo City.

So today Probolinggo City has a very complete system that collects most of the municipal solid waste generated within its boundaries and disposes of it in an environmentally responsible manner. Furthermore, the City places a high priority on waste minimisation, recycling and urban cleanliness; the BLH Profile for 2014 mentions over 50 groups/programmes concerned with environment, waste and cleanliness. Hence, there is very little scope for improving the City's solid waste management system.

Probolinggo City is already well into the process of planning for a future landfill to replace the existing Sanitary Landfill. The planning is found in the *Master Plan of Probolinggo City Landfill Development* where a sanitary landfill is planned on a 6 hectare site. Once the Ministry of Public

[29] TOR Page 3

Work and Housing Settlement makes the financial allocation for the new landfill, the detailed design, procurement and construction can go ahead. The first four cells will cover an area of 2.7 Ha on a 6 Ha site and are designed to accept all waste from Probolinggo City over a 20 year period. In all likelihood, the new landfill will be built just east of the existing Sanitary Landfill.

Obviously, the city's top SWM priority now is to obtain a grant for this new landfill from the Ministry of Public Work and Housing Settlement. At the same time, the City should apply for funding for the other *Recommended Actions* described in section 8, which will strengthen the overall solid waste management system.

It is expected that this re-packaged proposal of recommended actions will greatly increase the chances of the central government providing a grant to Probolinggo City for its SWM needs. This package, which consists of proposals for landfill construction, improved SWM activities and capacity building as well as acquisition of new equipment, includes:

- a new sanitary landfill to serve Probolinggo over the next 20 years;
- new containers and trucks to help process and transport waste;
- the collection of waste from local enterprises;
- the closure of informal recycling sites to better streamline and manage waste;
- institutional strengthening through capacity building, institutional reform and community development programs;
- improved cost recovery of SWM service fee from the private secto;
- improved hazardous waste management
- closure of the existing landfill which is already behind schedule and;
- improved performance of the leachate treatment plant to ensure the sustainability of the existing and future landfill sites

Table 17 provides an overview of the costs for these recommended improvements.

Finally, it should be reemphasised that the regional landfill option is too risky to conceive implementing both in terms of cost and operational management for Probolinggo City. Indeed going forward with this option which has no sound basis could be detrimental to Probolinggo's position as the city with the best SWM practices in Indonesia.

The conclusions drawn from this PFS will support Probolinggo City to further improve its basically well-functioning SWM system in the future and enable the city to continue thriving economically and environmentally.

Annex: A Current Waste Management Practices of the Neighbouring Local Governments

The *2014 Feasibility Study of Regional Landfill Construction* mentioned above assumes that the landfill will serve the western part of the Probolinggo Regency, Probolinggo City and the eastern part of the Pasuruan Regency. As previously mentioned, it would be logical for a regional landfill also to serve Pasuruan City.

The two cities, unlike the regencies, are financially better equipped to make use of a regional landfill, and inherently generate more waste in a denser area (providing obvious waste management efficiencies).

The *Feasibility Study* assumes that all waste will be collected within the served districts of the regencies and that these will deliver the majority of waste to the proposed landfill. There are several reasons why this is very unlikely:

- It is more costly to serve rural communities, as waste collection costs are higher, therefore the service coverage is generally low;
- The living standards are lower in the countryside, meaning that the average citizen generates less waste;
- In rural areas, many citizens have livestock that may be fed part of the waste stream; and
- In villages, there is more space to (illegally) burn or bury waste.

Furthermore, as will be seen in the subsections below, at present very large quantities of waste are not collected within the two regencies. The following subsections discuss the waste management practices in Probolinggo Regency, Pasuruan Regency and Pasuruan City, as these are the three districts that could technically share a waste disposal site with Probolinggo City.

Probolinggo Regency

The total population of Probolinggo Regency in 2014 was 1,203,817 inhabitants and the amount of waste generated was 219,696 tonnes/ year.[30] This corresponds to about 0.5 kg/ inhabitant/ day. Waste management services are currently provided by the Hygiene Section of the Environmental Agency, which serves 16 of 24 districts in Probolinggo Regency. The total of transported waste to the landfill in Probolinggo Regency is 5,380 tonnes/ year, or only 2.5% of the waste generated.

Citizens, shops and small enterprises are responsible for bringing their waste to the nearest collection point. The Environmental Agency is responsible for waste transportation from the collection point to the landfill, operation of the landfill, and for street sweeping. There is a total of 50 collection points spread within 16 districts of the Regency.

[30] Environmental Agency of Probolinggo Regency, 2014

Table 1: Total Waste Vehicle in Probolinggo Regency

Tipper Truck	unit	7
Hook Lift Truck	unit	5
Pick Up Car	unit	1
Motor Bike	unit	11
Cart	unit	29

Mixed waste from the source is usually contained in a waste bin till it is collected by cart and taken to a collection point or transfer station that has been established by Hygiene Section of the Environmental Agency. The frequency of waste collection is once a day, and the area serviced by one collector is identical to the jurisdiction of a Community Association. In some areas there is no primary waste collection, so the citizens must individually take their waste to the collection point. Waste is transported from the collection points to the landfill either in tipper trucks or in containers transported by hook lift trucks.

The Environmental Agency of Probolinggo Regency carries out street sweeping in Kraksaan.

The Seboro Landfill serves the Probolinggo Regency and has operated since 2012. This sanitary landfill was funded by the East Java Province and is located near Seboro Village in the Krejengan District. The total area of Seboro Landfill is 5.5 hectares, of which only a 2.3 hectares cell has been put into service. It is important that the Regency soon places an initial layer of waste in the second cell, so to avoid damage to the cell membrane and gravel layer due to long-term exposure to sunshine and rain.

Figure 1. Seboro Landfill, Probolinggo Regency

The waste that goes to Seboro Landfill is mostly organic, as can be seen in the following table.

Table 2: Waste Composition of Probolinggo Regency [31]

Waste Composition	Unit	Percentage
Organic waste	%	52.21
Paper	%	16.60
Plastic	%	16.91
Wood	%	3.44
Metal	%	0.42
Glass	%	2.08
Leather/Rubber	%	1.67
Textile	%	5.06
Hazardous	%	-
Others	%	1.61

Pasuruan Regency

The total population of Pasuruan Regency was 1,572,260 inhabitants at the end of 2014 with a total waste generation of 449,672 tonnes/ year.[32] This corresponds to approximately 0.78 kg/ person/ day. The waste management services are done by the Environmental Agency of Pasuruan Regency, which serves 9 sub-districts of the 24 sub-districts within the Regency. The collected waste is taken to the Kenep Landfill site in the western part of the Regency. The landfill states that it receives 15 truckloads per day; it all trucks are fully loaded, this would correspond to approximately 90 m^3 per day or about 30 tonnes per day. As over 1,200 tonnes of waste are generated daily (according to the received information) it can be seen, that also in Pasuruan Regency only 2.5% of the generated waste is collected.

The Waste Operating System in Pasuruan Regency is very similar to that in Probolinggo Regency (see the above section), where the primary waste collection is organised by the local communities, who bring the waste to the collection points. From the collection points, the Hygiene Section of the Environmental Agency transports the waste mostly in containers using hook lift trucks to the landfill; a few tipper trucks are also used to transport waste.

Table 3: Equipment owned by the Pasuruan Regency:

Tipper Truck	unit	4
Hook lift Truck	unit	14

[31] Environmental Agency of Probolinggo Regency, 2014

[32] Environmental Agency of Pasuruan Regency, 2014

Container (6 m3)	unit	62
Pick Up Car	unit	5
Motor Bike	unit	19
Cart	unit	25
Daily truck arrivals at landfill	times/day	15

Figure 2. Hook Lift Truck belonging to the Pasuruan Regency

The Regency has a total of 18 transfer stations and 34 collection points.

Kenep Landfill of Pasuruan Regency was established in 1994 as an open dumping site; it is located close to Kenep village in the Beji District. The site has a total area of 2.9 hectares which are fully utilised, and it is not expected that the landfill site can be developed further. The Kenep Landfill is designated as “a controlled landfill system”, and there is a wastewater treatment plant on the site.

Figure 3. Kenep Landfill

Pasuruan City

According to the Central Bureau of Statistics (2014), the total number of citizen in Pasuruan City in 2013 was 205,302 inhabitants. The city consists of 4 Sub-District with a total of 34 wards. In 2013 the

waste generation rate for the city was 246.79 m^3/day, of which 157.94 m^3/day,[33] or 64%, was collected. According to the Public Works Agency just under 75% of the inhabitants received waste collection services. The percentage received from each waste source can be seen in the following table:

Table 4: Waste Sources in 2013[34]

WASTE SOURCE	PERCENTAGE (%)
Households	57.80
Market	5.40
Store / Business	16.70
Hotel / Restaurant	1.60
Hospital	1.20
Street	15.40
Industry	1.00
Opened Area	0.90
TOTAL	**100.00**

Waste collection from households is done communally and is organised by the Community Associations. Street sweeping and waste transport is managed by the Public Works Agency. Twenty-one vehicles serve to collect waste from 27 collection points and 5 transfer stations with recycling facilities.

Figure 4. Litter bins in Pasuruan City and a collection point in Karangketug

The collected waste is transported to Blandongan Landfill about 4 km east of Pasuruan City. The site has a total area of 7.2 hectares, whereof 2.1 hectares have been used for a landfill cell with a total capacity is 352.000 m^3, so this first landfill cell is currently about 58% full.

[33] Solid Waste Management in Pasuruan City, Public Works Agency, 2014

[34] Solid Waste Management in Pasuruan City, Public Works Agency, 2014

The landfill is managed by the Public Work Agency of Pasuruan City and has been in operation since 2006. In 2014 the landfill received 42,393 m^3 of waste corresponding to 14,618 tonnes or 40.1 tonnes per day. [35] Given that there is ample space on the site, the City anticipates using this landfill location for many years to come.

Figure 5. Waste Disposal Site at Blandongan Landfill

Pasuruan City has made considerable efforts to implement 3R systems over the past five years; between 2010 and 2014, the quantity of waste received at the landfill decreased from 68,640 m^3/ year to 42,393 m^3/ year.[36] Waste recycling activities take place not only at the 5 transfer stations with recycling facilities, but also at the collection points. The amount of waste recycled is approximately 36 m^3 per day or over 12 tonnes per day. The recycling activity has involved the society, but is still in the scale of small groups. The city wishes to increase the waste recycling efforts, so that more citizens are involved in this activity.

Figure 6. Composting at the Blandongan Landfill Site

[35] The landfill's weighbridge records the received tonnage, but as official records are kept in cubic meters, all weights are converted to cubic meters using a factor of 2.9 m^3/ tonne.

[36] Information provided by the landfill site management and displayed at the site's weighbridge.

Appendix 1: Institutional and Financial Management Strengthening

No	Issue	Title of Campaign or Training		Type and Purpose	Duration / Number of Participants	Options for Campaign or Training Provider	Campaign or Training Venue	Cost estimate [37] (1,000 IDR)
1.	Willingness to Pay	1.1	Campaign about cost of services and need to pay	Public Campaign / Making people understand that the need to pay for solid waste collection	4 months (yearly) / All city inhabitants	Environmental Agency	Probolinggo City	*36,000* [38]
		1.2	Campaign about waste management system	Public Campaign / Making people understand that waste management starts from the source and continues until the landfill and that it needs people's participation including financial aspect for all stages.	4 months (yearly) / All city inhabitants	Environmental Agency	Probolinggo City	*36,000* [39]
2.	Implementation of Cost	2.1.1	Training of Trainers (ToT) about how to campaign	ToT / Getting trainers who have	2 days / 3 persons	Private Training Company	Jakarta	30,000 [40] (I)

[37] Rough estimates based on normal transportation and accommodation costs and usual fee level of training providers. The Environmental Agency does not at present have a budget for trainings

[38] City's own budget, based on costs of similar campaigns in recent years

[39] Same above Note

[40] There are 3 categories of training course costs depending on what is included:

(I): Cost of training delivery plus participants' travel and accommodation

(II) Cost of participants' transportation and accommodation

(III) Cost of participants' transportation only, i.e. when the accommodation is provided by the training host

These 3 categories are marked by (I), (II) and (III), respectively

No	Issue	Title of Campaign or Training		Type and Purpose	Duration / Number of Participants	Options for Campaign or Training Provider	Campaign or Training Venue	Cost estimate [37] (1,000 IDR)
	Recovery Improvement campaigns		effectively	knowledge and understanding how to disseminate proper waste management effectively		Provincial Office of Public Works-Human Settlements and Spatial Planning	Surabaya	10,000 (III)
						Surabaya of City Government	Surabaya	15,000 (II)
		2.1.2	Training about how to campaign effectively	Training / Dissemination and adaptation to conditions of Probolinggo City	1 day / 25 persons	Environmental Agency	Probolinggo City	18,000
		2.2.1	Training of Trainers about participatory approach of waste management	ToT / Getting trainers who have knowledge and understanding on the importance of public participation in waste management	2 days / 3 persons	Private Training Company	Jakarta	30,000 (I)
						Provincial Office of Public Works-Human Settlements and Spatial Planning	Surabaya	10,000 (III)
						Surabaya of City Government	Surabaya	15,000 (II)
		2.2.2	Training about participatory approach of waste management	Training / Dissemination and adaptation to conditions of Probolinggo City	1 day / 25 person	Environmental Agency	Probolinggo City	16,000
		2.3.1	Training of Trainers about sustainable waste management	ToT / Getting trainers who have knowledge and understanding on the importance of maintaining the sustainability of proper waste management	2 days / 3 persons	Private Training Company	Jakarta	25,000 (III)
						Ministry of Public Works and Public Housing	Jakarta	20.000 (III)

No	Issue	Title of Campaign or Training		Type and Purpose	Duration / Number of Participants	Options for Campaign or Training Provider	Campaign or Training Venue	Cost estimate [37] (1,000 IDR)
		2.3.2	Training about sustainable waste management	Training / Dissemination and adaptation to conditions of Probolinggo City	1 day / 25 persons	Environmental Agency	Probolinggo City	16,000
		2.4	Training about financing of waste management	Training / Participants have knowledge about the costs of investment, operation and maintenance of waste management	2 days / 5 person	Private Training Company	Jakarta	52,000 (I)
						Ministry of Public Works and Public Housing	Jakarta	33,000 (III)
3	Separation of regulator and operator	3.1	Training about law and institutional set-up for waste management	Training / Comparison Study / Participants are able to identify the suitable institutional form for waste management	2 days / 10 persons	Private Training Company	Jakarta	104,000 (I)
						Ministry of Public Works and Public Housing	Jakarta	65,000 (III)
						Jakarta of Province Government	Jakarta	83,000 (III)
						Denpasar of City Government	Denpasar	64,000 (II)
						Bandung of City Government	Bandung	68,000 (II)
		3.2	Training about Standard Operational Procedure (SOP) of waste management	Training / Participants gain knowledge about the preparation of SOP for waste management	3 days / 5 persons	Private Training Company	Jakarta	58,000 (I)
						Ministry of Public Works and Public Housing	Jakarta	36,000 (III)
		3.3	Training about rules and working procedures of the waste management institution	Training / Participants gain knowledge about the rules and working procedures of the waste management institution	3 days / 5 persons	Private Training Company	Jakarta	58,000 (I)
						Ministry of Public Works and Public Housing	Jakarta	36,000 (III)

No	Issue	Title of Campaign or Training	Type and Purpose	Duration / Number of Participants	Options for Campaign or Training Provider	Campaign or Training Venue	Cost estimate [37] (1,000 IDR)
Total Costs of Training (not including awareness campaigns)							**862,000**

Appendix 2: Comparison of Risks and Costs

Comparison of Risks and Costs		Local:	Regional:
Financial	Capital cost:	$2,289,100. Provincial / National Grant funded	$6,557,200. It is assumed Provincial / National Grant could fund this. Cost estimate based on 160T/day for 20 years.
	Operational cost:	$4.71/T (assuming 40 T/day)	$2.95/T (assuming 160 T/day)
	Tipping fee (to cover operations only as capital costs are assumed covered):	None	Based on above, tipping fee would be upwards of $4.00 to cover management overhead costs if operated by the province or an SOE. If operated by private sector it would be greater.
	Transport costs:	None	$2.62/T
	Cost per tonne for Probolinggo City	$4.71	$6.50 minimum
Waste delivery: This is the key parameter in determining landfill feasibility. It will impact capital cost (landfill size), operational cost, and if not reliable may cause a landfill project to fail as unreliable waste deliveries will adversely affect revenues and affect the utilisation of machinery etc. (driving the operational cost per tonne upwards).		Reliable. Currently 43 T/day increasing with population growth	Potentially unreliable. The assumed 160T/day is an optimistic estimate to illustrate that economies of scale can provide reduced operational cost which might outweigh additional transportation costs. Even using this optimistic waste estimate, the economies of scale for a larger landfill do not outweigh the increased transportation costs. It is very difficult to estimate the potential waste deliveries to a regional landfill site, particularly in dispersed and poor rural areas where high transport costs and tipping fees will deter waste delivery to the site. This is a huge risk for a costly sanitary regional landfill site in a location such as Tongas in Probolinggo Regency.
Institutional: Crucial to establishing a regional landfill site is close collaboration and a level of trust between stakeholders in project development, implementation and operation.		The City is in full control of all activities.	There has never been any real interest in a regional solution from either Pasuruan City or Pasuruan Regency. Whilst the original Feasibility Study was commissioned by Probolinggo Regency (for various reasons, including bettering their chances of obtaining funding for a sanitary landfill site), enthusiasm has fallen and currently there is no interest in a regional solution - they are preparing plans for a local solution in the western part of the regency. At this stage it seems unlikely that the potential stakeholders could agree terms and move forwards without difficulties including financial disputes down the line.

Comparison of Risks and Costs		Local:	Regional:
Implementation capacity:		The capacity exists in Probolinggo City to develop the project, obtain funding, implement, and operate a new landfill site for the City. There is a proven track record in good waste management in Probolinggo City and political will for continued improvement.	The capacity is relatively unknown.
Land Acquisition:		Land is already owned by the city	50,000 IDR/m2 is estimated for this land. 25Ha required, so cost is estimated at $925,000. It is expected that the Province would fund this but acquisition could cause project delays increase costs.
Resettlement:		Resettlement of resident squatters. No compensation of landowners.	Resettlement of residents and/ or compensation for loss of farmland.
Social:		Community outreach will provide better SWM and awareness of issues. No residential tariff increases are proposed.	Community outreach will provide better SWM and awareness of issues. No residential tariff increases are proposed.
Job Creation:		No net impact.	Loss of local scavenging jobs, and entrepreneurship. Increase in driving jobs associated with waste transport. Efforts should be made to provide jobs for Probolinggo residents at the regional landfill site, if developed.
Environment	General:	If well designed and operated, the landfill poses limited environmental risk apart from odour, dust, noise etc. Whilst there is always a groundwater and surface water contamination risk, the coastal location dictates it is not a threat to water supply contamination. Non-selection of a regional landfill options means more distributed waste management regionally.	Reduced impact due to single waste disposal site (if the site is well operated and maintained throughout its proposed lifetime). Potential water supply contamination risk.

Comparison of Risks and Costs		Local:	Regional:
	Odour, dust, noise etc.:	The site in an urban location poses a greater odour, dust and noise threat to humans.	A rural location means lower impact
	Construction:	The usual construction impacts such as surface runoff contamination. There is a risk of damage to cells if not constructed in sequence. The smaller size of cells and lower capital cost reduce this risk.	Depending on siting, provision of access roads and utilities could complicate issues and add significantly to capital cost estimates. Construction of landfill cells in sequence is critical as if large cells are left unutilised for long periods there is high risk of damage. Higher risk of construction cost and time over-runs.
	Climate impacts:	The coastal location dictates that the site is at risk of continued sea level rise. The site will have to be raised above predicted sea levels and the landfill will be sealed and contents will be inert before exposed to any significant threat. The site is well protected in a large bay and a mangrove swamp buffering zone.	No impacts from climate change. However, increased carbon emissions due to waste transport.

High risk to project success	
Medium risk	
Low risk	
Very low risk	