JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

FEDERATIVE REPUBLIC OF BRAZIL

THE STUDY FOR THE DEVELOPMENT OF AN INTEGRATED SOLUTION RELATED TO INDUSTRIAL WASTE MANAGEMENT IN THE INDUSTRIAL POLE OF MANAUS

FINAL REPORT

SUMMARY

August 2010

KOKUSAI KOGYO CO., LTD.

EX CORPORATION

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List of Volumes

Volume I	**Summary**
Volume II	**Main Report**
Volume III	**Supporting Report**
Volume IV	**Data Book**

This is the Summary.

The exchange rate used in this report is as follows.
US$ 1.0 ＝ 89.25 Yen, 1 BRL ＝ 48.784 Yen
(March 2010)

PREFACE

In response to a request from the Government of the Federative Republic of Brazil, the Government of Japan decided to conduct "The Study for the Development of an Integrated Solution Related to Industrial Waste Management in the Industrial Pole of Manaus" and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Susumu Shimura of Kokusai Kogyo Co., Ltd. and consisted of experts from Kokusai Kogyo Co., Ltd and EX Corporation from February 2009 to August 2010. In addition, JICA set up an advisory committee supported by Dr. Mitsuo Yoshida, Senior Advisor of JICA, and Dr. Haruo Matsumura, Director of International Cooperation Division, Japan Industrial Waste Technology Center, which examined the study from specialist and technical points of view.

The study team held discussions with the Brazilian counterparts and conducted field surveys at the study area. Upon returning to Japan, the study team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of the study and to the enhancement of the friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the Brazilian counterparts for the close cooperation they extended in conducting the study.

August 2010

Izumi Takashima
Vice-President
Japan International Cooperation Agency

Mr. Izumi TAKASHIMA
Vice-President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

We are pleased to submit the report of "The Study for the Development of an Integrated Solution Related to Industrial Waste Management in the Industrial Pole of Manaus" in the Federative Republic of Brazil.

The Study was conducted to review the current conditions of industrial waste management in the Industrial Pole of Manaus (PIM) and its surrounding area in the Manaus Free Zone (MFZ), and summarize the results into this Study Report. It was implemented with the aim to formulate a Master Plan for Industrial Waste Management in PIM as well as "Guidelines to Improve Industrial Waste Management".

The ultimate objective of this Study was to formulate a practical Master Plan and gain the understanding and cooperation of the public. It was carried out as support for the Brazilian side to conduct the Study. Emphasis was put on the process in which Study output was formulated, ensuring that all materials related to the reports, workshops and seminar were discussed with and accepted by the Brazilian side. To facilitate that process, the Study featured a total of 26 meetings held on a weekly basis to thoroughly discuss all issues.

The report on the current conditions of industrial waste management is based on the results of a survey of 187 factories—the generation source of industrial wastes—as well as a survey of 90 waste service companies which deal with transport, treatment and disposal of industrial wastes discharged from factories. The target year for the Industrial Waste Management Master Plan is 2015, and the issues and improvements clarified during the Study were prepared with this short-term goal in mind. Significant portions of the proposed Master Plan that were agreed upon have already been initiated by the Brazilian counterparts. As such, the Guidelines to Improve Industrial Waste Management include measures that should be carried out with the understanding of waste generators, waste service companies and the administrative bodies to achieve the Master Plan objective.

We would like to take this opportunity to express our sincere gratitude to the Japan International Cooperation Agency, the Advisory Committee, the Ministry of Foreign Affairs, and the Ministry of Environment of Japan. We would also like to extend our deep appreciation to the Government of Brazil, the Embassy of Japan in Brazil, the Consulate General of Japan in Manaus and the JICA Brazil office for their vital cooperation during the implementation of the Study in Brazil.

Furthermore, we hope that, ultimately, the improvements made through the Study of industrial waste management in the Industrial Pole of Manaus will contribute to sustainable development of Brazil nationwide.

August 2010

Susumu SHIMURA
Team Leader
The Study for the Development
of an Integrated Solution related
to Industrial Waste Management
in the Industrial Pole of Manaus

Executive Summary

1 Outline of the Study

1.1 The Study and Study Report

The Study for the Development of an Integrated Solution related to Industrial Waste Management in the Industrial Pole of Manaus was conducted between February 2009 and August 2010. The following is a concise digest of the reports produced in the study, which are: the Summary Report, Main Report, Supporting Report, and Data Book[1].

1.2 Objectives of the Study

The objectives of the study are:

1. To review the current conditions of industrial waste management in the Industrial Pole of Manaus (PIM[2]) in the Manaus Free Zone (MFZ) and the surrounding area, and compile the results into a report.
2. To formulate a master plan for industrial waste management in PIM, and "Guidelines for the Improvement of Industrial Waste Management" in PIM.

1.3 Study Area

The study area is the Manaus Free Zone (MFZ), where PIM is located; at its heart is the City of Manaus in the State of Amazonas.

1.4 Target Waste

The target waste in the study is industrial waste which factories are required by CONAMA Resolution 313 to report upon making a waste inventory. In accordance with differences between the generation sources and the characteristics of each industrial waste required by CONAMA Resolution 313, the waste was divided into the following 4 categories for the study:

1. General Industrial Waste
2. Health-care Waste
3. Construction Waste
4. Radioactive Waste

1.5 Basic Policy of the Study

The study was implemented according to a basic policy that the industrial waste master plan M/P) would be: (1) considerate of environmental protection wherever possible, (2) practicable, (3) be understood by and obtain the cooperation of members of society, and (4) be formulated on the initiative of the Brazilian counterpart.

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[1] With the exception of the Data Book, all reports are available in Portuguese, and the Summary Report is available in Japanese.

[2] The factories which receive tax benefits in the MFZ are not only those shown in the two Industrial Districts (DI), but also factories located outside of the DI.

Based on these basic policies, the study was implemented as follows.

- Development of the study through weekly meetings:

  During the JICA Study Team's stays in Manaus, 2-3 hour meetings were held on a weekly basis to discuss and form consensus on the progress of the study, the survey results, the content of the M/P and so forth. There were a total of 26 weekly meetings, attended by an overall total of 646 related persons.

- Holding workshops and seminars:

  Participation in the weekly meetings was limited to study participant organizations and their delegates. Therefore, in order to gain the understanding and hear the opinions of a wider range of stakeholders to understand the current conditions of industrial waste management and to formulate the M/P, there were 3 workshops, 3 short seminars and 1 full-day seminar held to offer opportunities for discussion and reach consensus on the improvement plans. An overall total of 665 related persons attended these events.

- Publicizing activities on the SUFRAMA Website:

  Progress of the study and reference information on industrial waste was put on the SUFRAMA website. As of late July 2010, there were 7 newsletters posted which cover the various study results as well as the content of the proposed M/P. In addition, the presentations from the 3 workshops and full-day seminar in Manaus were posted so that anyone is able to access the overall study results.

- Japan training for the counterpart:

  The M/P formulated in the study will be implemented by related organizations on the Brazilian side, starting with the counterpart (C/P). In the M/P, various improvement plans were proposed, given actual conditions in Manaus, some of the matters in the proposal required further comprehension. Thus, the decision was made that in order for the C/P to acquire the necessary knowledge to bring about the smooth implementation of the M/P, 5 members of the C/P received training in Japan over a three-week period.

As shown in the above items, stakeholders on the Brazilian side took a leading role in the study. The Master Plan which resulted was, therefore, formulated upon the basic consensus of the persons concerned.

2 Current Conditions of Industrial Waste Management and related Issues

2.1 Study of Current Conditions

The first step in understanding the actual conditions of industrial waste management in the Industrial Pole of Manaus (PIM) was to conduct a number of surveys, as follows, enlisting a local consultant.

1. Survey of 90 companies operating waste-related services in the target study area.
2. Survey of 187 factories to grasp factory industrial waste management practices and clarify actual generation amounts, treatment and disposal conditions of general industrial waste.

3. Survey of 9 factories to clarify actual generation amounts, treatment and disposal conditions of health-care waste from attached medical clinics.
4. Survey of 10 factories to clarify generation amounts, treatment and disposal conditions of construction waste from on-site projects conducted between June 2008 and May 2009.
5. Survey of 7 factories in the study target area which use radioactive materials.

2.2 Current Amount of Industrial Waste Generated

As a result of the above surveys, the current (2009) amount of industrial waste generated from PIM factories is estimated to be 628.9 tons per day. The detailed breakdown of this is shown in the table below.

Table 1 : Industrial Waste Generation Amount in 2009

Industrial Waste (Name of generation source survey)	Generation Sources	Surveyed Generation Sources	Non-Hazardous Industrial Waste (ton/day)	Hazardous Industrial Waste (ton/day)	Total Generation Amount (ton/day)
General Industrial Waste (Factory Survey)	440	187	471.8	119.7	591.5
Health-care Waste (Medical Institution Survey)	163	9	0.2	0.2	0.4
Construction Waste (Construction Waste Survey)	162	10	37.0	0.0	37.0
Radioactive Waste (Radioactive Waste Survey)	9	7	0.0	0.0	0.0
Total Industrial Waste	-	213	509.0	119.9	628.9

2.3 Flow of Industrial Waste Management

The following figure shows the management flow of industrial waste as estimated from the generation source surveys and survey of waste service companies.

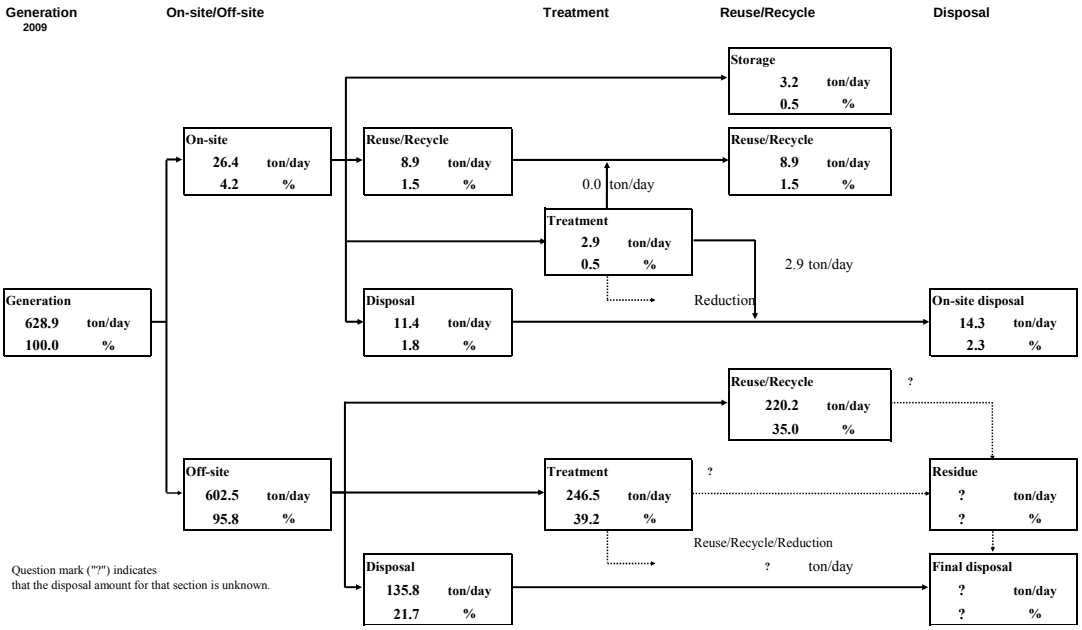


Figure 1 : All Industrial Wastes (IW) generated from PIM in 2009

2.4 Current Issues concerning Industrial Waste Management

Given the current situation as revealed by the surveys, the following issues concerning industrial waste management (IWM) were identified.

1. Insufficient understanding of actual disposal of industrial wastes. This is caused by the need to establish a better manifest system and the failure for many factories to produce and submit waste inventories.
2. The final disposal site that serves as final destination for the majority of industrial waste generated in PIM does not have an operation license. The final disposal site serves as the primary place of final destination for industrial waste generated from PIM, meaning that many PIM factories do not fulfill all ISO 14000 requirements.
3. Need to strengthen the administrative system for industrial waste management. Currently, the number of licensed waste service companies (WSC) and precisely what activities they are conducting are unclear. Furthermore, although factories may submit a waste inventory, these documents are not adequately analyzed or managed.
4. Poor business environment for industrial waste disposal. A large amount of industrial waste is disposed of in the Manaus City landfill, but it does not collect a disposal fee, severely limiting the administrative regulations against non-licensed companies and improper disposal. Under these conditions, competition between waste service companies is fierce, and disposal fees are extremely low. Thus, attracting investment for the construction and operation of appropriate treatment and disposal facilities is extremely limited.

3 Master Plan

3.1 Background of the Master Plan

The principal counterpart in this study is SUFRAMA. As an organization, SUFRAMA is responsible for granting investment incentives with the aim of realizing socio-economic development by promoting commercial investment, starting with factories, agro-business and others, while also pursuing sustainable management practices to preserve the biodiversity widely found in the Occidental Amazon region.

Therefore, in addition to manufacturers, the master plan (M/P) proposed in this study seeks to attract waste service companies that will play a role in environmental preservation and promote proper treatment of waste. The M/P was formulated keeping in mind the concept of further growth of PIM while continuing to promote the preservation of the State's natural environment.

3.2 Background of the Master Plan

The target year of the industrial waste management master plan (M/P) is 2015. In other words, the objective of the M/P is to achieve the "establishment of an appropriate system for industrial waste management" in the study target area, the Industrial Pole of Manaus (PIM), in five years, by the year 2015. Therefore, the M/P serves as the central proposition in addressing the issues concerning industrial waste management given above and make improvements in such a short period of time (see figure below).

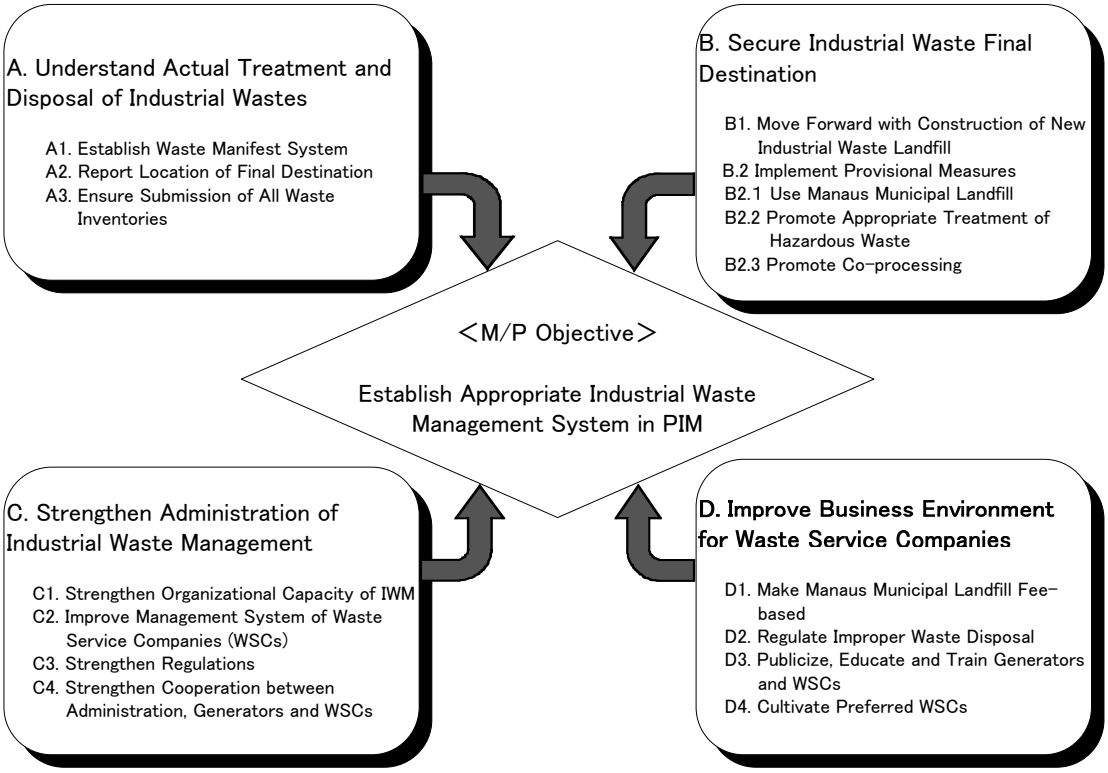


Figure 2: Summary of the Master Plan

3.3 Implementation Method

As mentioned above, the M/P given here is a highly strategic plan to "establish an appropriate industrial waste management system" in five years, by 2015. These improvements must be made quickly and efficiently. To do so, implementation of measures has been prioritized as follows.

1. The first step that must be taken in order to enforce regulations and establish an appropriate industrial waste management system is to improve the administrative system for IWM. To do so, administration must strengthen its organizational capacity as well as prepare a number of tools essential to industrial waste management.
2. The basic laws regarding industrial waste management in the study target area are already in place. Therefore, after strengthening administrative capacity and improving the management tools, the administration must strictly enforce IWM-related laws and regulations.
3. Given legal enforcement and compliance by generators (factories) and waste service companies, improper disposal methods will naturally be eliminated. Moreover, administration will serve to establish a system of appropriate industrial waste management by working closely with generators and waste service companies and publicizing appropriate treatment and disposal methods and 3R.

The following figure shows the relationship between improvements in the administrative system for IWM and legal enforcement in order to establish an appropriate IWM system, as mentioned above.

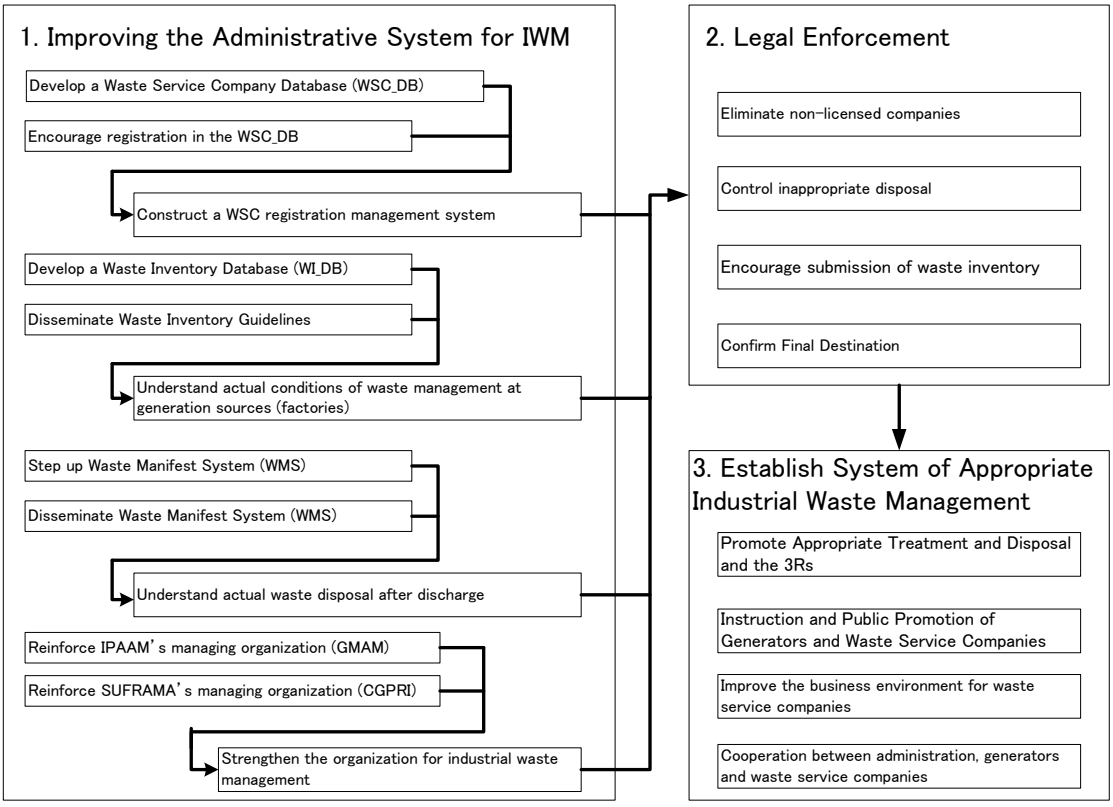


Figure 3: Improving the Administrative System of IWM and Establishing a System for Appropriate IWM

4 The Study Team's Recommendations

The M/P was formulated by stakeholders on the Brazilian side so the persons concerned have already reached consensus on its contents, and have already implemented important portions of the plan to strengthen administrative organization, develop management tools and so forth. However, a number of issues will have to be resolved when implementing the M/P. The JICA Study Team, therefore, offers recommendations as to how the related organizations should go about reaching those solutions.

4.1 Use the Waste Inventory Database (WI_DB) System

a. Applied in the Study Target Area

The waste inventory (WI) is an important tool for generators (i.e. factories), WI administration (which is IPAAM), and the superintendency of the Industrial Pole of Manaus and the industrial districts (which is SUFRAMA) in order to construct the respective systems for appropriate waste management. However, if the waste inventory is not properly produced, and the data not properly aggregated, analyzed and managed, the desired outcome cannot be expected. Therefore, a waste inventory database (WI_DB) system was developed in the study, in close cooperation with the C/P, in order to produce the WI and aggregate, analyze and manage the data properly. It is recommended that IPAAM and SUFRAMA use this system, and maximize the application of the waste inventories to construct an appropriate waste management system, by taking the following measures:

1. Until IPAAM is competent to carry out instruction and management of the WI, it will cooperate with SUFRAMA to spread the use of WI and improve the user guidelines.
2. IPAAM, with the cooperation of SUFRAMA, will use the improved WI_DB system and its user guidelines to inform and instruct all PIM factories how to produce and submit the waste inventory accordingly.

b. Disseminate the WI_DB system to other States and Industrial Parks

The WI_DB system developed in this study has the potential to be extremely useful to establish waste management systems in other states and industrial parks in Brazil, as intended by CONAMA Resolution 313. Consequently, the concerned organizations are recommended to promote dissemination of the WI_DB system and promulgate the intent of CONAMA Resolution 313 nationwide, contributing to conditions where industrial waste management systems can be established in each State.

1. First, Amazonas State will demonstrate that, using the developed WI_DB system as intended by the study team, it is possible to know the waste management conditions of each factory, related groups of factories and the State. In particular, this will confirm whether or not the waste stream can be drawn up. If so, the system will be spread to other States as follows.
2. The Ministry of Environment (MMA) collaborates with the Ministry of Development, Industry and Foreign Trade (MDIC) and the Brazilian Cooperation Agency (ABC) to hold a seminar for stakeholders in each State to disseminate the WI_DB system.
3. When holding the seminars, seek cooperation with SUFRAMA and IPAAM which are experienced in using the WI_DB system.

4. SUFRAMA and IPAAM, in response to a request by the Ministry of Environment (MMA) will actively dispatch technicians with experience in using the WI_DB system.

4.2 Construct a System to Manage the Licenses of Waste Service Companies

The waste service company license management system recommended in the Study is of great importance to "establish an appropriate industrial waste management system" in the target study area. However, it is not possible for the system to function unless waste service companies are legally required to obtain an operation license according to the proposed system. Therefore, it is suggested that the concerned organizations observe the following:

1. IPAAM will quickly revise its current licensing system and undertake measures so that the recommended license management system is part of the legal system. This means that it is necessary to carry out the required steps to deliberate the recommended license management system in the State Legislature (such as formulating a proposed revision of the law).
2. IPAAM will cooperate with SUFRAMA to move ahead with activities to promote the necessity of the recommended license management system to stakeholders.
3. Once the recommended license management system has become integrated into the legal system, IPAAM will immediately proceed with registration, and construct the WSC_DB.
4. Once the WSC_DB is constructed, IPAAM will make certain information about the newly licensed waste service companies, such as contact information and what licenses they hold, available on its website.

4.3 Use of the Guidelines to Improve Industrial Waste Management

The guidelines to improve industrial waste management in PIM were produced to support the aim of the M/P to "establish an appropriate system to manage industrial waste in the Industrial Pole of Manaus." The guidelines summarize the required actions to achieve the M/P objectives upon the understanding of waste generators, waste service companies and administration. It is suggested that those three parties make effective use of the guidelines to improve industrial waste management and establish an appropriate system of industrial waste management in PIM.

4.4 Form a Memorandum of Understanding concerning Implementation of the Master Plan

The authority to enforce the laws necessary to implement the M/P lies primarily with IPAAM. However, the various organizations will need to cooperate in a number of ways, as outlined below, for stakeholders to comply with the law in accordance with instruction and guidance by IPAAM and fulfill their respective obligations.

- SUFRAMA will grant various investment incentives to direct PIM factories to comply with regulation. Also, for waste service companies, SUFRAMA will attract the construction and operation of appropriate treatment and disposal facilities.
- The City of Manaus will make the current landfill fee-based, and promote the construction of a new landfill that is able to obtain an environmental license.

- The Public Ministry of Amazonas State will support IPAAM to enforce laws and regulation.
- Generators and wastes service companies will comply with laws and regulation and construct the respective systems for industrial waste management.

It is recommended that IPAAM clarify the roles and responsibilities of the related organizations and form a Memorandum of Understanding between those concerned with implementing the M/P.

4.5 Other

In addition to the four points given above, the Study Team makes the following recommendations:

- IPAAM will promptly prepare an electronic waste manifest system.
- Utilizing the output of the JICA study, SUFRAMA, in cooperation with IPAAM, will formulate an environmental management plan for the industrial districts (DI) and obtain the necessary environmental license.
- IPAAM will instruct waste generators and waste service companies on compliance with legal requirements and promote appropriate treatment and disposal and the 3Rs.
- IPAAM will cooperate with SUFRAMA to improve the poor business environment for waste service companies.
- IPAAM will strengthen cooperation between administration, waste generators and waste service companies.

A network of igarapé runs through the region and in Manaus. Here, illegal housing is built above igarapé 40.

There are a number of illegal settlements located in Manaus, including in the Industrial District.

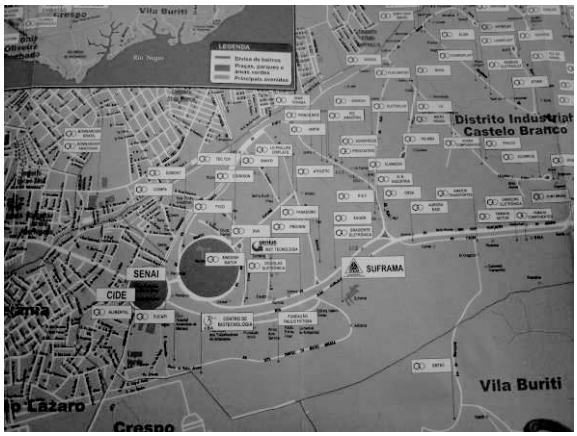
The watershed of Igarapé 40 includes much of Industrial District I. (Igarapé means tributaries of the Amazon River, narrow streams and canals)

Street vendors sell various items to passersby in downtown Manaus.

The busy port in Manaus, where tourist boats depart frequently, has a food court and market nearby.

Tourist activities also make up a large portion of Manaus' appeal as people come to explore the riches of the Amazon forest.

Plate 1:Natural and Social Conditions



SUFRAMA administrates the tax incentives for hundreds of companies, most of which are located in the two Industrial Districts, as shown here.

The SUFRAMA facility complex

Database equipment at the Industries Federation of Amazonas State (FIEAM) office in Manaus

A water treatment facility at a PIM factory. There is no wastewater treatment facility in Manaus, so factories must treat industrial effluent as well as domestic (non-industrial) wastewater themselves.

Erosion in the area is a major concern.

Billboards like this one, promoting the PROSAMIM igarapé program, are a common sight in Manaus.

Plate 2: State of Environmental Management

Illegal dumping can be found in forested areas where it is difficult to monitor conditions.

A view of the landfill in the city of Manaus

Illegal dumping of plastic containers with the Portuguese "*atenção cuidado*", indicating that *special care* is needed when handling them.

A collection truck on its way to the Manaus municipal landfill stops at the weigh bridge.

View of a private landfill

The rotary sieving machine for composting located at the Manaus municipal landfill.

Plate 3: State of Waste Management

A scrap metal recycler in Manaus compacts material for processing.

The scrap metal factory sorts materials for recycling.

The paper factory in Manaus produces a large amount of cardboard.

Workers process bundles of cardboard at the paper factory.

A cement factory in Manaus.

Materials are prepared for recycling at the SEMULSP recycling facility.

Plate 4: Supplement Studies on Current Conditions

JICA Team Leader, Susumu Shimura, and Deputy Superintendent of Projects, Oldemar Ianck, at the signing ceremony after reviewing the study Inception Report.

The kick-off meeting was attended by an extensive number of staff from SUFRAMA and other organizations involved in the study.

Regular weekly meetings at SUFRAMA are consistently attended by twenty or more stakeholders from various offices.

The first Workshop was held on September 11th, 2009 in the large SUFRAMA auditorium.

The study team and the SUFRAMA planning group discuss the schedule for workshops and the seminar that will be held.

IPAAM, the state environmental agency, is also actively involved in the study as a main counterpart.

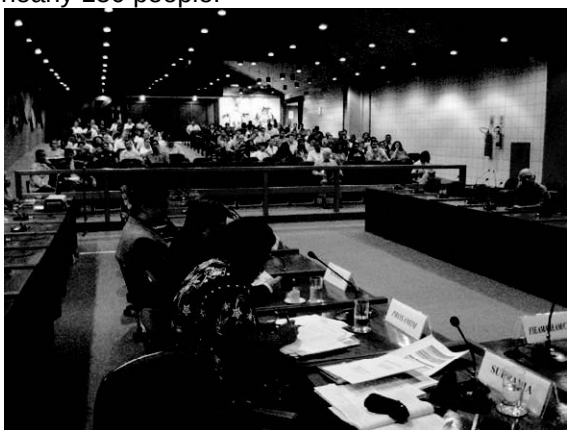
Plate 5: Capacity Development

Nearly 200 people attended the 1st Workshop on September 11th, 2009 in the large SUFRAMA auditorium.

Participants of the 1st Workshop divided into three smaller groups (about 25 people each) to discuss relevant issues

The 2nd Workshop was held on November 27th, 2009 at the Comfort Inn as part of the International Fair (FIAM 2009) and attended by nearly 150 people.

Participants of the 2nd Workshop divided into two smaller discussion groups, of about 20 people each, at the end of the afternoon.



The 3rd Workshop was a full-day event held on April 6, 2010 at the SUFRAMA Auditorium and attended by nearly 150 people.

The 3rd Workshop offered afternoon small group discussions on the issues of on-site, off-site and administration of industrial waste management.

Plate 6: Workshops

A half-day seminar was held on the morning of April 7, 2010 on how to complete the waste inventory using the proposed database.

In the afternoon of April 7, 2010, IPAAM instructed waste service companies on the proposed licensing system using specific licensing codes for waste services.

The seminar to announce the study results was hosted by SUFRAMA on May 27, 2010. It was attended by 112 participants and featured a lively question-and-answer session.

Speakers at the seminar presented the proposed M/P based on previous workshops and discussions with stakeholders.

Television and newspaper media also attended the seminar on May 27, 2010 to publicize the study results and conduct interviews.

Representatives from SUFRAMA and IPAAM in Amazonas went to Brasilia to explain plans to use databases for IWM to representatives from federal organizations and discussed extending the results elsewhere in Brazil.

Plate 7: Seminars

Pages

Contents

List of Tables

List of Figures

List of Abbreviations

Abbreviation	English	Portuguese
ABC	Brazilian Cooperation Agency	Agência Brasileira de Cooperação
ABNT	Brazilian Association for Technical Specs	Associação Brasileira de Normas Técnicas
ANA	National Water Agency	Agência Nacional de Aguas
ANEEL	Brazilian Electricity Regulatory Agency	Agência Nacional de Energia Elétrica
ANVISA	National Health Surveillance Agency	Agência Nacional de Vigilância Sanitária
ARSAM	Amazonas Regulatory Agency of Public Services	Agência Reguladora dos Serviços Públicos Concedidos do Estado do Amazonas
ATRINI	Non-hazardous & non-inert industrial waste temporary disposal site	Aterro Temporário de Resíduos Industriais Não-Inertes
CAPDA	Committee for Research and Development Activities in Amazonas	Comité das Atividades de Pesquisa e Desenvolvimento na Amazonia
CAS	Administration Council of SUFRAMA	Conseho Administração da SUFRAMA
CCINB-AM	Japanese-Brazilian Chamber of Commerce and Industry of Amazonas	Câmara de Comércio e Indústria Nipo-Brasileira do Amazonas
CD	Capacity Development	Desenvolvimento de Capacidade
CIEAM	Industries Center of Amazonas State	Centro da Industria do Estado do Amazonas
CNEN	National Commission of Nuclear Energy	Comissão Nacional de Energia Nuclear
CNI	National Confederation of Industies	Confederação Nacional da Indústria
COGEC	General Coordinator of Economic and Business Studies	Coordenação Geral de Estudos Economicos e Empresariais
CONAMA	National Council for Environment	Conselho Nacional de Meio Ambiente
COSAMA	Amazonas Sanitation Company	Companhia de Saneamento do Amazonas
C/P	Counterpart	Contraparte
DF/R	Draft Final Report	Minuta do Relatório Final
DG/L	Draft Guidelines	Esboço das Diretrizes
DI	Industrial District	Distrito Industrial
EIA	Environmental Impact Assessment	Avaliação de Impacto Ambiental
ERENOR	Representative Office of the Ministry of External Relations in the Northern Region	Escritório de Representação do Ministério das Relações Exteriores na Região Norte
FIEAM	Industries Federation of Amazonas State	Federação das Indústrias do Estado do Amazonas
F/R	Final Report	Relatório Final
FUCAPI	The Technological Analysis, Research, Innovation Center Foundation	Fundacão do Centro de Analise, Pesquisa e Inovacão
GEA	Government of Amazonas State	Governo do Estado do Amazonas
GIS	Geographical Information System	Sistema de Informação Geográfica

GOB	Federative Republic of Brazil	República Federativa do Brasil
GOJ	Government of Japan	Governo do Japão
IBAMA	Brazilian Institute for the Environment and Renewable Natural Resources	Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis
IBGE	Brazilian Institute of Geography and Statistics	Instituto Brasileiro de Geografia e Estatística
IBRD	International Bank for Reconstruction and Development	Banco Internacional para Reconstrução e Desenvolvimento (BIRD)
IC/R	Inception Report	Relatório Introdutório
IDB	Inter-American Development Bank	Banco Interamericano de Desenvolvimento (BID)
IEE	Initial Environmental Evaluation	Avaliação Ambiental Inicial
INEA	State Institute of Envirnment	Instituto Estadual do Ambiente
INMET	National Institute of Meteorology	Instituto Nacional de Meteorologia
INPA	National Amazon Research Institute	Instituto Nacional de Pesquisas da Amazônia
INPAE	National Institute for Environmental Preservation	Instituto Nacional de Preservação Ambiental
IPAAM	Institute of Amazonas Environmental Protection	Instituto de Proteção Ambiental do Amazonas
IT/R	Interim Report	Relatório Intermediário
JICA	Japan International Cooperation Agency	Agência de Cooperação Internacional do Japão
MCIDADES	Ministry of the Cities	Ministério das Cidades
MDIC	Ministry of Development, Industry and Foreign Trade	Ministério do Desenvolvimento, Industria e Comercio Exterior
MFZ	Manaus Free Zone	Zona Franca de Manaus
M/M	Minutes of Meeting	Minutas da Reunião
MMA	Ministry of Environment	Ministério do Meio Ambiente
MME	Ministry of Mine and Energy	Ministério de Minas e Energia
M/P	Master Plan	Plano Diretor
MS	Ministry of Health	Ministério de Saúde
NBR	Technical Rules	Normas Brasiliras
NGO	Non-Governmental Organization	Organização Não Governamental
OJT	On the Job Training	Treinamento em Trabalho
PIM	Industrial Pole of Manaus	Polo Industrial de Manaus
PMSS	Program for the Modernization of Sanitation Sector	Programa da Modernizacao do Setor de Saneamento
PROSAMIM	Socio- Environmental Program of Manaus Igarapes River Bank	Programa Social e Ambiental dos Igarapes de Manaus
RDC	CONAMA Resolution	Resolução do CONAMA
SEA	Strategic Environmental Assessment	Avaliação Ambiental Estratégica
SEDEMA	Municipal Secretariat of Development and Environment	Secretaria Municipal de Desenvolvimento e Meio Ambiente
SEINF	State Secretariat of Infrastructure	Secretaria de Estado de Infra-Estrutura
SEMMA	Municipal Secretariat of the Environment	Secretaria Municipal de Meio Ambiente
SEMULSP	Municipal Secretariat of Urban Cleaning and Public Services	Secretaria Municipal de Limpeza e Serviços Públicos
St/C	Steering Committee	Comité de Direcção
SUFRAMA	Superintendency of the Manaus	Superintendência da Zona Franca

	Free Trade Zone	de Manaus
SUDAM	Superintendency for the Development of Amazon Region	Superintencia do Desenvolvimento da Amazonia
S/W	Scope of Works	Escopo de Trabalho
TOR	Terms of Reference	Termos de Referência
TCSC	Technical Consultive Sub Committee	Subcomitê Consultivo Técnico
UGPI	Unit of Management of the Igarapes Program	Programa Social e Ambiental dos Igarapés
WB	The World Bank	Banco Mundial
WI_DB	Waste Inventory Database	Banco de Dados dos Inventários de Resíduos
WM	waste manifest	Manifesto de Resíduos
WSC_DB	Waste Service Company Database	Banco de Dados das Empresas de Serviço de Resíduos
W/S	Workshop	Workshop

Classification of Industries (Factories) and Industrial Wastes used in the Study

The following is the classification of the target industries (in the study, only factories) and industrial waste categorization used in the study, which served as the premise to conduct the study to improve industrial waste management.

1. Classification of Industries (SUFRAMA's factories)
2. Industrial Waste Categories
   - 2-1 General Industrial Waste
   - 2-1(a) Non-hazardous General Industrial Waste Categories used in the study
   - 2-1(b) Comparison of Study Code and CONAMA Code for Non-Hazardous General Industrial Wastes
   - 2-1(c) Hazardous General Industrial Waste Categories used in the Study
   - 2-1(d) Comparison of Study Code and CONAMA Code for Hazardous General Industrial Waste
   - 2-2 Health-care Waste
   - 2-3 Construction Waste
   - 2-4 Radioactive Waste

1. Classification of Industries (SUFRAMA's Factories)

Factory Code	Sector	
	Main Category	Sub-category
F01	Beverages	
F02	Leather	
F03	Printing	
F04	Electrical	
	4-1	Parts
	4-2	Products (except copy machines)
	4-3	Copy machines
F05	Lumber	
F06	Machinery	
	6-1	Clock/watch
	6-2	Other machinery industry
F07	Metal	
F08	Nonferrous	
F09	Furniture	
F10	Paper	
F11	Rubber	
F12	Food	
F13	Chemical	
F14	Plastic	
F15	Textiles	
F16	Clothing	
F17	Transportation	
	17-1	Two-wheelers
	17-2	Ships
	17-3	Other transportation
F18	Construction	
F19	Other	
	19-1	Optics
	19-2	Toys
	19-3	Small instruments
	19-4	Writing utensils, razor blades
	19-5	Other

Source: CGPRI & CGMER/COCAD SUFRAMA, up to 8/2008 "Industries (companies) established and producing in western Amazon with full projects approved by SUFRAMA "

2. Industrial Waste Categories

The study targeted industrial waste that factories must report upon making a waste inventory as required by CONAMA Resolution 313. Those wastes can be classified into 4 main categories, as shown below. Due to differences in the generation source and characteristics of each of these wastes, they were each surveyed individually in this study.

- General Industrial Waste: waste generated from factories other than 2, 3, and 4 below.
- Health-Care Waste: waste generated from medical facilities attached to factories.
- Construction Waste: waste generated from renovation and expansion construction at factories
- Radioactive Waste: waste generated from radioactive material used by the factory.

2-1 General Industrial Waste

In this Study, the general industrial waste generated from 187 factories of PIM was surveyed. Given the limited period of time for the study, a survey to gain an understanding of the overall management of general industrial waste in PIM was carried out using a simplified version of the complex industrial waste categories required by CONAMA Resolution 313. Namely, the study looked at 13 types of non-hazardous general industrial waste, and 16 types of hazardous industrial waste, and then clarified the management of each in terms of waste generation management (by creating "waste stream" diagrams and such). However, a user manual was put together for completing the waste inventory, which the factories are legally required to submit, according to the categories required by CONAMA Resolution 313. Tables comparing the JICA Study Team Code and the CONAMA Code are provided in order to clarify the factory survey results from the study and to facilitate cross-checks of the results of waste inventories made according to the manual after they are compiled and analyzed.

2-1(a). Non-Hazardous General Industrial Waste Categories used in the Study

Type of Non-Hazardous, Non-Inert Industrial Waste (Non-HGIW)	Non-HGIW Code
Kitchen waste (include waste from animal such as bone, skin, hair)	NH01
Wood	NH02
Paper	NH03
Plastic or polymers and resins	NH04
Textile and fiber	NH05
Animal oil, Vegetable oil	NH06
Rubber and Leather	NH07
Ash/dust from coal-fired power plants, etc.	NH08
Metals and metal alloys such as aluminum, copper, bronze	NH09
Ceramic & Glasses	NH10
Stone, sand or material that have composition of soil such as tile, brick, gypsum, cement	NH11
Mixed waste (This code shall be applied in case wastes are discharged without separation.)	NH12
Others	NH13

Source: JICA Study Team

2-1(b). Comparison of Study Code and CONAMA Code for Non-Hazardous General Industrial Waste

Study Code	CONAMA Code	Description of Non-HGIW
NH01	A001	Residues of restaurant (food remaining portions)
	A024	Bagasse of sugar cane
	A499	Carnaça
	A599	Residues organic of process (tallow, serum, bones, blood, others of the nourishing industry, etc)
	A699	Rind of rice
	A999	Residues of fruits (bagasse, must, rind, etc.)
NH02	A009	Residues wooden I contend not toxic substances
NH03	A006	Residues of paper and cardboard
NH04	A007	Polymerized plastic residues of process
	A107	Bombonas of plastic not contaminated
	A108	Etil acetate residues vinila (EVA)
	A207	Plastic films and small packings
	A208	Polyurethane residues (PU)
NH05	A010	Residues of têxteis materials
NH06	---*1	---
NH07	A008	Rubber residues
	A299	Caleadas shavings of skins
	A399	Atanado leather shavings, remnants
NH08	A111	Leached ashes of boiler
NH09	A004	Ferrous metal scrap iron
	A005	Not ferrous metal scrap iron (brass, etc.)
	A011	Not metallic mineral residues
	A012	Slag of aluminum casting
	A013	Slag of iron production and steel
	A014	Slag of brass casting
	A015	Slag of zinc casting
	A016	Sand of casting
	A104	Metallic packings (empty cans)
	A105	Not ferrous metal packings (empty cans)
	A204	Tambores metallic
NH10	A017	Refractory ceramic residues and material
	A025	Fibre glass
	A117	Glass residues
	A799	Atanado leather Serragem, bran and dust
NH11	---*1	---
NH12	A002	Generated residues outside of the industrial process (office, packings, etc.)
NH13	A003	Residues of varrição of plant
	A018	Solid residues not toxic metal composites
	A019	Solid residues of stations of treatment of effluent I contend material biological not toxic
	A021	Solid residues of stations of treatment of effluent I contend not toxic substances
	A022	Pastosos residues of stations of treatment of effluent I contend not toxic substances
	A023	Pastosos residues I contend limy
	A026	Slag of jateamento I contend not toxic substances
	A027	Used catalysers I contend not toxic substances
	A028	Residues of system of control of not toxic gaseous emission I contend substance (sleeve precipitadores, filters, among others) Products are of the specification or are of the validity stated period contend not dangerous substances
	A029	Other not dangerous residues
	A099	Salty shavings
	A199	Foam
	A308	Silt of the caleiro
	A899	Generated residues outside of the industrial process (office, packings, etc.)

Source: JICA Study Team

*1: There is no Study code where the corresponding CONAMA code is indicated.

2-1(c): Hazardous General Industrial Waste Categories used in the Study

Type of Hazardous General Industrial Waste (HGIW)	HGIW Code	Example of Hazardous General Industrial Waste (HGIW)
Inorganic acid	HW01	Sulfuric acid (H_2SO_4), Hydrochloric acid (HCl), Nitric acid (HNO_3), Phosphoric acid (H_3PO_4), Other inorganic acids
Organic acid	HW02	Acetic acid (CH_3COOH), Formic acid (HCOOH), Other organic acids
Alkalis	HW03	Caustic soda (NaOH), Ammonia (NH_3), Sodium carbonate (Na_2CO_3), Other alkaline materials
Toxic Compounds	HW04	including Hg, As, Cd, Pb, Cr, CN
Inorganic Compounds	HW05	Plating wastes, Picking waste, Sulphides, etc.
Other Inorganic	HW06	Asbestos, Slug, etc.
Organic Compounds	HW07	Reactive chemical wastes (Oxidizing agents, Reducing agents, etc), Solvents etc.
Polymeric Materials	HW08	Epoxy resin, Chelate resin, Polyurethan resin, Latex rubber etc.
Fuel, Oil and Grease	HW09	Fats, Waxes, Kerosene, Lubricating oil, Engine oil, Grease etc
Fine Chemicals and Biocides	HW10	Pesticides, Medicine, Cosmetic, Drugs, etc.
Treatment Sludge	HW11	Inorganic sludge, Organic sludge, Septic tank sludge, etc.
Ash from incinerator	HW12	---
Dust and Air pollution control (APC) products	HW13	Soot and dust waste from incineration facilities, treating exhaust gas
Other Hazardous substance (besides HW01-HW13)	HW14	HIWs other than the above
Mixed Waste	HW15	---
Hazardous materials from Non-production process	HW16	Fluorescent tubes, Thermometer (use mercury), Batteries, Pesticides (Household use), etc.

Source: JICA Study Team

2-1(d): Comparison of Study Code and CONAMA Code for Hazardous General Industrial Waste

Study code	CONAMA code	Description of Hazardous General Industrial Waste (HGIW)
HW14	C001 to C009	Listing 10 - dangerous residues for containing volatile components, of which do not apply solubility and/or leaching tests, presenting superior concentrations to the indicated ones in listing 10 of Norm NBR 10004
HW10 HW08 HW09 HW14	D001	Dangerous residues for presenting inflammability
HW01 HW02 HW03	D002	Dangerous residues for presenting corrosively
HW01 HW02 HW03 HW07	D003	Dangerous residues for presenting reactivity
HW10 HW14	D004	Dangerous residues for presenting pathogenicity
HW05 HW06 HW10 HW11	D005 to D029	Listing 7 of Norm NBR 10004: dangerous residues characterized by the leaching test
HW04	K193	Shavings of leather tanned with chromium
HW04	K194	Leather Serragem and dust containing chromium
HW04	K195	Silt of effluent treatment stations for chromium tanning
HW14	F102	Residue of catalysers not specified in Norm NBR 10.004
HW04 HW10	F103	Deriving residue of industrial laboratories (chemical products) not specified in Norm NBR 10.004
HW14	F104	Not specified contaminated empty packings in Norm NBR 10.004
HW07	F105	Solvent contaminated (to specify solvent and the main contaminant)
HW14	D099	Other dangerous residues - to specify
HW04 HW07	F001 F0301	Listing 1 of Norm NBR 10004- admittedly dangerous residues - Classroom 1, of not-specific sources
HW07	F100	Bifenilas Policloradas - PCB`s. Packings contaminated with PCBs also transforming and capacitors
HW07	P001 to P123	Listing 5 of Norm NBR 10004 - dangerous residues for containing toxic substances acutely (remaining portions of packings contaminated with substances of listing 5; contaminated residues of spilling or ground, and products are of specification or products of commercialization forbidden of any constant substance in listing 5 of Norm NBR 10.004
HW04 HW07	K001 to K209	Listing 2 of Norm NBR 10004- admittedly dangerous residues of specific sources
HW07	K053	Remaining portions and spots of inks and pigments
HW07	K078	Residue of cleanness with solvent in the manufacture of inks
HW07 HW11	K081	Silt of ETE of the production of inks
HW10	K203	Residues of illness research laboratories
HW01 HW09	K207	Residue the used oil re-refining (containing acid)
HW14	U001 to U246	Listing 6 of Norm NBR 10004- dangerous residues for containing toxic substances (contaminated residues of spilling or ground; products are of specification or products of commercialization forbidden of any constant substance in listing 6 of Norm NBR 10.004

Source: JICA Study Team

2-2: Health-care Waste

Health-care waste categorization is regulated by the Brazilian Association for Technical Specifications (ABNT) according to ABNT NBR 12808. Moreover, Handling of health-care waste is done according to RDC 306/2004-ANVISA and CONAMA Resolution 358/2005.

In this study, a medical institutions survey was conducted using a questionnaire based on ABNT NBR 12808. After the survey, it was revealed that at present, RDC 306/2004-AVNISA is being used, so the results of the survey were converted accordingly. The following table shows conversion of health-care waste categories of the RDC 306/2004-ANVISA and ABNT NBR 12808.

Conversion of Health-care Waste Categories between RDC 306/2004-ANVISA and ABNT NBR 12808

RDC 306/2004-ANVISA			**ABNT NBR 12808**	
Group		Description	Class, Type	Description
1. Group A	A.1	Biologic	Class A, Type A.1	Biologic
			Class A, Type A.2	Blood and Derivates
	A.2	Animals	Class A, Type A.5	Contaminated animal
	A.3	Body part	Class A, Type A.3	Surgical, anatomopatologic and exudates
	A.4	Patient care etc.	Class A, Type A.6	Patient care
	A.5	Prions	Not applicable	---
2. Group B		Chemical etc.	Class B, Type B.2	Pharmaceutical waste
			Class B, Type B.3	Hazardous chemical waste
3. Group C		Radioactive waste	Class B, Type B.1	Radioactive waste
4. Group D		Common waste	Class C	Common waste
5. Group E		Piercing or Cutting	Class A, Type A.4	Piercing or Cutting

2-3: Construction Waste

Construction Waste Categories in CONAMA Resolution 307

Class	Description
Class A:	The reusable or recyclable waste as aggregates, such as:
	a) from construction, demolition, refitting and repair of pavement and other infrastructure constructions, including land preparation;
	b) from the construction, demolition refitting and repair of edifications: ceramic components (bricks, blocks, tiles, insulation planks, etc.), cement and concrete;
	c) from manufacturing and/or demolition process of concrete pre-modulated pieces (blocks, pipes, gutter, etc.) produced in the construction sites.
Class B	The recyclable waste for other purposes, such as: plastics, paper/carton, metals, glass, wood and others.
Class C	Waste which has no economically feasible technology or applications which may allow it to be recycled/recovered, such as the products arisen from plaster.
Class D	Hazardous waste arisen from construction process, such as paints, solvents, oils and so forth, or those contaminated or harmful to health arisen from demolitions, refitting and repairs of radiology clinics, industrial facilities and others, as well as tiles and other objects and materials containing asbestos or other products harmful to health. *(new text given by Resolution n. 348/04)*.

2-4: Radioactive Waste

Categorization of Radioactive Waste

Class	Type	Level
1. Waste containing beta or gamma emitters	1.1 Liquid Waste	・Low Level Radioactive Waste ・Mid Level Radioactive Waste ・High Level Radioactive Waste
	1.2 Solid Waste	・Low Level Radioactive Waste ・Mid Level Radioactive Waste ・High Level Radioactive Waste
	1.3 Gaseous Waste	・Low Level Radioactive Waste ・Mid Level Radioactive Waste ・High Level Radioactive Waste
2. Waste containing alpha emitters	2.1 Liquid Waste	・Low Level Radioactive Waste ・Mid Level Radioactive Waste ・High Level Radioactive Waste
	2.2 Solid Waste	・Low Level Radioactive Waste ・Mid Level Radioactive Waste ・High Level Radioactive Waste

Source: Management of Radioactive Wastes in Radioactive Facilities CNEN-NE-6.05 – December 1985

The generation of the radioactive waste is not informed by the user of radioactive materials in the study area.

1 Outline of the Study

1.1 Background and Objectives of the Study

1.1.1 Background of the Study

The aim of the Manaus Free Zone (MFZ), an economic development model put forth by the Brazilian government, is not to exploit the valuable natural resources of the Amazon which are recognized the world over, but to realize sustainability of the western Amazon. The primary infrastructure of the MFZ is the Industrial Pole of Manaus (PIM[1]), which is one of the most preeminent industrial parks in Latin America. Presently, there are roughly as many as 550 domestic and multinational factories, mainly assembly production, operating in the PIM, indirectly responsible for creating 500,000 jobs and directly employing 100,000 people. In order to further promote the sustainable development of the western Amazon, the Ministry of Development, Industry and Foreign Trade (MDIC) hopes to entice production of raw materials, increase its value as an industrial complex and promote the overseas export of its products.

PIM factories are required to submit waste inventories based on CONAMA Resolution 313; however, despite the clear interest in environmental conservation and industrial waste management, the PIM as a whole displays a lack of knowledge in these areas, and although foreign-capital and large corporations have been sure to comply, the number of inventories received is largely insufficient.

Also, due to delays in the administration constructing a database and conducting analysis, the inventories that have been received do not clarify the amount or composition of the wastes disposed of from PIM or basic waste management conditions such as the percentage of PIM factories that conduct at-source wastewater treatment. Furthermore, even though a basic legal system is in place, research is lacking on the conditions of industrial waste treatment, and the state and municipal environmental offices in charge of regulation must improve their structure and capacity to do so, thus it remains unclear as to how industrial waste from factories is actually being treated. As a result, there have been indications from Igarapé of water pollution from factory effluent and environmental problems caused by illegal dumping of industrial wastes.

It is under these circumstances that the Superintendency of the Manaus Free Trade Zone (hereinafter, SUFRAMA) hopes to attract more industry to the MFZ/PIM and invite economic development of the MFZ with consideration for the environment. This has further necessitated the formulation of a plan for industrial waste management for the entire PIM which could then be used to coordinate industries located there, construct an appropriate industrial waste management system and promote infrastructure provisions. For these reasons, assistance is needed to obtain an accurate view of the current state of industrial waste management in the PIM and to formulate an appropriate master plan for industrial waste management.

In response to a request from the Government of the Federative Republic of Brazil (hereinafter, GOB), the Japan International Cooperation Agency (hereinafter, JICA)

[1] This indicates a group of factories located in the MFZ that receive tax benefits, including factories located both within and outside of the two industrial districts.

dispatched the second preparatory study team to clarify the framework of "The Study for the Development of an Integrated Solution related to Industrial Waste Management in the Industrial Pole of Manaus" (hereinafter, "the study"). The Minutes of Meeting (M/M) on the second preparatory study was signed on September 24th, 2008 and the Scope of Works (S/W) was signed on November 26th the same year.

To conduct the study, JICA selected Kokusai Kogyo Co., Ltd. and Ex Corporation in a joint venture as the consultants consigned to carry out the study operations. The joint venture began operations in February 2009, and the study was completed in August 2010.

1.1.2 Objectives of the Study

The objectives of the study are:

- To review the current conditions of industrial waste management in the MFZ PIM and the surrounding area and compile the results into a report.
- To formulate a master plan for industrial waste management (five-year plan from 2011 to 2015) in PIM and guidelines for the improvement of industrial waste management in PIM.

Also, by achieving these study objectives, the following end goals are pursued:

- To establish appropriate industrial waste disposal and the 3Rs (Reduce, Reuse, Recycle) based on the master plan for industrial waste management in the target study area.
- With the establishment of appropriate industrial waste disposal and 3Rs, reduce improper disposal of industrial wastes and minimize environmental impact.
- To realize the above conditions, companies both domestic and foreign will be encouraged to enter PIM and create new employment opportunities.

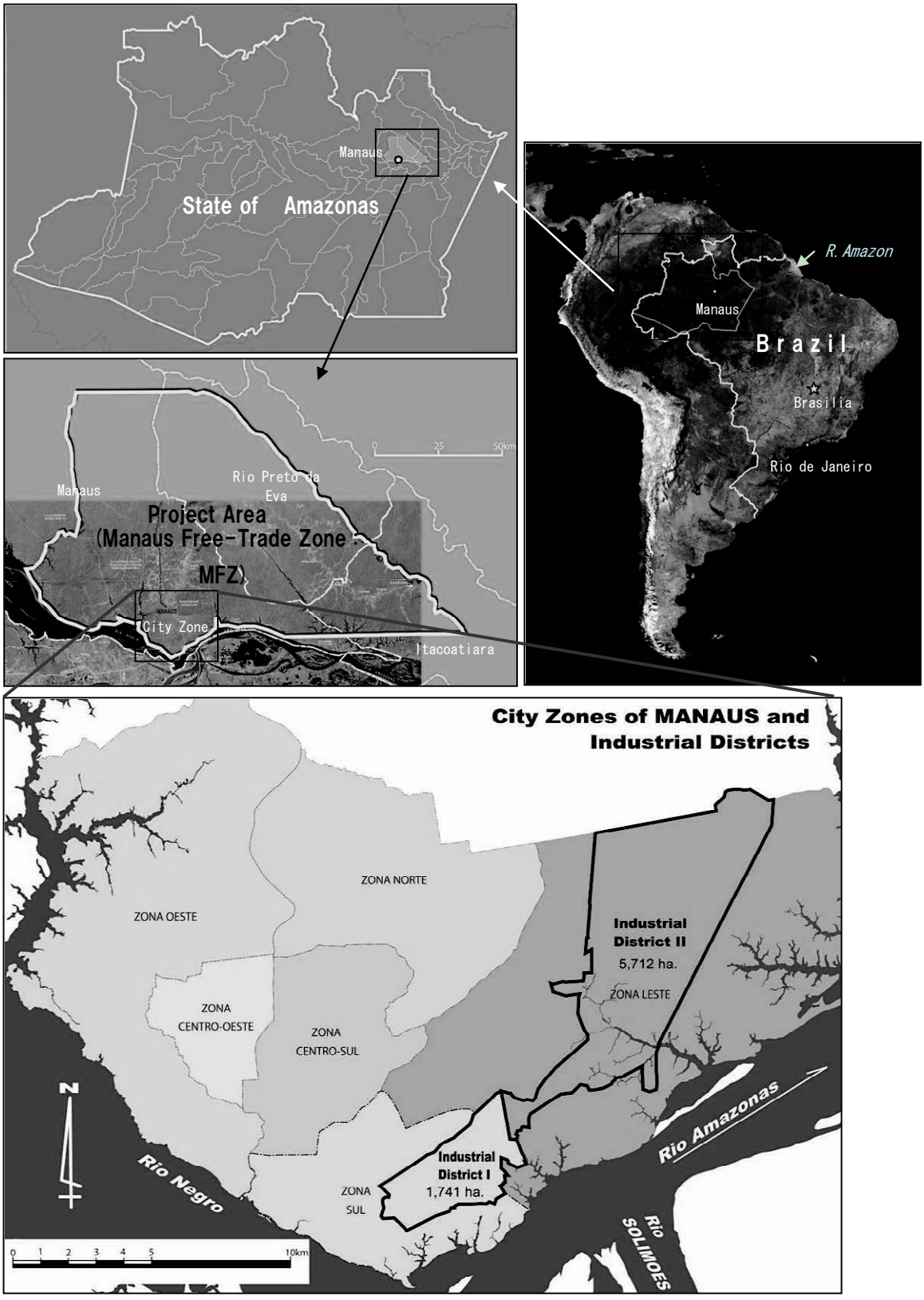
1.1.3 Study Area

The study area is the Manaus Free Zone (MFZ), where the PIM is located; at its heart, the City of Manaus, State of Amazonas (see map below). The MFZ, as detailed in the table below, is an area that enters three municipalities.

Table 1: Municipal Areas of MFZ

Name of Municipality	A. Municipal Area (km^2)	B. Area in MFZ (km^2)	Percentage of MFZ Area (B/A x 100 (%))
Manaus	11,458	4,950	43.2
Itacoatiara	8,600	1,250	14.5
Rio Preto da Eva	5,813	3,800	65.3
MFZ	-	10,000	-

Source: Brazilian Institute of Geography and SUFRAMA



Source: PERSPECTIVA, Amazonas Map

Figure 1: Map of the study area

1.1.4 Target Waste

The target waste in the study was industrial waste factories are required by CONAMA Resolution 313 to report upon making a waste inventory. Those wastes can be classified into 4 main categories, as shown below. Due to differences in the generation source and characteristics of each of these wastes, they were each surveyed individually in this study.

- General Industrial Waste
- Health-care Waste
- Construction Waste
- Radioactive Waste

The target waste of the study was the general industrial waste generated in the Industrial Pole of Manaus (PIM), but this also included waste such as health-care waste generated from medical institutions[2] linked to PIM factories and construction waste discharged from PIM construction sites. Improvement recommendations are not included in the master plan for radioactive waste, but a fact finding study of current conditions was conducted.

Each country has its own specific definitions and criteria for wastes. Each target waste in Brazil in this study, its definition, criterion and the entities which it targets are outlined in the table below.

Table 2: Target Wastes' Definition, Criteria and Corresponding Entities

Waste	Definition	Criterion	Target Entities
General Industrial Waste	Defined as factory-generated waste, roughly categorized as *production process* and *non-production process* waste.	CONAMA Resolution 313	All PIM factories
Health-care Waste	Health-care waste is defined as waste generated from medical institutions and is largely divided into the following 5 groups: Infectious (Group A: institutions, etc), Infectious (Group E: syringes, etc), Chemical (Group B) etc, Radioactive Waste (Group C), and Common (Group D) waste.	RDC 306/2004 – ANVISA (On-site), Resolution 358/2005 – CONAMA (Offsite)	Medical institutions (clinics) located at PIM factories and a SUFRAMA-approved hospital.
Construction Waste	Defined as construction-generated waste, roughly categorized as reusable or recyclable as aggregate, recyclable as non-aggregate, uneconomical recyclables, and hazardous waste.	CONAMA Resolution 307	Construction performed at all PIM factories.
Radioactive Waste	Material created through human activity, containing radioactive material at or above the limit set for radioactive licensing in CNEN-NE-6.02, defined as items unsuitable for, or impossible to, reuse. Waste which (1) emits beta or gamma rays, and (2) emits alpha rays,	CNEN-NE-6.05	All factories and organizations licensed by the Ministry of Science and Technology or the National Nuclear Energy Commission for Radioactive to

[2] The term "medical institutions" is used in the study in place of "hospitals", indicated in the Scope of Works (S/W).

	further categorized as liquid waste and solid waste. Also, each is regulated according to a low-level, mid-level and high level numerical range. Regulation is in place for allowable limits of alpha rays, although there is no such regulation for beta and gamma rays.		use radioactive material in the study area.

1.2 Outline of the Study

1.2.1 Basic Policy of the Study

The study was implemented according to the basic policy set forth below, as proposed in the IC/R and approved by the C/P.

The industrial waste management plan formulated in this study shall:

1. **be considerate of environmental protection wherever possible**
2. **be practicable**
3. **be understood by and obtain the cooperation of members of society, and**
4. **be formulated on the initiative of the Brazilian counterpart**

1. Consideration for environmental protection

The target area for the industrial waste management plan is the Amazon, a place where environmental protection has attracted global attention, and simply promoting appropriate treatment and disposal is not enough. Instead, it will be necessary to produce a plan that balances environmental protection and development (industrial activity). Such a plan will have to promote the 3Rs at the generation sources, preventing waste from being generated as much as possible, and stopping the illegal disposal through maximum reuse and recycling or energy conversion. In particular, the plan shall establish a *material recovery network* within the MFZ and aim for zero environmental impact from industrial waste generated in the area.

2. Practicability

It can not be overstated that establishing an adequate management system for industrial waste has great influence on further attracting industry and the continuation of development in MFZ. Nevertheless, no matter what the plan, it would be meaningless if not adhered to. Waste reflects the character of a society; regional differences are apparent in both the characteristics and amount of that waste. This means it is not possible to simply apply the economic and technical mechanisms used in Japan and other developed countries, but that a feasible master plan (M/P) must be formulated according to the circumstances of the study target area. In order to do so, there must be a proper understanding of the current waste management practices by the companies in PIM, the conditions concerning disposal of wastes generated by them, and the capability and capacity of related organizations and institutions.

3. Social understanding and cooperation

Industry raises their profits through production output, while at the same time society acquires the materials they need and enjoy wealth. Thus, the problem of industrial waste emerging from factory output is not solely the problem of industry, but an issue all members

of society must bear. Society bears the expense through the cost of goods or taxes regardless of whether treatment and disposal is done by the industries that generate waste, or if the government has a hand in it. Without social understanding and cooperation, there will be obstacles to industrial waste management.

4. Brazil's initiative

As expected, the master plan was formulated through close cooperation with the Brazilian counterpart and the study team so that it can be implemented smoothly. It was necessary, however, for the Brazilian side to take the initiative to conduct the study on its own. Also, part of the process to formulate a plan to improve industrial waste management in which "a study is carried out to grasp the current conditions and formulate a master plan based on the results" will not only serve PIM, but by formulating a model plan that can be applied to other industrial hubs, it should be able to be replicated nationwide. However, to actualize this, it was necessary for the Brazilian side to be proactive in their approach and to take the initiative in conducting this study.

1.2.2 Approach of the Study

The study has been implemented according to the basic policies above, specifically, by carrying out the following central activities:

- Study development through weekly meetings
- Holding workshops and a seminar
- Publicizing activities on the SUFRAMA website
- Provide Japan Training to C/P

a. Study development through weekly meetings

There are a great number of different parties engaged in the study which deal with the management of the target wastes--industrial, health-care, construction and radioactive wastes--in the study. Also, the administrative authority of these parties may be redundant or unclear in some cases. Furthermore, to come to a proper understanding of the actual waste management practices carried out in PIM, the study has carried out a survey on generation sources such as factories, medical institutions, and construction sites, and a survey of waste service companies and related organizations. In order to implement these surveys properly in the limited study period, it was necessary to begin with a proper understanding of which organizations had existing data related to the study, how they have been managing it, and so forth. To do so, the concerned parties were called together for weekly meetings to discuss the progress of the study. These meetings allowed the concerned parties to discuss at least the forthcoming week's schedule, what other parties, if any, should be invited, and deliberate about the progress of the study. Namely, the meeting sought to involve not only dischargers of waste, but also participation from administrative organizations and waste service companies or NGOs and other related parties should their participation be necessary to the progress of the study.

In the weekly meetings, the counterpart (C/P) was the driving force behind formulating the M/P and promoting its implementation. Each week, about 25 participants on average attended and spent a couple hours to discuss the contents of the study and how it should proceed, in addition to why the study was necessary, and who put the results into practice and how. Through the discussions that took place during the weekly meetings, the participants from varying organizations came to understand each other's roles and were able to make any

necessary adjustments. Basically, this has formed a network of each party's information and personnel, and a network like this would likely be influential, particularly in promoting the implementation of the formulated industrial waste master plan (M/P).

For each weekly meeting, the study team prepared discussion materials (hereafter, the agenda), SUFRAMA recorded the Minutes of Meeting (M/M), and these were then distributed to the Ministry of Environment, JICA Brazil Office and other related organizations. These agenda and M/M covered not only the progress of the study, but also all discussion items such as industrial waste management issues and policies for improvement. These are provided in the Data Book.

A total of 26 weekly meetings were held from March 3, 2009 to May 26, 2010, and were attended by a total of 646 related persons. The following table shows the breakdown of those attendees.

Table 3: Weekly Meeting Attendee Breakdown

Affiliation	Total Attendees
1. SUFRAMA (C/P)	278
2. Amazonas State Government Affiliate other than SUFRAMA (C/P)	127
3. Local Consultant	77
4. Generator (Industry)	2
5. Waste Service Company	10
6. JICA Study Team	150
7. Other	2
Total	646

b. Holding workshops and seminars

The weekly meetings are limited to participant organizations and their delegates. However, in order to gain an understanding and hear the opinions of a wide range of stakeholders to understand the current conditions of industrial waste management and to formulate the master plan for industrial waste management, a series of workshops and seminars were held to offer an opportunity for discussion, as outlined below.

Table 4: Workshops and Seminars Overview

Workshops and Seminars	Date	Purpose
1st Workshop	11 September 2009	Opinion gathering from stakeholders on the current conditions of industrial waste management and policy for improvement
2nd Workshop	27 November 2009	Present the concept of the Industrial Waste Management Master Plan, to explain the content to stakeholders and seek their opinions
3rd Workshop	6 April 2010	Plan for Industrial Waste Management M/P including selection of an alternative plan, and exchange with stakeholders.

Waste Inventory Database (WI_DB) Seminar	7 April 2010	Present a summary of the WI_DB developed in the study to those responsible for completing the waste inventory on behalf of factories and actively seek their cooperation. Also, to receive any recommendations to improve database input methods and so forth.
Waste Service Company Database (WSC_DB) Seminar	7 April 2010	Present a summary of the WSC_DB developed in the study to waste service companies and seek their understanding of its intent. Also, to receive any recommendations to improve database input methods and so forth.
Seminar (in Manaus)	27 May 2010	Disclosure of all study results, including M/P, and forming consensus with stakeholders on spreading results and plan.
Seminar (in Brasilia)	28 May 2010	Present a summary of the WI_DB and WSC_DB developed in the study to federal government representatives and seek their understanding, as well as opinion concerning dissemination to other parts of the country.

Furthermore, it is ideal to reflect the opinions of as many stakeholders as possible in the Industrial Waste Management Master Plan (M/P). To do so, when formulating the M/P, three workshops and a seminar will be held, seeking the opinions of stakeholders, and reflecting them in the M/P upon analysis, as the following chart illustrates.

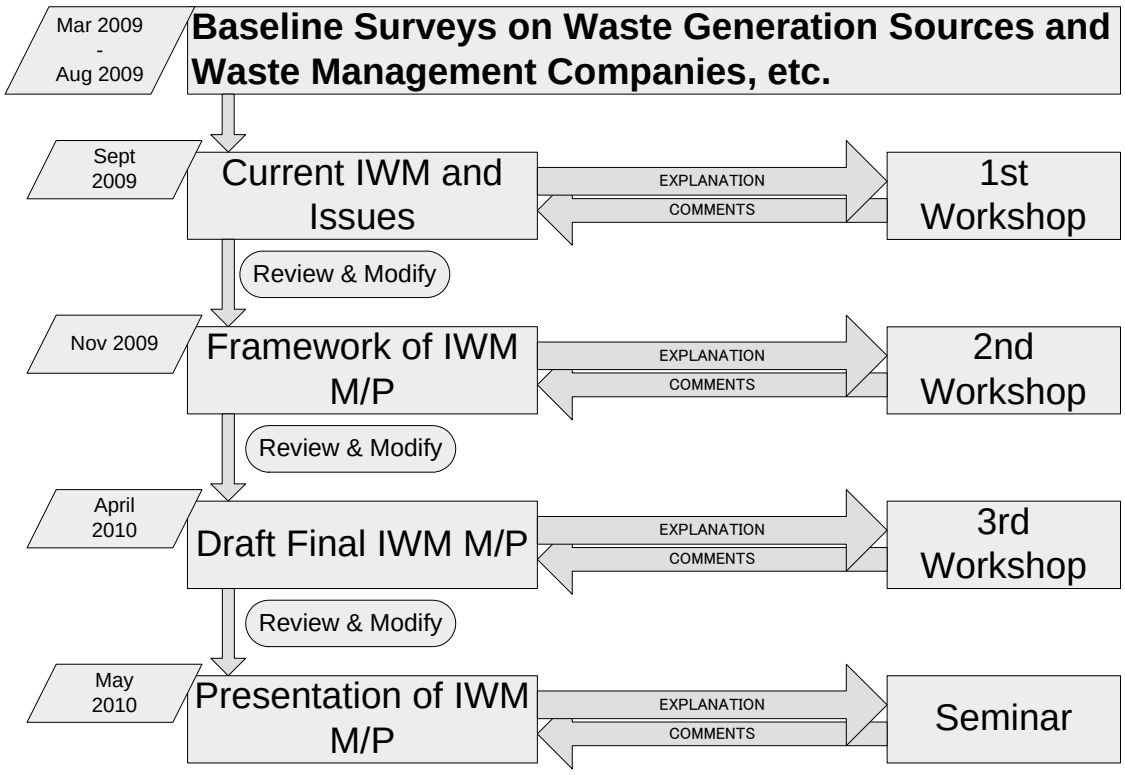


Figure 2: Formulation of the Master Plan through Workshops and Seminar

Based on this process, as mentioned in the basic policies earlier, this served to gain cooperation and understanding from society in formulating the plan, to promote disclosure of information and include environmental considerations in the plan.

At the three workshops and main seminar in Manaus, there were a total of 573 attendees. The breakdown of attendees is shown below.

Table 5: Workshops and Seminar Attendee Breakdown

Affiliation	1st Workshop	2nd Workshop	3rd Workshop	Manaus Seminar
1. SUFRAMA (C/P)	34	13	32	32
2. Amazonas State Government Affiliate other than SUFRAMA (C/P)	19	13	12	13
3. Local Consultant	12	3	4	2
4. Generator (Industry)	65	72	54	28
5. Waste Service Company	22	12	10	8
6. JICA & JICA Study Team	8	9	6	5
7. Other	21	16	24	24
Total	181	138	142	112

Moreover, additional seminars were held to explain the waste inventory database (WI_DB) and waste service company database (WSC_DB), which attracted 46 and 36 participants, respectively. Another seminar was held in Brasilia with 10 participants.

c. Publicizing activities on the SUFRAMA website

Progress of the study and reference information on industrial waste has been put on the SUFRAMA website. The following information, mainly in the form of newsletters, was posted, as of the end of July.

Table 6: Content of the Information Posted on the SUFRAMA website

Type of Information	Date Posted	Contents
Newsletter 1	Late April 2009	Overview of the study
Newsletter 2	Late June 2009	Purpose and overview of the generation sources survey and survey of waste management companies
Workshop (1)	Mid September 2009	Workshop (1) Presentation Materials
Newsletter 3	Mid October 2009	Results of Waste Generation Source Survey, Waste Service Company Survey
Newsletter 4	Mid November 2009	Overview of Workshop (1)
Workshop (2)	Early December 2009	Workshop (2) Presentation Materials
Newsletter 5	Mid February 2010	Overview of Workshop (2)
Workshop (3)	Early April 2010	Workshop (3) Presentation Materials
Newsletter 6	Mid June 2010	Overview of Workshop (3) and explanatory meetings on the Waste Inventory and Waste Service Company databases.
Seminar in Manaus	Mid June 2010	Seminar Presentations Materials
Newsletter 7	Late July 2010	Overview of the Seminar

d. Japan Training for C/P

The Industrial Waste Management Master Plan (M/P) formulated in the study will be implemented by related organizations on the Brazilian side, starting with the C/P. In the M/P, various improvement plans were proposed, given actual conditions in Manaus, some of the matters in the proposal required further comprehension. Thus, the decision was made that it was necessary for the C/P to acquire knowledge related to the following items in order to bring about the smooth implementation of the M/P, and to understand conditions in Japan, training was carried out in Japan.

- The background and state of implementation of zero emission factories and industrial complexes
- Necessities to promote 3R
- Proper operation of various types of industrial waste treatment and disposal facilities
- The established state of a material cycle network centered around a cement factory

The training took place over an 18-day period from January 24 to February 10, 2010, attended by 5 C/P members who will be central to implementing the M/P.

Table 7: Japan Training Participants

Name	Affiliation	Post
David Rocha Silva	SUFRAMA	Waste Management Unit (will be established in 2010)
Armando Bandeira dos Santos Jr	SUFRAMA	Waste Management Unit (will be established in 2010)
Rita de Cássia de Vasconcelos Dias Mariê	SUFRAMA	Waste Management Unit (will be established in 2010)
António Ademir Stroski	IPAAM	Assessor
Alexandre Kadota	FIEAM/CIEAM/CCINB-AM	Co-Director

1.2.3 Organizations of the Study

SUFRAMA designated members from the counterpart (C/P), steering committee (St/C) and technical consultative sub-committee (TCSC) to encourage smooth implementation of the study. At the same time, JICA established an advisory committee in Japan to support the study team. The structure of these organizations in relation to the study is shown in the figure below.

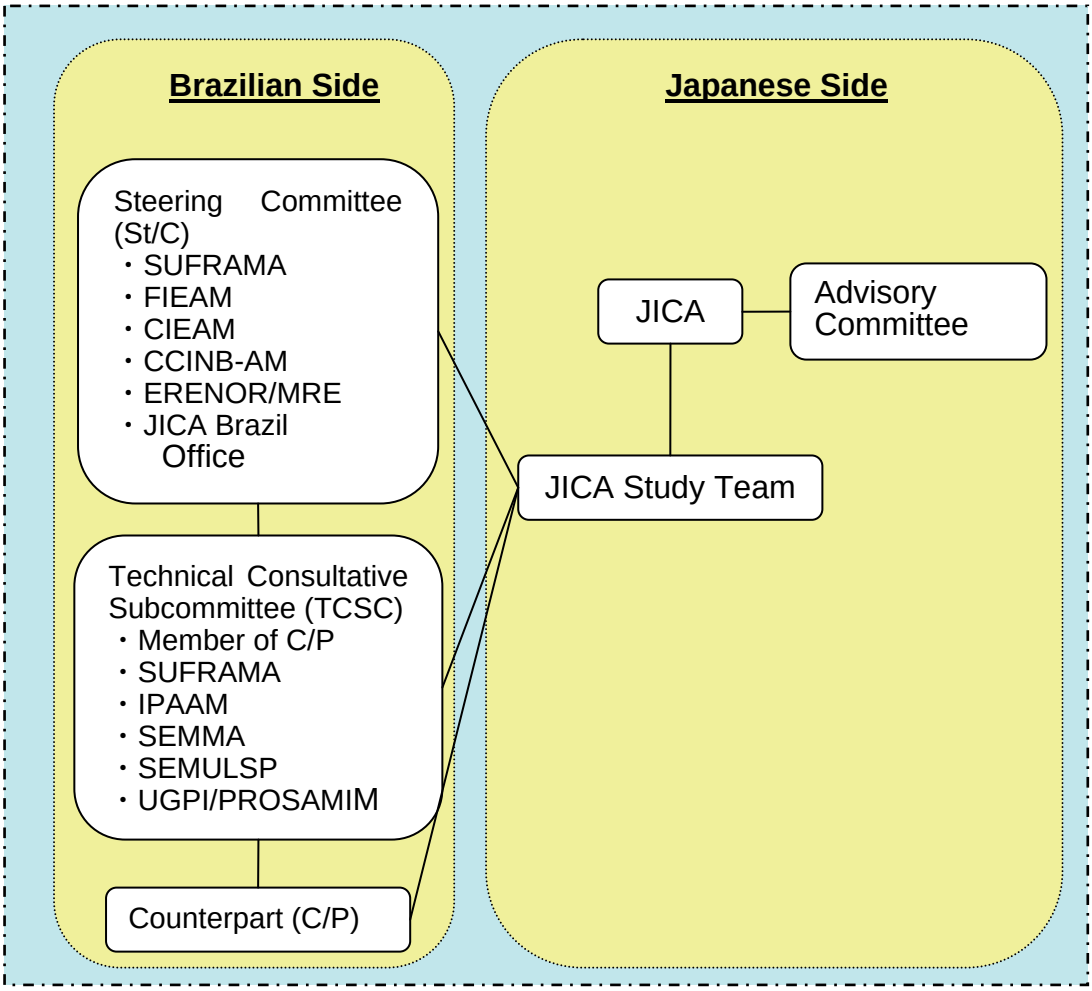


Figure 3: Organizational Structure of the Study

1.2.4 Study Schedule

The study is divided into two phases, starting in February 2009, and concluding in August 2010:

Phase 1: Study of current conditions (February 2009 - September 2009)

Phase 2: Formulation of the industrial waste management master plan and guidelines (October 2009 – August 2010)

An overview of the work schedule is illustrated below.

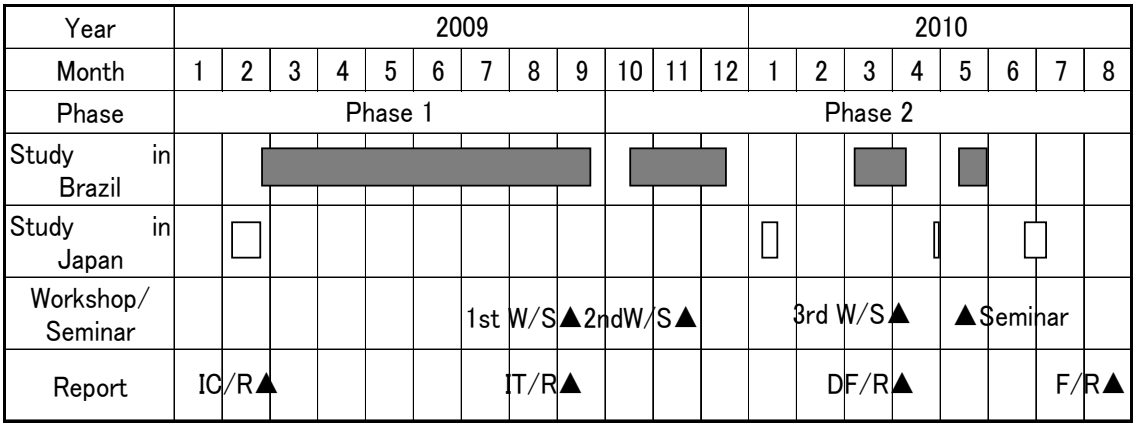


Figure 4: Overview of Study Work Schedule

1.2.5 Overview of the Study

The study is summarized as follows.

a. Phase 1: Study of Current Conditions (February 2009-September 2009)

First, in order to comprehend the current conditions of industrial waste management in the study target area, the following supplemental studies were carried out.

1. Waste Generation Source Survey
   - Survey of 187 PIM factories which generate industrial waste
   - Survey of 10 PIM medical institutions which generate medical waste
   - Survey of 10 PIM factories which performed construction projects over the past one-year period which generated construction waste.
   - Survey of 8 PIM institutions which use radioactive materials and generate radioactive waste
2. Study of current waste management conditions for 90 waste service companies

Prior to implementing the studies, the current conditions of industrial waste management in the State of Amazonas, and particularly the legal system related to the types of waste and what organizations manage them, was investigated through cooperation with the C/P. Then, each of the survey items, target factories and companies were discussed with those concerned at weekly meetings and questionnaires for each survey were produced. Based on these, with the exception of radioactive wastes, a tender was carried out for each of the 4 surveys and local consultants were consigned accordingly. The radioactive waste survey was done by the study team and in cooperation with a survey assistant.

- For each survey, the local consultant visited a sample group to carry out the survey based on the questionnaire, then summarized the results. The study team analyzed these results and created a waste stream diagram for general industrial waste, health-care waste and construction waste, and outlined the conditions and issues related to waste management. Concerning radioactive waste, it was discovered that there is no radioactive waste generated.

- Upon discussion with those concerned at the weekly meetings, the current conditions and issues of industrial waste management in PIM were organized. Workshop (1) was held on September 11, 2009 to present this to stakeholders and solicit their opinions. A total of 181 people participated in Workshop (1), and after the above was presented by the C/P, attendees were divided into three groups where they proceeded to discuss these. Afterwards, a representative from each group presented the issues of industrial waste management and policies for improvements as discussed in their groups.
- Based on the conclusions and suggestions from Workshop (1), the study team and C/P summarized the output of Phase 1 in an Interim Report (IT/R).

b. Phase 2: Formulation of the industrial waste management master plan and guidelines (October 2009-August 2010)

Phase 2 of the study started at the end of October 2009, beginning with discussion of in what ways the issues of industrial waste management in PIM, as found in phase 1 of the study, should be approached for improvement. Discussing with related stakeholders in weekly meetings, a policy was produced for improving these issues by conceiving of the concept for an Industrial Waste Management Master Plan (M/P). On November 27, 2009, Workshop (2) was held, attended by 137 stakeholders. After the C/P presented the concept of the Industrial Waste Management M/P, participants divided into two groups for active discussion on the topic. Afterward, a representative from each group presented the conclusions related to the IWM M/P as discussed in the groups.

It was planned, during this time, to carry out an Initial Environmental Evaluation (IEE), but was it was ultimately decided to forego the IEE after it was confirmed that the preparation of waste related facilities required in the M/P were basically left to the hand of private companies and the government side is not involved.

From the end of October 2009 to early December, along with the formulation of the M/P concept, the following two databases, which are extremely significant toward improving upon issues of industrial waste management, were developed through discussion with SUFRAMA and IPAAM related staff.

1. Industrial Waste Inventory Database (WI_DB)
2. Waste Service Companies Database (WSC_DB)

In January and February 2010, in Japan, the study team arranged the details based on the concept of the M/P. Also, from late January to mid-February, spanning approximately 3 weeks, support was given for Japan training for the five members of the C/P. Through the Japan training, the C/P member's understanding of the improvements recommended in the M/P was greatly strengthened.

The third study period in Brazil was carried out from early March to early April 2010. During that time, 4 weekly meetings were held, at which participants discussed the details of the M/P and the content of the (draft) guidelines to improve industrial waste management in PIM, on which the Draft Final Report (DF/R) was based. Consensus was sought among as many stakeholders as possible over the content of the proposed M/P in the DF/R by holding Workshop (3) on April 6, 2010. At the workshop, the five members of the C/P who had received training in Japan presented three themes, on-site and off-site industrial waste management as well as IWM administration in Japan, so that participants could comprehend the content of the proposed M/P. In addition, a representative of the C/P explained the proposed M/P and then took comments and suggestions from the audience. There were 142

participants at Workshop (3), and following the presentation on the proposed M/P, participants were divided into three groups where they proceeded to actively discuss the topics. Then, a representative of each group gave a summary of what was discussed in their group concerning the proposed Industrial Waste Management Master Plan.

In the third study period in Brazil, a user guide was made concerning data input and management of the industrial waste inventory database (WI_DB) and waste service company database (WSC_DB), which is the framework to the (draft) guidelines to improve industrial waste management in PIM. Then, in order to ensure the effective use of these databases and facilitate IWM improvements, staff related to these databases (i.e. the factory staff members in charge of making the WI at factories for the WI_DB, and waste service company (WSC) staff responsible for undertaking the application process for operation licenses (OL) for the WI_DB) were invited to the respective seminars to show an outline of the database structures, make sure they understood them, and ask for their suggestions. The seminars for the WI_DB and WSC_DB attracted 46 and 36 participants, respectively, who discussed the databases and content of the user manuals.

From mid-April to mid-May 2010, based on the results of group discussions at Workshop (3), the Study Team discussed the content of the DF/R with related parties at JICA headquarters and made the suggested improvements to the DF/R while in Japan.

Starting in mid-May 2010, until the end of the month, the Team carried out the fourth study period in Brazil. A Steering Committee (St/C) meeting was held on May 24th, as well as two weekly meetings, to discuss improvements to the DF/R, all of which was recorded in meeting minutes. Then, in order to form consensus on the M/P, a seminar was held in Manaus on May 27, 2010 to disclose and publicize the Study results. A total of 112 stakeholders attended the seminar and actively participated in opportunities to offer comments and ask questions.

Also during the fourth study period, the Team assisted the C/P to enter the 2010 waste inventory (WI) data received into the WI_DB developed in the study. Through this process, the C/P understood the need to work closely with those who would complete the WI at factories and gain their support in order to effectively operate the WI_DB, as well as the importance in providing training to factory officers and making them aware of the WI_DB user guide. Given the results, and the importance of the 2 databases, the WI_DB and WSC_DB, a seminar was held in Brasilia on May 28 for the purpose of disseminating these beyond Amazonas State to other states in Brazil. Ten participants gathered at the seminar in Brasilia and the officers in charge of managing the respective databases from IPAAM and SUFRAMA explained issues pertaining to their purpose and functionality.

The Team finalized the Final Report (F/R) in Japan from June to early August 2010 based on the results of group discussions at Workshop (3) and suggestions received at the seminars, in addition to comments from Brazilian counterparts and JICA headquarters, and submitted the report to JICA headquarters.

2 Profile of the Study Area

2.1 Natural, Social and Economic Conditions

2.1.1 Natural Conditions

Brazil has a total area of 8,514,877 sq km (about 23 times the size of Japan) and a population of 184 million (2005). The study area is the Manaus Free Trade Zone (hereafter, MFZ), which is located in northwest Brazil in the eastern part of Amazonas State. Amazonas State is the largest of nine states that constitute the Legal Amazon. Of those, the states of Amazonas, Acre, Rondonia, and Roraima make up what is known as the Occidental Amazon, which covers an area of 2,195,000 sq km, which is 25.7% of Brazil's total area. Amazonas State itself is an expansive 1,577,820 sq km, more than four times the size of Japan, yet with a population of merely 3.3 million (2008), only 2.7% the population of Japan's. The Amazon forest, the world's largest rainforest, covers most of the state.

The MFZ is located at 3 degrees southern latitude, 60 meters above sea level, in the world's largest basin area along the Amazon River, which empties into the Atlantic Ocean and which is the source of 20% of the world's river water. On the left bank of the MFZ is the Rio Negro, the largest tributary of the Amazon, which comes together with the Rio Solimões in the eastern area of Manaus to form the Amazon. Rainforest is located in the northern area of the MFZ, with an average annual rainfall of 2,087.5mm, an average temperature of 28.7°C (83.6°F), and extremely high average humidity of 82%. The rainforest is a dense collection of tall evergreen broad-leafed trees, and the largest collection of plant variety with several hundred different types per hectare. Likewise, the rainforest is home to various insects and fish, a diverse collection of fauna said to be a cornucopia of genetic resources.

2.1.2 Social Conditions

a. Administration and Population

MFZ is located across three different municipalities, as shown in the map below: Manaus, Itacoatiara, and Rio Preto da Eva. The total area of MFZ is 10,000 sq km, approximately half of which is in the city of Manaus at 4,950 sq km. The area and population of these three local governments is as follows.

Table 8: Area, Population and Pop. Density of Amazonas State, Manaus, Itacoatiara and Rio Preto da Eva (2008)

Name of Municipality	Area (km^2)	MFZ Area(km^2)	Population	Pop. Density (per/km^2)
Manaus	11,458	4,950	1,709,010	149.15
Itacoatiara	8,600	1,250	87,896	10.22
Rio Preto da Eva	5,813	3,800	26,004	4.47
A. Total (of 3 cities)	25,814	10,000	1,822,910	70.62
B. Amazonas State	1,577,820	-	3,341,096	2.12
Ratio of three cities area of Amazonas State (A/B)	1.64%	0.63%	54.6%	-

Source: IBGE (Brazilian Institute of Geography and Statistics): population estimates, July 2008

As shown in the above table, the area of the three cities where the MFZ is located is only 1.64% of Amazonas State, yet it contains over half (54.6%) of the population. This is a clear indication that industry in the state is centralized in PIM/MFZ.

Further, looking at the shift in population of Manaus, the capital city of Amazonas State and the heart of PIM/MFZ, the 1967 presidential order to establish MFZ shows a striking increase in the city's population (an influx of people from other regions and so on). At present, Manaus is Brazil's seventh largest city by population.

Table 9: Change in Manaus City Population

Year	1920	1940	1950	1960	1970
Population	75,704	106,399	139,620	175,343	311,622
Year	1980	1991	1996	2000	2008
Population	633,833	1,011,501	1,157,357	1,405,835	1,709,010

Source: IBGE

SUFRAMA's jurisdiction has increased from the development of four states to five with the addition of the State of Amapa. The Industrial Pole of Manaus (PIM), where SUFRAMA is headquartered, is the most developed region.

PIM refers to a group of factories that receive tax benefits by being located in the MFZ. Most of these PIM factories are located in Manaus. Two industrial districts (DI) have been set up in Manaus, where SUFRAMA has laid roads, electrical lines and other infrastructure. The areas of Industrial District 1 (DI I) and Industrial District 2 (DI II) are 1,712 ha and 5,712 ha, respectively.

b. PIM/MFZ Development Plan

There is no overall development plan for PIM/MFZ, so the factories formulate their own development plans, part of the framework to obtain individual environmental licenses from IPAAM as stipulated in CONAMA Resolution 001. Therefore, it is difficult to properly ascertain how PIM/MFZ will develop, or how to guarantee water service or the treatment of effluent and so on. In response, The Public Ministry of Amazonas State's Operational Support Center for the Environmental Prosecutor's Office (CAOMAPH) issued Recommendation 003/2001 on December 21, 2001 recommending that SUFRAMA obtain an environmental license for PIM/MFZ. Although this license has yet to be obtained, it is necessary to mention that the MFZ has been a model for regional development and constant improvement during its 43 years of existence.

2.1.3 Economic Conditions

a. National Economy

In Real (Brazilian currency), the Gross Domestic Product (GDP) for the country according to the latest data from the Central Bank of Brazil in 2008 at current price is R$ 2.9 trillion, (US$1.6 trillion). The Brazilian economy has been showing 4.7% annual growth on average for the past five years (2004 ~ 2008) and a per capita GDP of R$ 15,240 (US$8,230) in 2008.

By economic sector, the highest rate of GDP in 2006 was for the tertiary (service) sector at 69.6%, followed by the secondary sector (mining, manufacturing and construction) at 25.0% and the primary sector (agriculture, forestry and fisheries) at 5.4%.

b. Regional Economy

b.1 State of Amazonas

The regional GDP of Amazonas State for 2006 was approximately R$ 39.2 billion. Per capita GDP for that year was R$ 11,829, the highest in northern Brazil.

The tertiary sector is the largest component of the regional GDP at 50.4%, followed by the secondary sector at 44.6%, nearly twice that of the national average. In particular, the proportion of manufacturing in the region is high at 36.8%, a unique aspect of the economy of the State of Amazonas.

b.2 Manaus City

The regional GDP in the City of Manaus for 2006 at current price was approximately R$ 32 billion, central to the state's economy at approximately 86% of Amazonas' GDP. Manufacturing from the secondary sector is about 53% of the city's GDP, while the service sector is around 47%. The primary sector, on the other hand, accounts for only 0.2% of the total GDP in Manaus. In 2006, per capita GDP in Manaus was R$ 18,902, outweighing national per capita GDP.

Development of Manaus in the past few decades has been centred on the Manaus Free Trade Zone (MFZ), which was introduced through federal government investment incentives and various tax benefit schemes. Today most major electronics manufacturing is located here, such as the world's premier cell phone company Nokia.

c. Manaus Free Trade Zone (MFZ)

c.1 Background of MFZ

The MFZ was created in 1967 by the Federal Government of Brazil through Decree-Law No. 288 with the objective of creating employment and stimulating manufacturing activities, as a tool of promoting socio-economic development in the Western Amazon Region.

This development model was introduced to achieve the social and economic development of the region by offering various investment incentives to encourage manufacturing and industry, as well as agro-industry and commercial investment, while also sustaining the rich biodiversity in the area.

The fiscal incentive policy is administered by the Superintendence of the Manaus Free Trade Zone (hereafter, SUFRAMA), a Federal Government body attached to the Ministry for Development, Industry and Foreign Trade.

c.2 Investment Incentives in MFZ

There are various special incentives available for investment in the Manaus Free Trade Zone. An applicant company must fill out and submit detailed information sheets about their business activities and production processes to SUFRAMA in order to be approved and receive these incentive benefits. This policy also helps to ensure that the applicant companies are not simply limited to bottling, wrapping or conditioning operations, so-called free-riders.

Once an enterprise is approved by SUFRAMA, it becomes eligible to receive various federal, state and municipal tax and tariff incentives.

c.3 Industry in the SUFRAMA (PIM) Area

As of June 2009, 736 companies have been approved by SUFRAMA, of which 494 have already begun operations, whereas the remaining 242 are currently preparing to begin full operations. The total number of workers employed by the above projects is estimated at 138,000 workers, with a total investment of some 14.2 billion US dollars.

Most of the industry located in the MFZ is: manufacturing electro-electronic and communication appliances, machinery, metallurgy, chemical, plastics, and transport machinery.

c.4 Industrial Production and Trade in the SUFRAMA Area

Industrial production value in the Manaus Free Trade Zone has increased 31% over the past five years (2004 to 2008) to R$ 54.4 billion (US$29.4 billion). Within the zone, the largest contributors to this are electro-electronics, two-wheel production (motorbikes and bicycles), and chemical industries, which in 2008 were 65% of the total industrial production value.

Although the MFZ recorded a trade deficit for the overseas market, it gained enough trade surpluses in the domestic market to gain net trade profit.

In the MFZ, the major contributors to foreign currency earnings through overseas export are the top-ranking industries in production value: the electro-electronics, two-wheel, and chemical industries. However, the ratio of export to the total industrial production output was less than 10% for all those industries in 2008. The industries with a high percentage of product export are: the timber/lumber industry (45%) and manufacturers of articles for daily use (15%), such as lighters, pens, shavers, etc.

2.1.4 Superintendency of the Manaus Free Trade Zone (SUFRAMA)

a. Area of Supervision

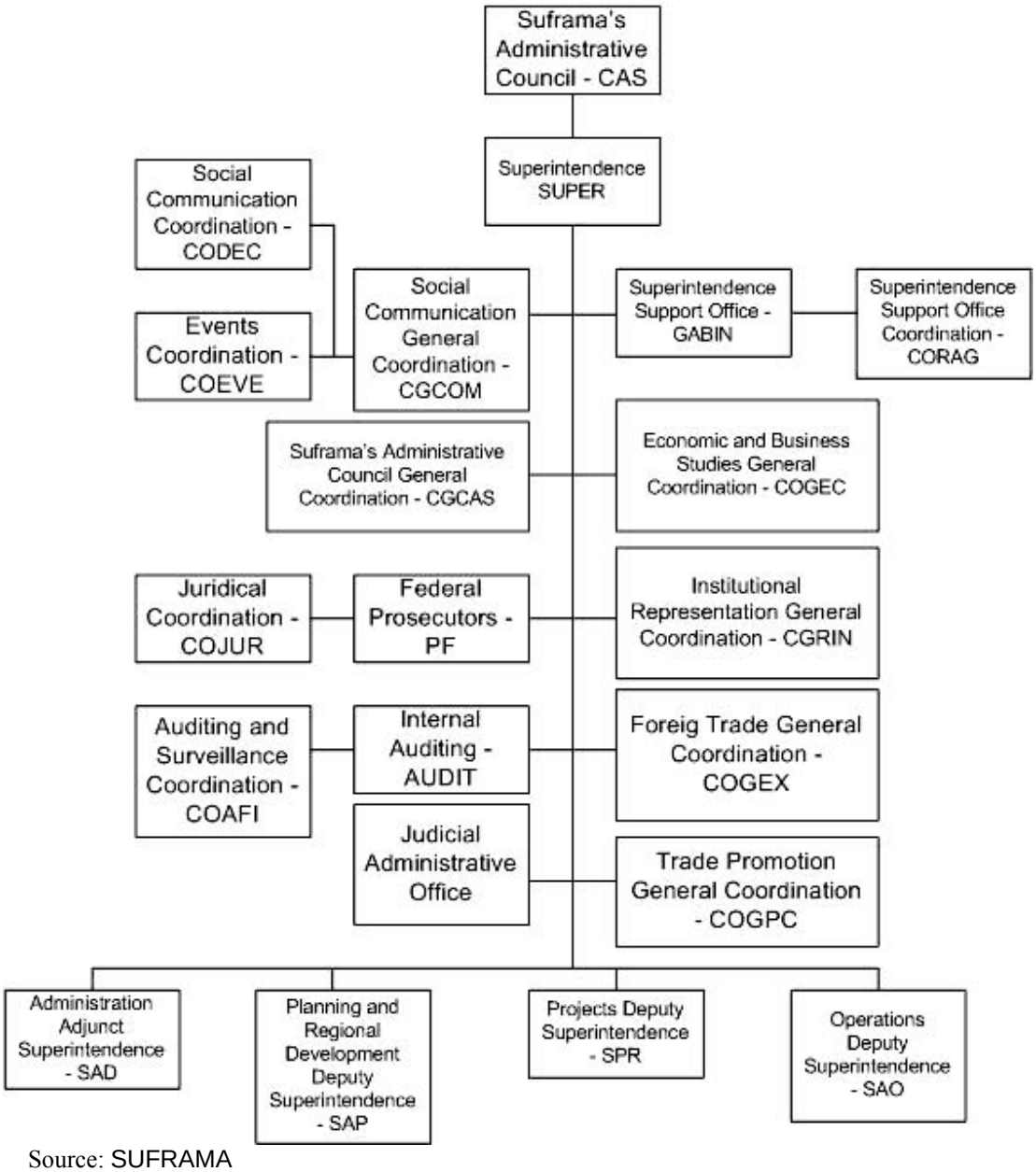
SUFRAMA is vitalizing the regional economy through creating employment opportunities and stimulating production toward socio-economic development not only in the MFZ in the State of Amazonas, but also in the other four states of the Occidental Amazon (Acre, Amapa, Rondonia, and Roraima).

b. Structure

As the figure below illustrates, there are four deputies under the Superintendent, each in charge of its own department: Administration Adjunct Superintendence (SAD), Planning and Regional Development Deputy Superintendence (SAP), Projects Deputy Superintendence (SPR), and Operations Deputy Superintendence (SAO), respectively. In addition to these four departments, there are nine coordinations and offices, such as Social Communication and Judicial Administration, directly below the Superintendent.

There was no unit at SUFRAMA in charge of industrial waste management, and therefore, the primary counterpart for this study is COGEX (Foreign Trade General Coordination)--one of the nine coordinations and offices directly under the Superintendent--which generally deals with all overseas technical cooperation and international cooperation.

However, as an output of this study, SUFRAMA has formed an Industrial Waste Management Group (IWM Group) dedicated to industrial waste management at SUFRAMA and three SUFRAMA officers have been assigned the group. As of May 2010, no decision has been made as to which department the group will be attached, however, it will be officially established within the 2010 fiscal year in order to put into effect the master plan (M/P) that has been formulated for the improvement of industrial waste management.



Source: SUFRAMA

Figure 5: Organizational Structure of SUFRAMA

c. Personnel

SUFRAMA has a total of 1,354 officers and workers as of 2008, of which 356 are officially hired permanent public servants. SUFRAMA also outsource 936 administration officers, security and sanitation services, and other workers. There are also 40 trainees employed at SUFRAMA. In 2008, the total personnel expenditure at SUFRAMA for the above officers and workers amounted to R$ 77.5 million.

d. Fiscal Expenditures of SUFRAMA

The fiscal expenditure of SUFRAMA for six years, from 2003 to 2008, for development of the five states of the Occidental Amazon, including MFZ, as well as stimulus of various industrial sectors, was R$ 440 million. The largest expenditure went toward infrastructure development, accounting for some 73% of total expenditure for that period (2003~2008).

2.2 State of Environmental Management

2.2.1 Environmental Laws and Regulations

Environmental policy in Brazil and the current legal framework were established by the National Environmental Policy Law No. 6938/81 on 31 August 1981. With this National Environmental Policy Law, the revision of the Federal Constitution of 1988, Article 225, states that environmental conservation is the responsibility of both the government and society. Moreover, Article 23 states the joint competence of the Federal government, States and Federal Districts and Municipalities—three levels of government—to protect the environment and combat pollution. Article 24 establishes the competence of the Federal government, States and Federal Districts to jointly legislate the responsibility for damage to the environment.

The national government prepares common federal laws dealing with the environment, and based on these, each state establishes laws which are more stringent than the constitutional requirement.

2.2.2 Environmental Organizations

a. Federal Level

The following table summarizes the federal government organizations which establish and enforce environment related laws at the national level.

Table 10: Summary of Federal Organizations related with Environmental Management

Organization	Description
MMA: Ministry of Environment	An environmental agency was established in 1990 which in 1992 became the Ministry of Environment, the central federal organization dealing with the environment. Responsible for the formulation of environmental policy and guidelines at the national level. Similarly, it carries out planning, coordination and monitoring of national environmental policy.
IBAMA: Brazilian Institute for the Environment and Renewable Natural Resources	Established in 1989 responsible for the inspection and approval of environmental assessments and such, as well as the enforcement of environment related federal policy and regulation. With 6800 employees, offices are located throughout the country, but it does not deal with environmental administration at the state level.
CONAMA: National Council for the Environment	The paramount organization for national environment policy, established in 1981, which deals with the formulation of federal environmental standards. The council is made up of 108 members, presided over by the Environment Ministry and its Executive Secretariat is managed by the Environment Minister Executive Secretary. CONAMA examines environmental standards, guidelines and laws and issues resolutions therein.
Public Attorneys' Office	In charge of the investigation and prosecution of civil and criminal cases dealing with the rectification or compensation for environmental pollution.
Environment Police Precincts	Works in parallel with the Public Attorneys' Office and cooperates to investigate environmental crimes.

b. Amazonas State

The following table summarizes the State government organizations which establish and enforce environment related laws of the State of Amazonas.

Table 11: Summary of Amazonas State Organizations related with Environmental Management

Organization	Description
SDS: Secretariat for Environment and Sustainable Development	The central Amazonian State organization, dealing with environment, is responsible for the formulation and managing the execution of environmental policy and conservation planning at the State level. There are five Autonomous Entities, of which IPAAM is one.
IPAAM: Institute of Environmental Protection of the State of Amazon	The organization which enforces environmental policy in the State of Amazonas, established in 1995. The major environmental administrative powers of IPAAM are environmental licensing approval, environmental monitoring and inspection. Its mission is to enforce environmental policy for the sustainable development of the State of Amazonas. The director is supported by a management department, technical department and law department, with a total of 183 employees, of which 59 are engineers in charge of actual operations. The organizational structure is shown in the Figure 6: Organization Chart of IPPAM.
Regional Public Attorneys' Office for the State of Amazonas	In charge of the investigation and prosecution of civil and criminal cases dealing with the rectification or compensation for environmental pollution. The Environmental and Cultural Assets Department is also the unit which specializes in environmental affairs.
Amazonas State Environmental Police	Works in parallel with the Public Attorneys' Office and cooperates to investigate environmental crimes.

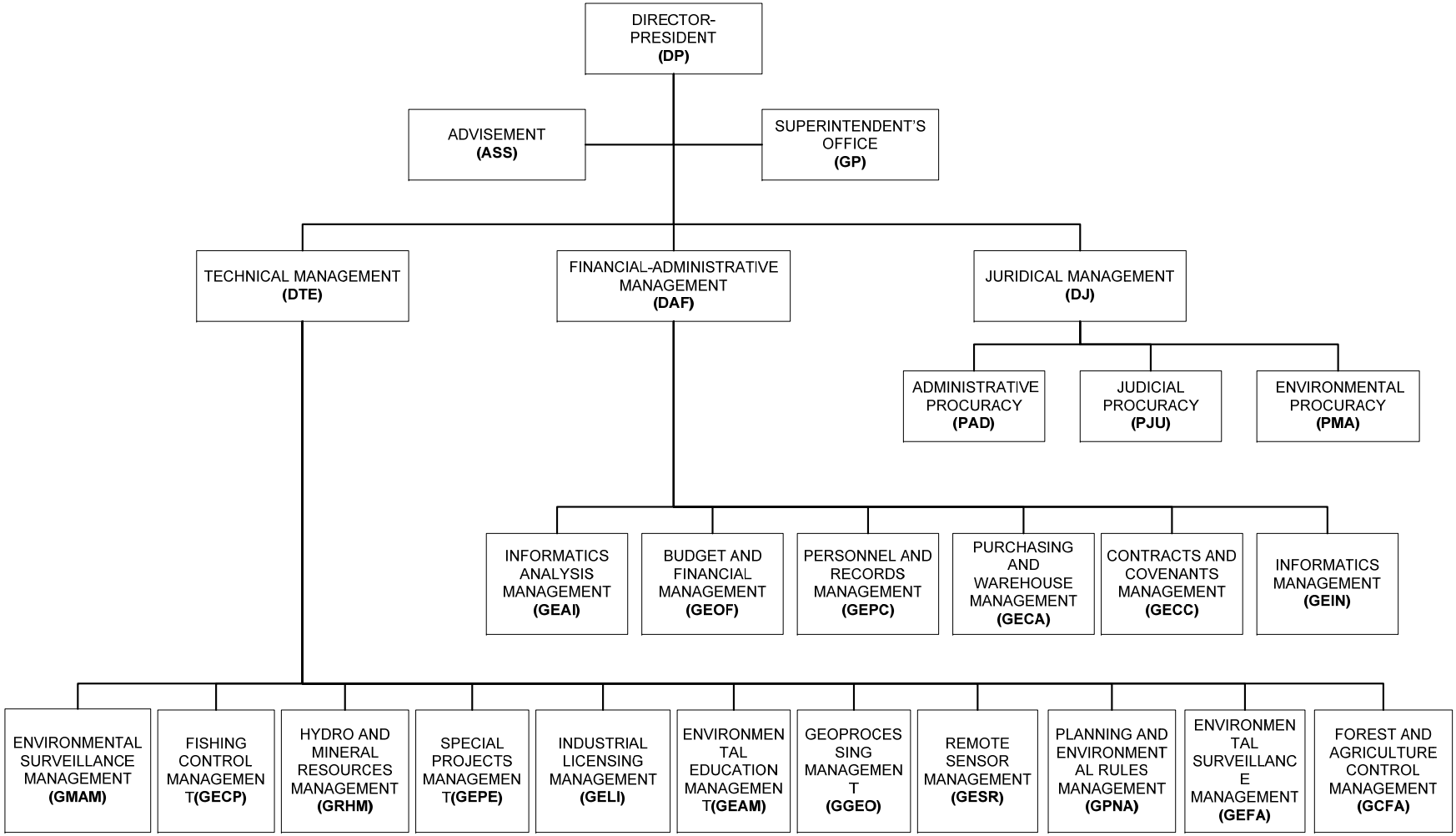


Figure 6: Organization Chart of IPAAM

c. Manaus City

The following table summarizes the municipal government organizations which establish and enforce the environment related laws of Manaus City.

Table 12: Summary of Manaus City Organizations related with Environmental Management

Organization	Description
SEMMA: Municipal Secretariat of the Environment	SEMMA was established in 1989, and restructured in April 2006, to carry out the environmental regulations of Manaus City. There are 323 employees with an additional 195 interns. There are four departments: Land Management Department, Environmental Quality Management Department, Plant and Afforestation Department, and Environmental Preservation Zones Department. The Environmental Quality Management Department is monitoring factories, but it is unclear how this task is shared with IPAAM. Basically, this department has been handling small factories within the municipality.
SEMULSP: Municipal Secretariat of Urban Cleaning and Public Services	SEMULSP is in charge of waste management and cleaning services of Manaus City. There are 2100 employees, in addition to 1200 staff outsourced from an agency. The operating budget for the 2006 fiscal year was R$ 75 million.

2.2.3 Environmental Licensing System

a. Environmental Impact Assessment and Environmental License System

The Environmental Impact Assessment (EIA) in Brazil is included in the procedures to obtain an environmental license. The inclusion of EIA in the procedures to obtain an environmental license is true for the State of Amazonas and other States in Brazil as well.

b. Environmental License Procedures

There are three environmental licenses that a proponent must acquire when conducting a project, starting with the Previous License (PL) from the planning stage to the implementation stage, and then an Installation License (IL) and Operation License (OL), according to the provisions put forth in CONAMA Resolutions 01/86 and 237/97. CONAMA Resolution 237/97 provides a summary of each license and the effective period of validity. In cases where state regulations differ from the said resolution, the state regulation takes precedent.

CONAMA Resolution 237/97, Article 10 states, "to start the process in accordance with the required license, upon discussion with the proponent, the environmental monitoring body (IBAMA, State, Municipal environmental agency) will determine the forms, environmental plans and environmental studies required. Based on this same resolution, the proponent will meet with the relevant environmental monitoring body at the first stage in acquiring an environmental license.

Through this preliminary discussion, the governing body (IBAMA, State, Municipal environmental agency) will determine the environmental license needed for the project, and may determine that the project is partially exempt from the process, when deciding the type of license (PL, IL, OL) required.

Once the required environmental licenses are determined, the required studies are decided, (EIA/RIMA[3], EAS/RAS[4], AR[5] and so on). Basically, for projects that require EIA are those given in CONAMA Resolutions 01/86 and 05/87, but as stated in CONAMA Resolution 237/97, Article 10, the governing body has the authority to stipulate the required studies and reports, so that body will determine the type of reporting required.

The environmental licensing system of Amazonas State significantly differs from that of the Federal level in the period of validity of each license. It is much shorter than the federal one and the periods of validity of Previous License (PL), Installation License (IL) and Operation License (OL) are one, two and two respectively.

c. Environmental License System in the Amazonas State

Environmental licensing in the State of Amazonas was established by the first State environmental law No. 1532 of 6 July 1982. The details are given in Regulation No 10028. According to Law No.1532, stipulates that CODEAMA (The Center for Development, Research and Technology of the State of Amazonas) will issue environmental licenses in Amazonas State, but CODEAMA was abolished and now the rights for this were transferred to IPAAM. Provisions in Act 8 state that industrial activities, as shown below, that could potentially impact the environment require an environmental license[6].

- Mineral excavation, treatment
- Tree harvesting
- Agriculture, cattle breeding
- Hunting, fisheries
- Manufacturing
- Engineering, construction, land creation/zoning
- Collection, storage, treatment and final disposal of products, raw materials and wastes
- Infrastructure (dams, airports, ports, roads, etc.)
- Hospitals, clinics, laboratories
- Activities with commercial- or service-oriented use of fuel (solid/liquid/gaseous)
- Incineration of waste or materials
- Activities that change igarape and other aquatic ecology
- Use or storage of agrochemicals
- Activities with potential environmental impact to landscape or nature
- Activities with potential environmental impact to cultural assets, historical artifacts, etc.
- Activities IPAAM deems may have potential impact to the environment

[3] Environmental Impact Assessment (EIA)/Environmental Impact Report (RIMA)
[4] Simplified Environmental Study (EAS)/ Simplified Environmental Report (RAS)
[5] Risk Assessment (AR)
[6] Decree No 10028 of February 1987

As shown above, most industrial activities require a license. These activities are divided into categories according to 32 codes, and further into sub-category codes. The following table shows the major classification codes of activities with potential environmental impact under which are the detailed classification codes.

d. License Types and Fulfillment of Conditions in Amazonas State

There are three types of environmental licenses, as shown below. Business activities require three types of license be obtained.

1. Previous License (PL): Granted at the preliminary stage of the enterprise or activity. It is granted for up to one year, after which the license must be reissued. In order to obtain the PL license, the place and activity must be approved in accordance with local government guidelines.
2. Installation License (IL): Authorizes the construction of a factory and installation of a facility, with a maximum term of 2 years; it is necessary to extend the license prior to expiration.
3. Operation License (OL): Authorizes the operation of the activity or enterprise, with a maximum term of 2 years; it is necessary to extend the license prior to expiration.

e. Role of IPAAM

IPAAM may prosecute a polluter that has obtained an environmental license in the case of illegal activity. When IPAAM issues the environmental license, they check the application forms and the site. Also, when the licenses (OL) are renewed after one or two years, they monitor by checking the forms and site. Moreover, should there be protest or reports from residents of the surrounding area, IPAAM may carry out a check even during the license period, and if there is any illegal activity found, may revoke the license or impose a fine.

According to the 2008 Annual Report of IPAAM, there were 2,806 licenses (new and renewals) for 2008, of which 1,041 were for the rural area outside of city boundaries and 1,765 within city boundaries. According to issue, about 70% were related to PIM and municipal (Brown Issue), 413 were related to aqua farming, aquatic or mineral resources (Blue Issue), and 436 were for forestry resources and agriculture (Green Issue). Furthermore, 44% of the licenses were for 861 projects within PIM. IPAAM earns 6 to 7 million Real (Brazil currency) for the issuance and renewal of environmental licenses.

2.2.4 Environmental Impact Assessment (EIA)[7]

a. EIA-related Laws and Ordinances

The environmental impact assessment (EIA) in Brazil was introduced with the Basic Environmental Law (Federal Law n. 6,938/81). The CONAMA Resolution 01/86 (1986) and CONAMA Resolution 237/97 (1997) define the detailed provisions for EIA requirements, evaluation and approval process.

[7] This paragraph contains reference to the following, particularly in regards to federal regulations: "Report on Trade Protections of OECD Member Countries Concerning Environmental Problems Part II Environmental Regulations in Implementing Countries, February 2007, Global Environmental Forum

Similar to other states in Brazil, in Amazonas State EIA is included in the process to obtain environmental licensing. The major laws and regulations in Amazonas State pertaining to environmental licenses and the EIA system are given below.

Table 13: Major Laws and Ordinances related to EIA Procedures in Amazonas State

Regulation	Year Enacted	Description
1. State Basic Environmental Law (n. 1,532/82)	1982	Provision for basic policy of Amazonas State related to pollution control and management, environmental improvement and restoration, and natural resource conservation
2. State Environmental License Decree (n. 10,028/87)	1987	Provision for the license system in Amazonas State pertaining to activities which have potential impact on the environment

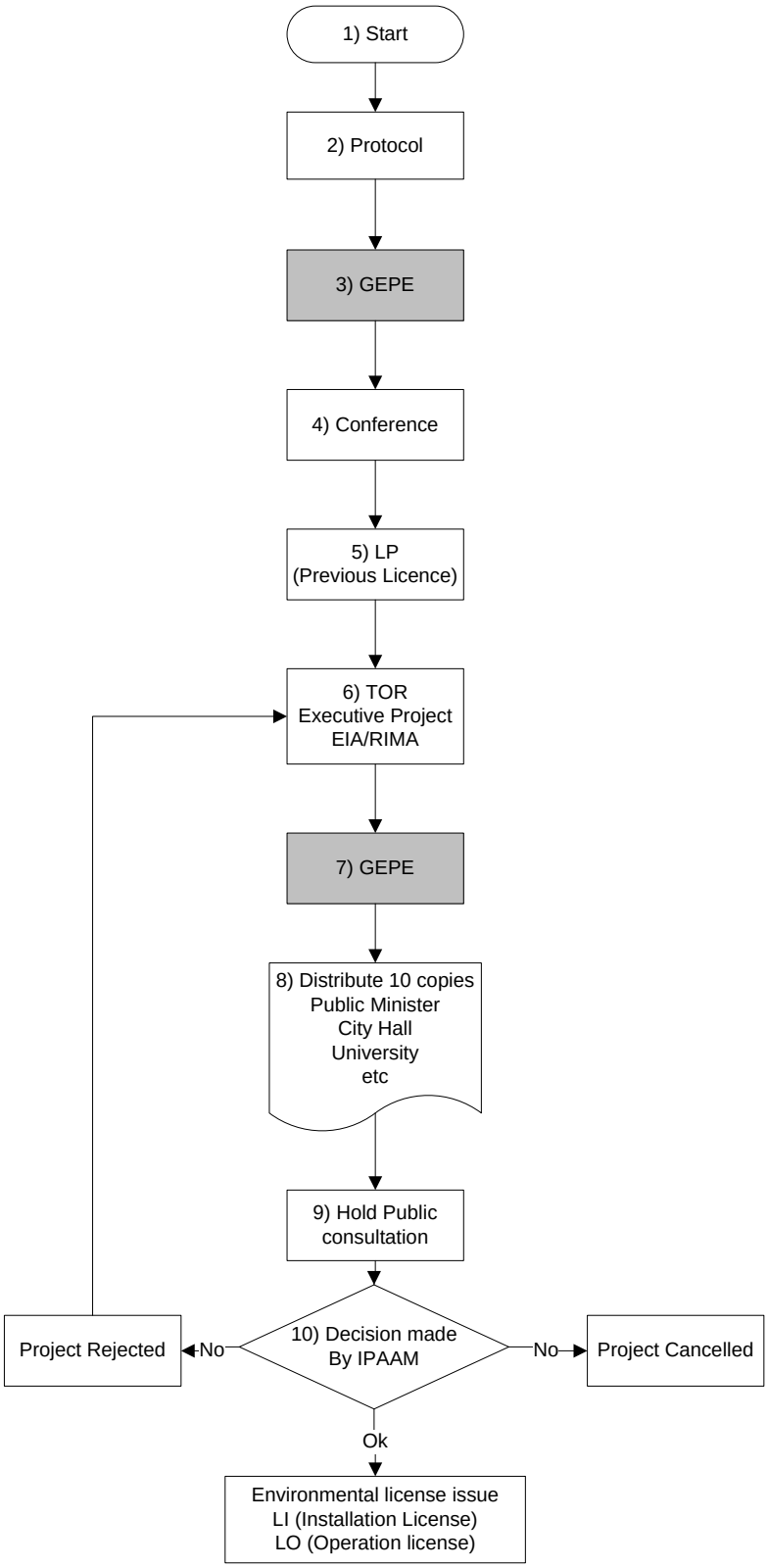
b. Requisites for Projects which require EIA

In Brazil, there is some difference in the projects which require EIA at the federal and state levels. Also, there is no standardized or uniform procedure between the two since the requirements (EIA/RIMA, EAS/RAS, etc) vary greatly depending on the jurisdiction of the body overseeing the environmental licensing process.

When a proponent applies for an environmental license, IPAAM in Amazonas requires that an environmental impact assessment (EIA), simplified environmental study (EAS) or Risk Assessment (AR) is conducted, depending on the environmental impact of the project. After conducting EIA or EAS, the proponent must submit an Environmental Impact Report (RIMA) or Simplified Environmental Report (RAS), respectively, in order to obtain a license.

c. The EIA and Environmental License Acquisition Process in Amazonas State

The process of EIA and acquisition of environmental license in the Amazonas State is shown in the flowchart below.



Abbreviations:
GEPE - SPECIAL PROJECTS MANAGEMENT

RIMA – Summary report of Project for Public consultation

Figure 7: Flowchart showing EIA and Acquisition of Environmental License in Amazonas State

d. Publication of EIA Report

Release of project data and EIA reporting is stipulated in CONAMA Resolution 09/87, which states, "IBAMA will issue the previous license after the EIA/RIMA is published in the official daily gazette or newspaper for 30 days, should there be no comment from local residents."

The process of public announcement of the EIA report and each environmental study report is also the same in Amazonas State.

3 Current IWM and Issues

3.1 Supplement Studies on Current Conditions

3.1.1 Contents of Supplement Studies

a. Contents of Supplement Studies

The first step in formulating the master plan for waste generated in the Industrial Pole of Manaus (PIM) is to gauge the characteristics and amount of that waste. An essential and most fundamental method to grasp the actual conditions of waste management is to produce a flowchart diagram, such as the one shown below. The key to producing this flowchart is to first divide the waste stream into two large categories: "on-site" management at the source of generation, and "off-site" management handled by waste service companies (WSCs).

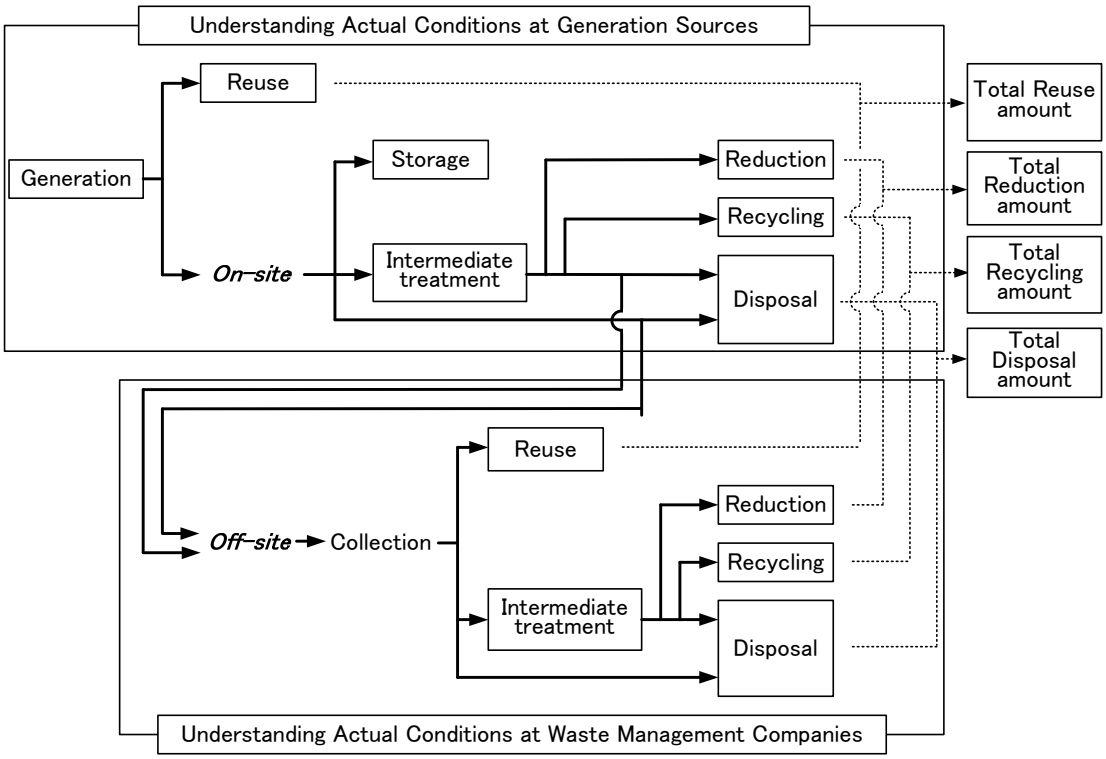


Figure 8: Flowchart of Waste Stream

The following supplemental studies were carried out in order to understand the current waste management conditions at the PIM generation sources, i.e. on-site management.

- Factory Survey
- Medical Institutions Survey
- Construction Waste Survey
- Radioactive Waste Survey

Furthermore, a supplemental study to survey waste service companies (WSCs) was conducted to grasp the current conditions of off-site management.

b. Waste Categories applied to the Study

Target waste of the Study is the waste which CONAMA Resolution 313 requests factories to report an inventory to the environmental authority. The waste requested by CONAMA Resolution 313 is broadly classified into the following four categories. Since each waste differs in its generation source and characteristics, the following surveys have been conducted to identify management of each waste:

- General industrial waste => Factory Survey
- Health-care waste => Medical Institutions Survey
- Construction waste => Construction Waste Survey
- Radioactive waste => Radioactive Waste Survey

The waste category applied to each study is shown in the Tables for Classification of Factory and Industrial Waste on the first page of text.

3.1.2 Study of Waste Service Companies (WSCs' Survey)

a. Study Objective

The study aims to survey the flow of PIM generated waste which is outsourced to waste service companies for collection and transport, treatment (reuse, recycle, rendering waste harmless, etc.) and final disposal. These results will be checked against the survey of generation sources (Factory, Medical Institutions and Construction Waste Survey) in order to clarify the waste stream after it is discharged from the PIM.

b. Study Method

A local consultant was consigned to conduct the study. The local consultant visited and conducted interviews with 90 waste service companies using a questionnaire form made by the study team. The study team produced a draft of the questionnaire form, and upon discussion with the C/P, revisions were made. Then members of the study team accompanied the local consultant initially on a trial basis to further modify the questionnaire that was used in the full-scale survey.

c. Selection of Target Waste Service Companies

Registration of waste service companies (WSCs) is handled by the Institute of Amazonas Environmental Protection (IPAAM) through the approval and issuance of environmental licenses for WSCs.

IPAAM environmental licensing covers all industry that impacts the environment using a 4-digit code (01**). The first two digits designate the major division of industries into 32 classes, and the last two digits further divide these into sub-classes. The study team used this classification system to pick up codes of waste related activities. Based on the code, IPAAM supplied a list of 84 companies (below, IPAAM WSC List) that had obtained environmental licenses for operation, as well as a 2-page summary for each company's environmental license.

All 84 of the companies on the IPAAM WSC List were contacted by a local consultant to ask for their cooperation in the survey, and 35 companies agreed. Consequently, based on the information from the interviews conducted with factories and WSCs, the local consultant

searched and found an additional 55 WSCs and conducted the survey with a total of 90 companies.

d. Survey Results

The survey results are available in the Supporting Report, Section 2.1.4. Also, these results are analyzed in the Main Report, Section 3.2.4.

3.1.3 Study of Waste Management in Factories (Factory Survey)

a. Study Objective

The study aims to clarify the current conditions of industrial waste management at the source of generation by visiting the PIM factories where waste is generated and conducting an interview survey to assess operation conditions, the types and amounts of wastes generated and the conditions of industrial waste management.

b. Study Method

A local consultant was consigned to conduct the study. The local consultant visited and conducted interviews with 187 target factories using a questionnaire made by the study team. The study team produced a draft of the questionnaire to use as the basis for discussion with the C/P. Revisions were made based on that discussion, and then members of the study team accompanied the local consultant initially on a trial basis to further modify the questionnaire that was used in the full-scale survey.

c. Categories of Target Wastes

CONAMA Resolution 313 was issued and went into effect on 29 October 2002. Despite the fact that SUFRAMA also began to receive a number of waste inventories from PIM factories in 2001[8], neither the types and amounts of PIM generated wastes nor the actual management practices were understood at the start of this study. This indicates an inadequate system to manage this at SUFRAMA; however, the failure to grasp actual conditions of waste management in most cases is the immense and complicated categorization of waste that makes it exceedingly difficult to identify.

CONAMA Resolution 313 condensed waste categorization in ABNT NBR 10004 in order for factories to make their waste inventories; however, it remained difficult to identify to which category the generated wastes would be attributed. Thus, the study team held repeated discussions with the C/P to categorize wastes as follows in order to conduct the present study:

1. General Industrial Waste will be broadly divided into the following categories.

- Non-HGIW (Non Hazardous General Industrial Waste) generated from Non-production process
- HGIW (Hazardous General Industrial Waste) generated from Non-production process
- HGIW (Hazardous General Industrial Waste) generated from Production process

[8] In 2001, the Public Ministry of the State of Amazonas, through Recommendation No. 003/2001, advised SUFRAMA to obtain an operation license for PIM and for each PIM factory to submit a waste inventory. In response, SUFRAMA appealed to the PIM factories to submit their waste inventories, which a number of factories, in turn, submitted.

- HGIW generated from Production process

2. Given the above, it was reasoned that making it easier for the creators of the waste inventory--i.e. the factories--to identify the wastes generated, that it would in turn become easier for those receiving the waste inventory to compile and manage that information. To do so, general industrial wastes were grouped to the greatest extent possible into 13 non-hazardous and 16 hazardous categories, each with their own respective code, as shown in the Tables for Classification of Factory and Industrial Waste on the first page of text.

d. Selection of Target Factories

At the beginning of the study, the Study Team planned to select some non-PIM factories. However, upon discussion with the C/P, it was decided to abandon non-PIM factories for the following reasons:

- The majority of PIM subcontracted factories are licensed by SUFRAMA and PIM factories are the ones receiving tax benefits.
- The non-PIM factories are non-registered cottage industries, and the C/P was not in possession of the locations and other such basic data that would be required for the study, making it impossible for the C/P to conclude which factories would be targeted.

The 19 industrial sectors, as reported in "Industries (companies) established and producing in western Amazon with full projects approved by SUFRAMA" (Source: CGPRI & CGMER/COCAD SUFRAMA, up to 8/2008), were used when conducting the survey of generation sources.

SUFRAMA formulates a list of PIM factories[9], hereafter referred to simply as the SUFRAMA factory list. The target factories for the study were chosen by selecting 200[10] from the total 457 listed in the SUFRAMA Factory List. The following criteria were used to make the selection:

1. The PIM is divided largely into two Industrial Districts (DIs), as well as those outside the DIs, and target factories were to be selected from each.
2. A minimum number of factories to be surveyed in each industrial sector was established in order to grasp the waste management conditions in as many of the 19 sectors as possible.

Based on the above criteria, the C/P and Study Team established the minimum number of factories to be surveyed in each sector. A local consultant was consigned to carry out the survey.

Although the study team intended to survey 200 factories, the local consultant has completed 187 factories due to certain difficulties, as listed below. This report, therefore, was based on the analysis of data completed for 187 factories.

- Time limitation;
- Insufficient cooperation of factories selected; and
- Some information of the factories provided to the study team was not updated.

[9] Profile of the Companies with Projects Approved by SUFRAMA, December 2008 (Perfil Das Empresas Com Projetos Aprovados Pela SUFRAMA Dez/2008)

[10] It is preferable to survey as many factories as possible. However, considering limited time of the survey and experience of the previous similar study, it was decided as 200.

Table 14: Number of PIM Factories and Number of Samples for Factory Survey

Factory Code	Sector	Inside Industrial District			Outside Industrial District			Total No. of Factories (A)	Target Factories	
		Part 1 No. of Factory	Part 2 No. of Factory	Sub-total	Part 1 No. of Factory	Part 2 No. of Factory	Sub-total		No. Surveyed (B)	Ratio (%) (B/A)
F01	Beverages	3		3	12		12	15	5	33.3
F02	Leathers									
F03	Printing	6		6	3	7	10	16	6	37.5
F04	Electric/-tronic	64	1	65	51	5	56	121	65	53.7
F05	Wood	2		2				2	0	0.0
F06	Mechanical	19		19	9		9	28	17	60.7
F07	Metallurgy	23	2	25	19	3	22	47	19	40.4
F08	Non-metallic Minerals		1	1	2	3	5	6	1	16.7
F09	Furniture	1		1	3	1	4	5	2	40.0
F10	Paper	7		7	6		6	13	7	53.8
F11	Rubber	2		2	1		1	3	0	0.0
F12	Food Products				4	9	13	13	3	23.1
F13	Chemical	13	2	15	15	4	19	34	12	35.3
F14	Plastic	31	2	33	35	7	42	75	24	32.0
F15	Textile				1		1	1	0	0.0
F16	Fabric				2		2	2	0	0.0
F17	Transport mat.	15		15	16	2	18	33	19	57.6
F18	Construction		1	1	2	3	5	6	0	0.0
F19	Others	7		7	5	8	13	20	7	35.0
	Total	193	9	202	186	52	238	440	187	42.5

Source: Profile of the Companies with Projects Approved by SUFRAMA, December 2008 (Perfil Das Empresas Com Projetos Aprovados Pela SUFRAMA Dez/2008), and JICA Study Team

e. Survey Results

The results of the survey are available in the Supporting Report, Section 2.2.5. Also, analysis of the survey results is available in the Main Report, Section 3.3.5. Based on the responses, in this survey, it was revealed that 440 factories are PIM factories operating in the MFZ.

3.1.4 Study of Health-care Waste Management in Medical Institutions (Medical Institution Survey)

a. Study Objective

The study aims to clarify the current conditions of health-care waste management at generation sources in the PIM by visiting those hospitals (one location) and clinics on factory premises (nine locations) and conducting direct interviews to survey the types of waste generated, amount discharged and conditions of health-care waste management, etc.

b. Study Method

A local consultant was consigned to conduct the study. The local consultant visited and conducted interviews with medical institutions using a questionnaire form made by the study team. The study team produced a draft of the questionnaire form to use as the basis for discussion with the C/P, and then revisions were made based on that discussion.

c. Health-care Waste Categories

Health-care waste (i.e. Health Service Waste) is regulated by the Brazilian Association of Technical Standards (ABNT) NBR 12808 and the National Health Surveillance Agency (ANVISA). Handling health-care waste is prescribed by both RDC 306/2004-ANVISA and CONAMA Resolution 358/2005.

In this study the questionnaire for the medical institutions survey has been prepared based on the health-care waste categories described in the ABNT NBR 12808 and the survey was conducted using the questionnaire. After the questionnaire survey was completed, it was pointed out that the RDC 306/2004-ANVISA is being used at present. The results of the survey were, therefore, converted into the health-care waste categories described in the RDC 306/2004-ANVISA. The following table shows conversion of health-care waste categories of the RDC 306/2004-ANVISA and the ABNT NBR 12808.

Table 15: Conversion of Health-care Waste Categories between RDC 306/2004-ANVISA and ABNT NBR 12808

RDC 306/2004-ANVISA			ABNT NBR 12808	
Group		Description	Class, Type	Description
1. Group A	A.1	Biologic	Class A, Type A.1	Biologic
			Class A, Type A.2	Blood and Derivates
	A.2	Animals	Class A, Type A.5	Contaminated animal
	A.3	Body part	Class A, Type A.3	Surgical, anatomopatologic and exudates
	A.4	Patient care etc.	Class A, Type A.6	Patient care
	A.5	Prions	Not applicable	---
2. Group B		Chemical etc.	Class B, Type B.2	Pharmaceutical waste
			Class B, Type B.3	Hazardous chemical waste
3. Group C		Radioactive waste	Class B, Type B.1	Radioactive waste
4. Group D		Common waste	Class C	Common waste
5. Group E		Piercing or Cutting	Class A, Type A.4	Piercing or Cutting

d. Selection of Target Medical Institutions

There are 475 factories in the factory list provided by SUFRAMA, and of those, 18 factories are located outside the target area, the MFZ. A total of 457 PIM factories in the MFZ area were contacted by telephone to confirm whether they had an attached clinic. 334 factories in total responded the inquiry.

It was found that at least 1/3 of the total (35.3%), or 124 factories, have an attached clinic. Of those 124, nine within the PIM were chosen for direct interview using the prepared survey

questionnaire. A summary of these medical facilities, including one general hospital in the PIM, is given below.

Table 16: Summary of Medical Facilities

Type	No. Surveyed	No. of Employees*1	No. of Beds	Avg No. of Inpatients/Day	Avg No. of Outpatients/Day
General Hospital	1	439	70	48	900 (*3)
Attached factory clinic	9	4.1 (*2)	1.2 (*2)	No reply	19 (*2)

Notes: *1: Including part-time employees

*2: Average of 9 clinics

*3: Of this number, 22 were emergency room outpatients

e. Survey Results

The survey results are available in the Supporting Report, Section 2.3.5. Also, analysis of the survey results can be found in the Main Report, Section 3.4.5.

3.1.5 Study of Construction Waste Management (Construction Waste Survey)

a. Study Objective

The study aims to clarify the generation of construction waste, its disposal and management at PIM factories (including those outside of the DI) where construction projects exist.

b. Study Method

A local consultant was consigned to conduct the study. The local consultant used a questionnaire produced by the Japanese study team and conducted interviews with those in charge of construction at factories. The study team produced a draft questionnaire, which was discussed with the C/P and then revisions were made as necessary.

c. Construction Waste Categories

The National Environment Council (CONAMA) issued Resolution 307 in the form of guidelines for construction waste management on 5 July 2002. Construction wastes are categorized in CONAMA Resolution 307 as shown in the following table.

Table 17: Construction Waste Categories in CONAMA Resolution 307

Class	Description
Class A:	The reusable or recyclable waste as aggregates, such as:
	a) from construction, demolition, refitting and repair of pavement and other infrastructure constructions, including land preparation;
	b) from the construction, demolition refitting and repair of edifications: ceramic components (bricks, blocks, tiles, insulation planks, etc.), cement and concrete;
	c) from manufacturing and/or demolition process of concrete pre-modulated pieces (blocks, pipes, gutter, etc.) produced in the construction sites.
Class B	The recyclable waste for other purposes, such as: plastics, paper/carton,

	metals, glass, wood and others.
Class C	Waste which has no economically feasible technology or applications which may allow it to be recycled/recovered, such as the products arisen from plaster.
Class D	Hazardous waste arisen from construction process, such as paints, solvents, oils and so forth, or those contaminated or harmful to health arisen from demolitions, refitting and repairs of radiology clinics, industrial facilities and others, as well as tiles and other objects and materials containing asbestos or other products harmful to health. (new text given by Resolution n. 348/04).

The waste categories in CONAMA Resolution 307 identify criterion for whether or not certain construction waste is recyclable. Thus, it would be difficult to get a detailed picture what kinds of waste were being generated if the survey were conducted based on these categories. The study team discussed the matter with the C/P and decided upon 44 materials into which construction waste could be categorized and used for the survey. In addition, it was determined in which of the 4 classes given in CONAMA Resolution 307 these 44 wastes would be placed.

d. Selection of Target Factories

The 457 factories located in the MFZ in the factory list provided by SUFRAMA, were contacted by telephone to confirm whether they had conducted any construction projects in the past year, from June 2008 to May 2009. 334 factories in total responded the inquiry.

It was found that, of the 334 factories, 123 factories, over one-third (36.8%), have conducted construction projects between June 2008 and May 2009. Ten of the 123 factories were chosen at random for direct interview using the prepared survey questionnaire. A summary of these factory construction projects is given below.

Table 18: Summary of Construction Projects

Type of Construction Project	No. of Respondents	Ratio (%)
1. New construction	2	20.0
2. Additional construction	0	0.0
3. Demolition	0	0.0
4. Renovation	6	60.0
5. Others[*1]	2	20.0
Total	10	100.0

(Note) *1: In detail,
1. Installation of a waste water treatment facility (WWTF)
2. Construction of a retaining wall and drainage of the rain water.

e. Survey Results

The survey results are available in the Supporting Report, Section 2.4.5. Also, the survey results are analyzed in the Main Report, Section 3.5.5.

3.1.6 Study of Radioactive Waste Management (Radioactive Waste Survey)

a. Study Objective

The study aims to clarify the current management practices of radioactive waste management by visiting PIM factories where radioactive materials are used and there is a possibility that wastes will be generated, and conducting interviews to assess the types of radioactive materials used, the management conditions, and whether or not radioactive waste is generated.

b. Study Method

The management of radioactive waste was confirmed with stakeholders that attended the first weekly meeting in the study. There it was revealed that a single entity, the National Commission of Nuclear Energy, Ministry of Science and Technology (CNEN), manages radioactive waste, with the exception of small-scale businesses in the medical sector. Still, it became apparent that the management practices of radioactive materials used by businesses in the target area (MFZ) are unclear.

Thus, members of the study team visited the CNEN headquarters in Rio de Janeiro to conduct an interview. There it was discovered that there are 14 institutions using radioactive materials in Manaus.

Eight of the 14 facilities listed were selected and visited for direct interviews. The study team provided a draft questionnaire form, which was used as the basis for discussion with the C/P, and then revised.

c. Selection of Target Factories/Organizations

According to CNEN, they have issued licenses for the use of radioactive materials to 14 factories and organizations in the target study area. During the survey, 8 factories and medical institutions of these 14 were selected for direct interviews.

- Factories located in the Industrial District (DI) which use these materials for manufacturing process control, etc.: Five (5)
- Factories located in DI which use these materials for analytical techniques, etc. of those manufactured goods: Two (2)
- Organizations located outside of DI which use these materials for nuclear medicine diagnosis: One (1)

d. Survey Results

The survey results are available in the Supporting Report, Section 2.5.5. Also, the survey results are analyzed in the Main Report, Section 3.6.4.

3.2 Current Industrial Waste Management

3.2.1 Administration of Industrial Waste Management

a. Industrial Waste-related Policies

a.1 National Development Plan

The national development plan in Brazil is called the PPA[11] (Multi-Year Plan), which is formulated every four years. The current development plan is the PPA 2008 – 2011. The key development issues put forth in PPA 2008 – 2011 are: 1. Economic Growth, 2. Education Improvement, 3. Solving Social Issues (transfer of earnings, social security, etc). In essence, it aims to align environmental preservation with economic growth.

a.2 Development Plan of the State of Amazonas

Like the Federal Government, the State of Amazonas has formulated a State PPA 2008 – 2011. The State version puts forth key issues similar to those in the Federal plan.

a.3 National Waste Management Policy

After 19 years of deliberation, the National Congress[12] approved the Substitute of Draft Bill No. 203 National Policy on Solid Waste[13] on March 10, 2010. This bill clarifies the waste management plans that should be prepared at the national, state, municipal and regional levels.

b. Factory Classification and IW Classification

b.1 Factory Classification

Factories are classified at SUFRAMA into 19 industrial sectors, and subdivided for a total of 28 (See the Table for Classification of Factory on the first page of text). In this Study, the current conditions and issues concerning industrial waste management in PIM/MFZ were arranged according to the 19 industry sectors set forth by SUFRAMA. The results of the study in this report are based on the factory list produced by SUFRAMA and as of September 2009, estimated that a total of 440 factories are operating in PIM.

b.2 Industrial Waste Classification used in this Study

CONAMA Resolution 313 specifies the creation of a waste inventory according to ABNT NBR 10004. ABNT NBR 10004 classifies waste into the following 3 major groups:

- Class I: Hazardous Waste
- Class II-A: Non-Hazardous Waste and Non-Inert Waste
- Class II-B: Non-Hazardous Waste and Inert Waste

Although the above classification was used as the basis for this study, the following 4 groups were used for the survey of waste generation sources, composition and management method of waste generated from factories.

1. General Industrial Waste
2. Health-care Waste
3. Construction Waste
4. Radioactive Waste

Although CONAMA Resolution 313 simplified the waste categorization of ABNT NBR 10004 to make it easier for factories to make the waste inventories, it is still difficult for them to identify to which category the wastes generated is attributed. Thus, upon discussion with

[11] Plano Plurianual
[12] Camara de Deputado
[13] Substitutivo Projeto de Lei No. 203 Politica National de Residuos Solidos

the counterpart, this study used the categorization for the above 4 wastes as shown in the Tables for Classification of Factory and Industrial Waste on the first page of text.

c. Administration of Industrial Waste Management

c.1 Industrial Waste-related Regulation

Although Brazil does not have a law equivalent to the so-called 'Basic Waste Law' in Japan, the National Council for Environment (CONAMA) has established a number of resolutions related to industrial waste management. Consequently, industrial waste management is in essence carried out according to the various resolutions put forth by CONAMA. Additionally, the standard that supports these CONAMA resolutions is established by the responsible waste-related organizations. The table below is a list of the major regulations used for this study.

Table 19: Industrial Waste-related Regulation

Purpose	Regulation name	Organization
Environmental License System	Resolution CONAMA no. 237/1997	CONAMA
Construction Waste Management	Resolution CONAMA no. 307/2002	CONAMA
Industrial Waste Inventory	Resolution CONAMA no. 313/2002	CONAMA
Health-care Waste Disposal	Resolution CONAMA no. 358/2005	CONAMA
Health-care Waste Management at Medical Institutions	RDC 306/2004-ANVISA	ANVISA
Radioactive Waste Management at Facilities Using Radioactive Materials	CNEN-NE-6.05/1985	CNEN

c.2 Industrial Waste-related Organizations

The major organizations related to industrial waste, and their activities, are given in the table below.

Table 20: Industrial Waste-related Organizations

Organization	Affiliated Agency	Jurisdiction
1. National Level		
1.1 IBAMA	Ministry of Environment (MMA)	Manages industrial waste (such as application of the WI submitted by each state) and formulates industrial waste management plan at the national level.
1.2 CONAMA	MMA	Formulates regulations and standards for industrial waste management at the national level.
1.3 ANVISA	Ministry of Health	Formulates management standards for health-care waste at medical institutions and its management.
1.4 CNEN	Ministry of Science and Technology	Manages registration of organizations that use radioactive materials and the management of radioactive waste.
2. State Level		
2.1 IPAAM	Secretary of Environment and	Manages both those which discharge waste and provide waste services through monitoring facilities and factories as well as issuing and managing

	Sustainable Development (SDS)	environmental licenses.
2.2 DEVISA/AM	Health Services Bureau	Appropriate management and monitoring of health-care waste.
3. Municipal Level		
3.1 SEMMA	City of Manaus	Management of factories under the City of Manaus and appropriate management and monitoring of health-care waste.
3.2 SEMULSP	City of Manaus	Final disposal of general industrial waste, health-care waste and construction waste.

c.3 Waste Manifest System (WMS)

Regardless of the fact that Brazil has no systematic standard at the national level, most states have introduced a Waste Manifest System (WMS).

In general, a waste manifest is usually required for industrial (manufacturing) and health-care waste, but not for municipal waste. Recently, obligation for construction waste has also appeared.

The State of Amazonas requires an operational license to be issued to create and submit the forms needed for a waste manifest. Regardless of this, the Institute of Amazonas Environmental Protection (IPAAM), which issues operational licenses, has not established a waste manifest system. In other words, there has been no official recommendation of forms which should be used for the waste manifest. Therefore, dischargers, transporters and those who receive the waste each use their own waste manifest forms.

d. Administration of Waste Service Companies

The Institute of Amazonas Environmental Protection, IPAAM, manages waste service company (WSC) registration. This system is not solely for registering WSCs, but is a registration system for WSC environmental licenses. IPAAM manages the application and renewal of operational licenses (valid for maximum 2 years) for WSCs similar to environmental licenses for other industrial activities.

IPAAM environmental licenses are digitized, but there are the following problems.

- WSCs are registered by various business codes, but it is not possible to properly extract WSCs as desired.
- Due to the joint management of environmental license data along with other IPAAM services, it is extremely difficult to retrieve license information as needed.
- The database server is old with insufficient functionality to manage environmental licenses within a framework.

Under such conditions, at present it is not possible to clarify the actual number of WSCs in the study target area or in what kind of activities they are currently engaged. Furthermore, it is estimated that there are a significant number of entities operating as WSCs without an environmental license. At least 23 such entities were revealed when conducting the survey of waste service companies in this study.

3.2.2 Current IWM in PIM

a. Current IW Generation Amount

a.1 Estimation Method

The current amount of industrial waste being generated was estimated using a generation rate method. This method requires the following indicators.

- Generation rates of factories by sector and type of waste.
- Activity indicators such as number of employees, shipment values, etc. In this study, the former was given that factories would be more forthcoming with their number of employees rather than shipment values.

The current amount of industrial waste generated was estimated using the generation rate method, but the generation rates of the following 4 types of waste were estimated respectively. The estimation method is detailed in the Main Report, Section 4.2.2.

- General Industrial Waste
- Health-care Waste
- Construction Waste
- Radioactive Waste

a.2 Number of Factories and Employees

The following table is a summary of the 440 PIM factories in operation (in 2009) showing the number of factories and employees by sector, number of employees per factory, industrial output (2008) and industrial output per factory (2008).

Table 21: Summary of 440 PIM Factories

Factory Code	Description of Sector	No. of Factories	No. of Employees	No. of Employees per Factory	Industrial Output (IO) in mil. Real	IO per Employee in 1,000 Real
F01	Beverage (soft drink, alcoholic) and vinegars	15	2,975	198	178	60
F02	Leathers, skins and similar	0	0	0	0	0
F03	Printing and graphical company	16	843	53	70	83
F04	Electric, electronic and communication materials	121	37,765	312	15,974	423
F05	Wood	2	348	174	41	118
F06	Mechanical	28	5,464	195	1,399	256
F07	Metallurgy	47	6,003	128	3,712	618
F08	Non metallic minerals	6	698	116	269	385
F09	Furniture	5	445	89	48	108
F10	Paper, cardboard, cellulose	13	1,789	138	333	186
F11	Rubber	3	133	44	3	23
F12	Food products	13	538	41	111	206
F13	Chemical	34	1,355	40	5,305	3,915
F14	Plastic material products	75	9,625	128	3,138	326
F15	Textile	1	20	20	14	700

F16	Clothing, fabric and travel goods	2	589	295	38	65
F17	Transport material	33	43,937	1,331	13,620	310
F18	Construction	6	440	73	NA	NA
F19	Others	20	3,225	161	9,347	2,898
	Total	**440**	**116,192**	**264**	**53,600**	**463**

a.3 Current IW Generation Amount

In accordance with the above estimation method, the IW generation amount from PIM factories in 2009 was estimated at 628.9 tons per day, based on this study's results of four types of generation sources. The detailed breakdown of this is shown in the table below.

Table 22: IW Generation Amount in 2009

Industrial Waste (Name of generation source survey) *1	Generation Sources	Surveyed Generation Sources	Non-HIW (ton/day)	HIW (ton/day)	Total Generation Amount (ton/day)
General Industrial Waste (Factory Survey)	440	187	471.8	119.7	591.5
Health-care Waste (Medical Institution Survey) *2	163	9	0.2	0.2	0.4
Construction Waste (Construction Waste Survey)	162	10	37.0	0.0	37.0
Radioactive Waste (Radioactive Waste Survey)	9	7	0.0	0.0	0.0
Total Industrial Waste	-	213	509.0	119.9	628.9

Note: *1: Only in reference to PIM factories targeted in this survey

*2: Does not include the generation amount of the one General Hospital surveyed

a.4 General Industrial Waste Generation Amount

The generation amount of the 29 general industrial waste types classified into 13 non-hazardous (Non-HIW) and 16 hazardous (HIW) are given in the tables below.

Table 23: Non-HIW Generation Amount by Sector

Unit: ton/day

Waste Code	Description of Non-HIW	Generation Amount
NH01	Kitchen waste (include waste from animal such as bone, skin, hair)	26.0
NH02	Wood	29.2
NH03	Paper	120.0
NH04	Plastic or polymers and resins	54.5
NH05	Textile and fiber	1.0
NH06	Animal oil, Vegetable oil	0.1
NH07	Rubbers and Leather	0.2

NH08	Ash/dust from coal-fired power plants, etc.	0.7
NH09	Metals and metal alloys such as aluminum, copper, bronze	163.6
NH10	Ceramic & Glasses	13.4
NH11	Stone, sand or material that have composition of soil such as tile, brick, gypsum, cement	1.7
NH12	Mixed waste (This code shall be applied in case wastes are discharged without separation.)	1.5
NH13	Others	59.9
Total		**471.8**

Table 24: HIW Generation Amount by Sector

Unit: ton/day

Waste Code	Type of HIW	Description of HIW	Generation Amount
HW01	Inorganic acid	Sulfuric acid (H_2SO_4), Hydrochloric acid (HCl), Nitric acid (HNO_3), Phosphoric acid (H_3PO_4), Other inorganic acids	0.2
HW02	Organic acid	Acetic acid (CH_3COOH), Formic acid (HCOOH), Other organic acids	-
HW03	Alkalis	Caustic soda (NaOH), Ammonia (NH_3), Sodium carbonate (Na_2CO_3), Other alkaline materials	-
HW04	Toxic Compounds	including Hg, As, Cd, Pb, Cr, CN	2.8
HW05	Inorganic Compounds	Plating wastes, Picking waste, Sulphides, etc.	0.2
HW06	Other Inorganic	Asbestos, Slug, etc.	-
HW07	Organic Compounds	Reactive chemical wastes (Oxidizing agents, Reducing agents, etc), Solvents etc.	18.9
HW08	Polymeric Materials	Epoxy resin, Chelate resin, Polyurethan resin, Latex rubber etc.	1.0
HW09	Fuel, Oil and Grease	Fats, Waxes, Kerosene, Lubricating oil, Engine oil, Grease etc	20.0
HW10	Fine Chemicals and Biocides	Pesticides, Medicine, Cosmetic, Drugs, etc.	-
HW11	Treatment Sludge	Inorganic sludge, Organic sludge, Septic tank sludge, etc.	20.6
HW12	Ash from incinerator	---	0.2
HW13	Dust and Air pollution control (APC) products	Soot and dust waste from incineration facilities, treating exhaust gas	1.0
HW14	Other Hazardous substance (besides HW01-HW13)	HIWs other than the above	34.4
HW15	Mixed Waste	---	14.7
HW16	Hazardous materials from	Fluorescent tubes, Thermometer (use mercury), Batteries, Pesticides (Household	5.7

	Non-production process	use), etc.	
Total			**119.7**

b. Flow of Industrial Waste Management

The following management flows of industrial wastes were estimated using the survey of generation sources (factory, medical institutions and construction waste surveys) and survey of waste service companies:

- All industrial wastes (Non-hazardous and hazardous of general IW + Non-hazardous and hazardous of health-care waste + construction wastes) in Figure 9 ;
- All General industrial wastes (Non-hazardous and hazardous of general waste) Figure 10 ;
- All health-care waste (Non-hazardous and hazardous of health-care waste) Figure 11 and
- Construction waste Figure 12.

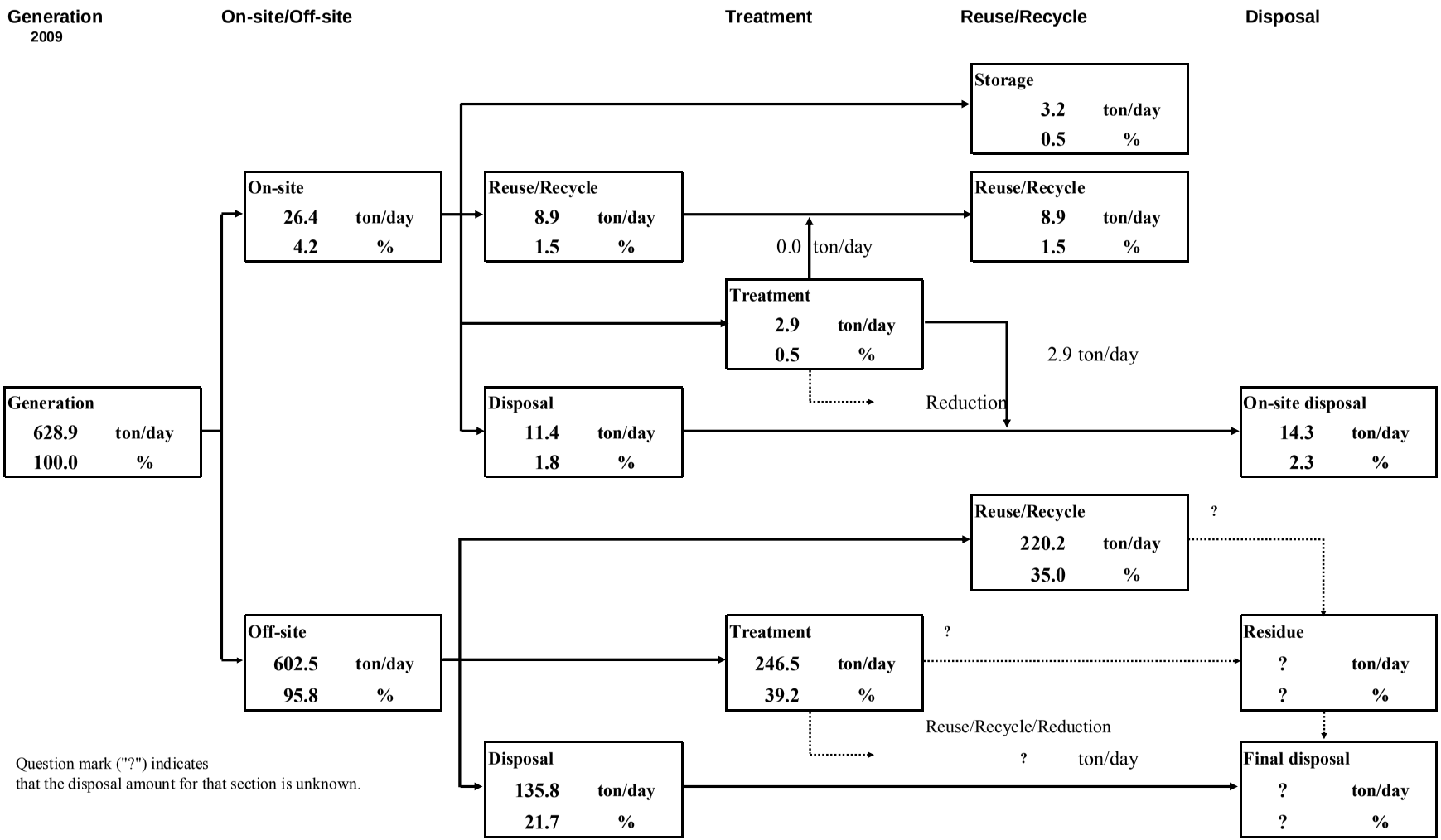


Figure 9: All Industrial Wastes (IW) generated from PIM (2009)

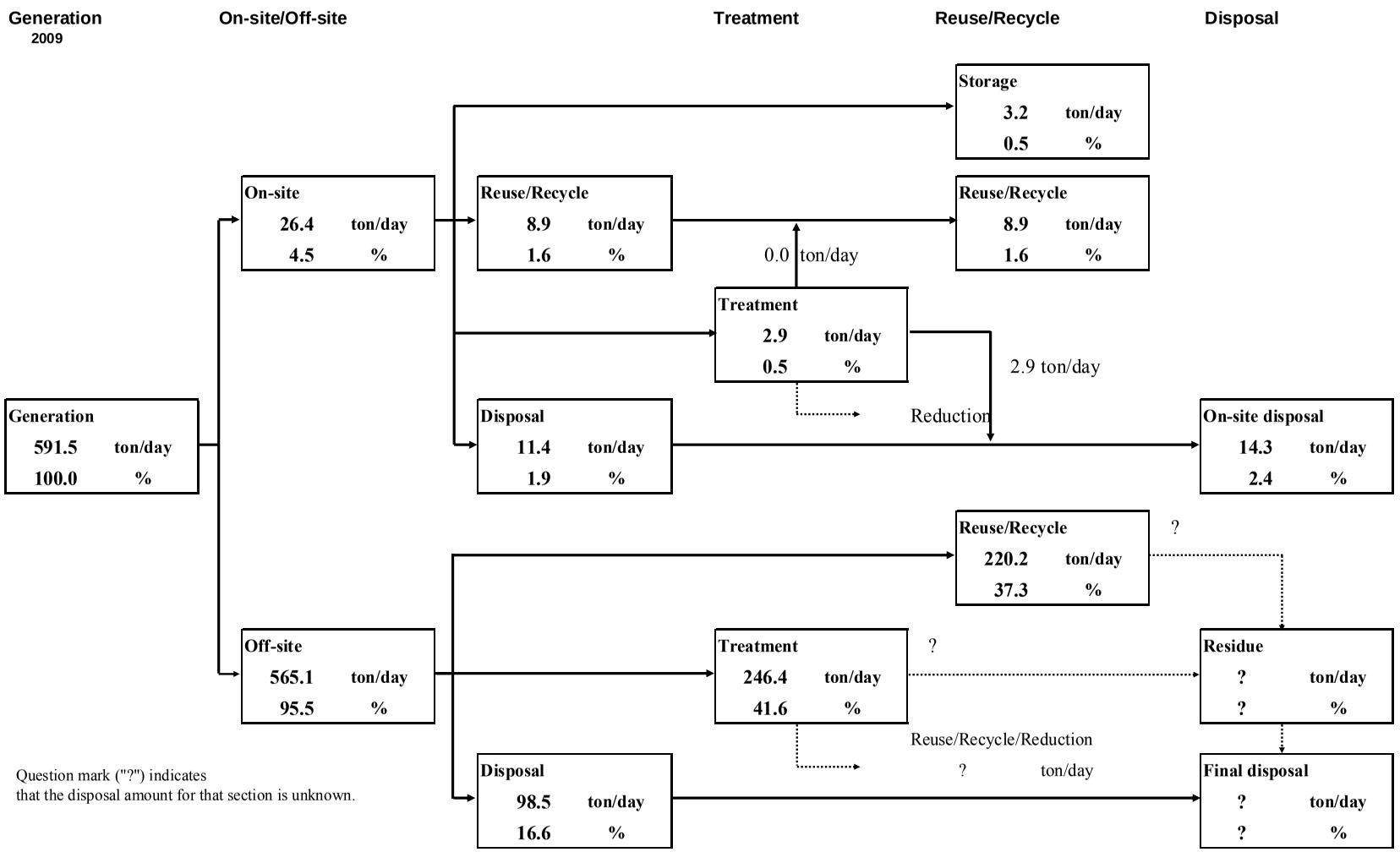


Figure 10: All General Industrial Wastes (IW) generated from PIM (2009)

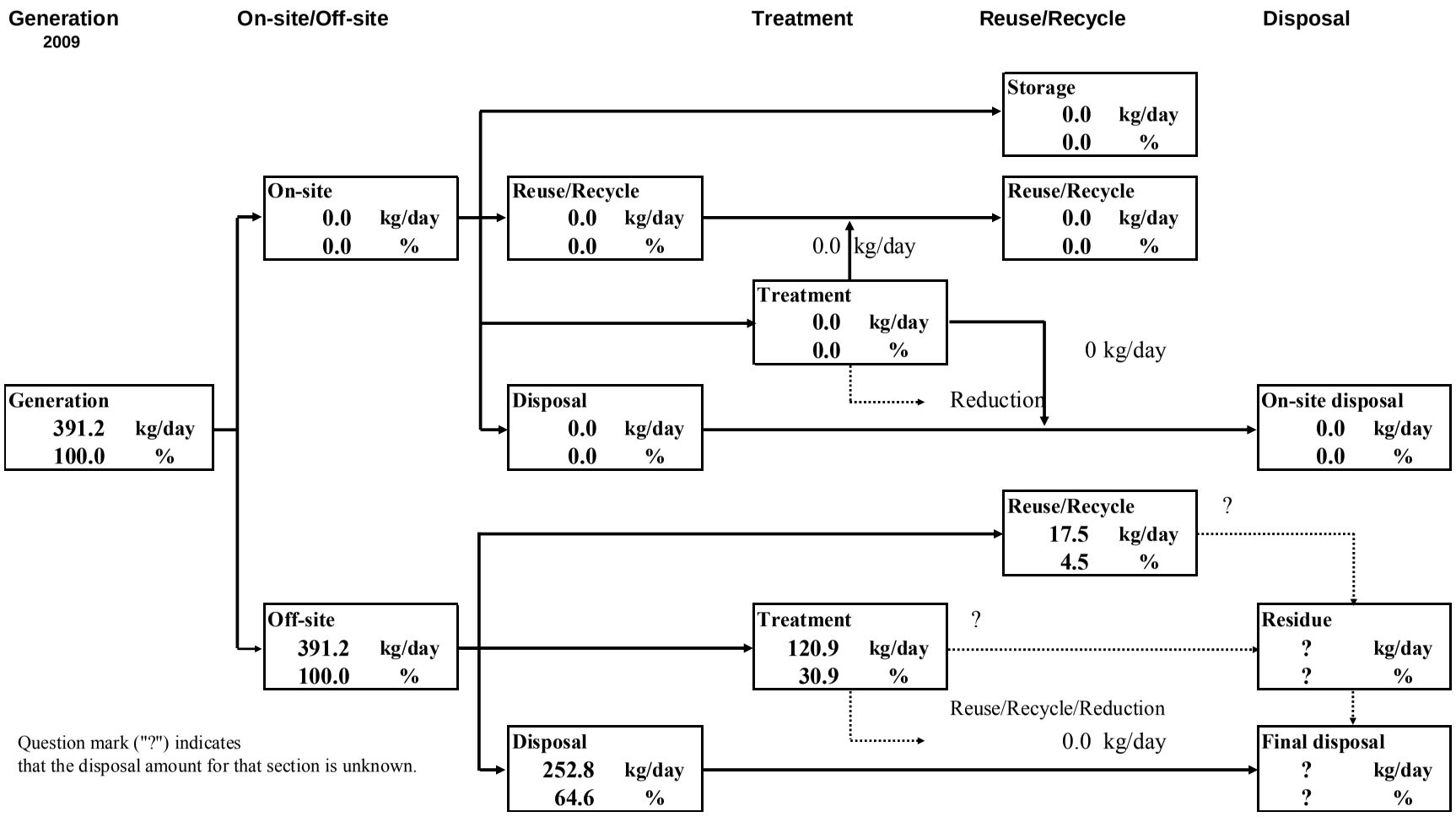


Figure 11: All Health-care Waste generated from PIM (2009)

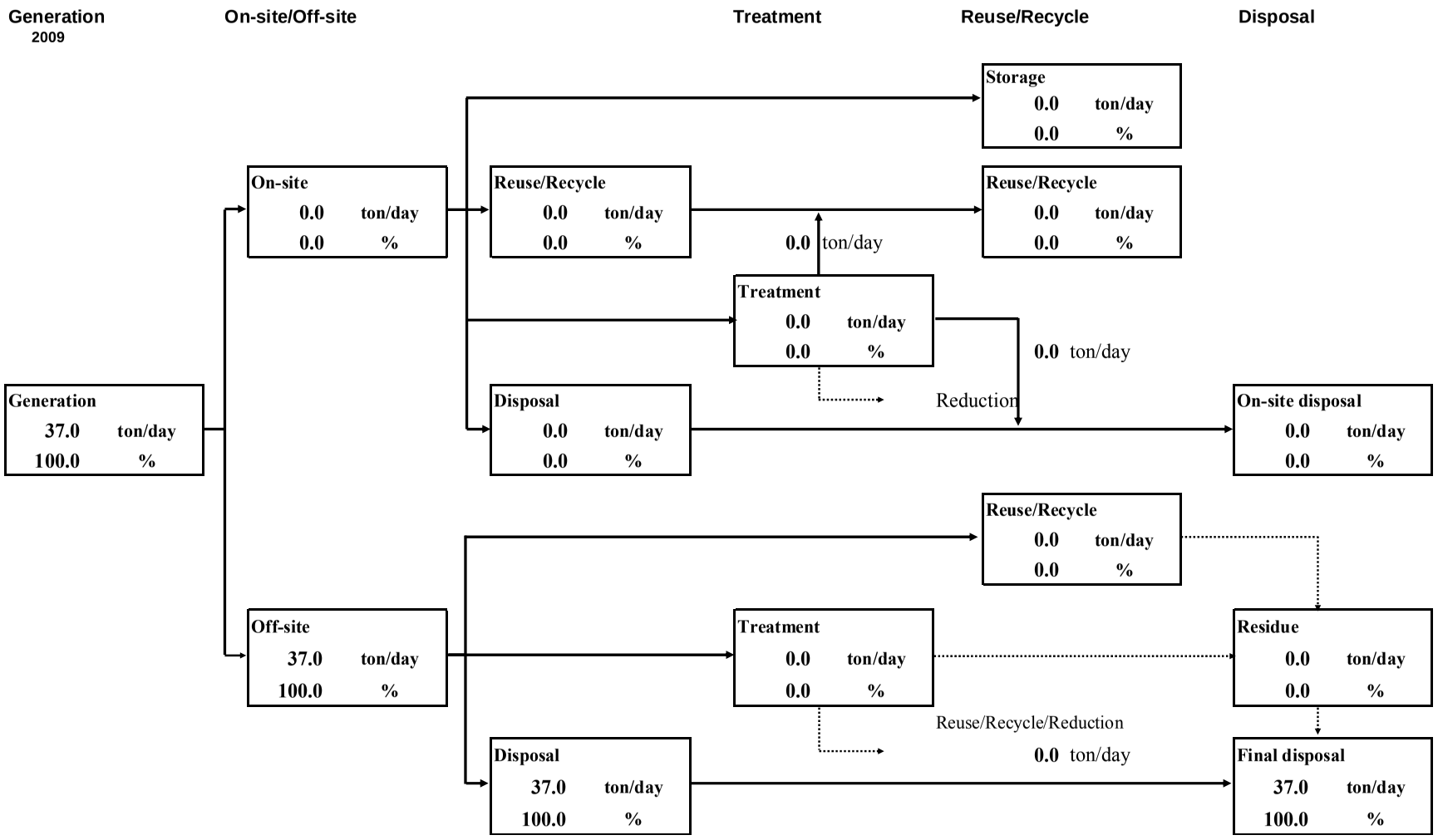


Figure 12: Construction generated from PIM (2009)

c. Current Conditions of PIM Factories

PIM is dominated by relatively large, assembly production factories. In 2009, there were a total of 440 factories operating overall. It is estimated that 116,192 people, equivalent to 6.8% of the population of Manaus, are employed at these 440 factories. Also, the total production value of the 440 factories for 2008 was 53.6 billion Real. Therefore, it follows that an average 264 people work at each factory, and the annual production per employee is 463,000 Real.

The industrial sector with the most factories is Factory Code F04: Electric, electronic and communication materials, which accounts for 27.5% of the total number of factories. The sector with the highest number of employees is F17: Transport material, which accounts for 37.8% of the total in PIM.

According to the factory survey, the installation rate of pollution control facilities is as follows.

Table 25: Installation Rate of Pollution Control Facility

Type of Facility	Installation Rate (%)
Incinerator	1.8
Industrial wastewater treatment facilities	27.5
Domestic wastewater treatment facilities	54.3
Dust collector	11.6
Air control facilities	12.4

The rate of treatment facilities installed for domestic wastewater from non-production processes is 54.3%, which is relatively high in comparison to the other facilities. Nevertheless, a Manaus City regulation (Law No. 1,192/2007) established 31 December 2007, requires the installation of domestic wastewater treatment facilities for enterprises that have at least 40 employees. Even with a one-year grace period, this will obligate most factories to install facilities from 2009.

3.3 Current IWM Issues in PIM

The current issues of industrial waste management in PIM from various perspectives, such as management at waste generating factories, management of waste discharged from factories and management by government administration of both, is given below.

3.3.1 On-site (Factory) IWM Issues

a. Extremely low on-site waste treatment at factories

A significant characteristic at present of IWM in PIM is that most wastes generated are disposed of off-site, as shown in the table below. All health-care waste and construction waste generated is disposed of off-site.

Table 26: Comparison of On-site and Off-site IW Disposal Ratio

Study Area	On-site disposal (%)	Off-site disposal (%)
1. PIM Industrial Waste	**4.2**	**95.8**
General Industrial Waste	4.5	95.5
Health-care Waste	0.0	100.0
Construction Waste	0.0	100.0
2. Bangkok Metropolitan Area, Thailand (2002)	**35.0**	**65.0**
3. Mie Prefecture, Japan (2000)	**53.9**	**46.1**

The reason for such a low rate of on-site waste disposal is the drastically low cost of off-site disposal. In particular, it is probably due to the fact that the Manaus City final disposal site, where most IW is sent, does not charge a disposal fee. Accordingly, the conditions are not such that readily promote 3R activities in factories. As a result, the reuse/recycle rate is a mere 1.4% of waste generated. Notably, the reuse/recycle rate of construction waste is only 0.1%, including off-site disposal, so that 96.9% of waste generated is disposed of free of charge at the Manaus city landfill.

In comparison, the disposal rate at a Japanese factory (in Mie Prefecture) at 53.9% is 13 times that of PIM, and even the Bangkok metropolitan area was 35.0% or 8.3 times that of PIM. The reason for the high on-site disposal rate is the high cost of off-site waste disposal, so the factories use 3R measures as much as possible to reduce the off-site disposal of wastes as much as they can. In Japan, progressive factories are reducing waste generation, with some even achieving Zero Emission, where no waste is discharged from the factory.

In order to dispel concerns of environmental pollution caused by industrial wastes generated from production activities in PIM, the first step is promoting 3R in factories, which calls for constructing a system so that wastes are discharged as little as possible from factories.

b. Lack of incentive to construct a system for appropriate on-site waste management

According to the factory survey, it is assumed that there will be a slight increase in industrial waste generated at PIM factories in the future. However, the majority of factories (78.8%) have not formulated a management improvement plan for the wastes generated. Furthermore, many factories (70.2%) are without a plan to promote 3R. In other words, from this it would seem there is a lack of commitment toward improving on-site waste management and reducing waste discharge.

In order to construct a system for appropriate industrial waste management, it is important to (1) reduce the generation of industrial waste as much as possible, (2) reuse and recycle IW that is generated to the greatest extent possible, and (3) the waste that is generated despite the previous two efforts is appropriately treated and disposed. Thus, the first measure is to establish a system of appropriate on-site waste management by reducing waste generation and conducting reuse or recycle on-site, and then to establish an appropriate treatment and disposal for IW that is discharged at off-site.

Nevertheless, under current conditions where most industrial waste that is discharged can be disposed of free of charge at the landfill, there is no incentive to promote 3R of IW at factories that generate waste or appropriate disposal of wastes generated.

c. Insufficient understanding of off-site disposal of IW

The first step to "constructing an appropriate system of industrial waste management" is to correctly understand actual disposal of IW. As long as these conditions and the issues surrounding them are left unclear, constructing such a system is not possible. However, due to the following factors, the actual disposal of IW in PIM remains in need of clarification.

c.1 Factory lack of interest in off-site disposal

The responsibility for appropriate disposal of industrial waste lies not only with waste service companies (WSCs) consigned to dispose of the discharged wastes, but also with the discharging entity. Accordingly, if the residues from inappropriate disposal cause environmental pollution, assumption of responsibility is extended to the factory which discharged the waste. In fact, when large-scale illegal dumping was discovered in the state of Para, next to Amazonas, in cases where the discharger could not be specified, the federal government also placed liability on the discharger for the clean-up fee.

Not limited to such instances, as shown in Figure 9 : All Industrial Waste (IW) generated from PIM (2009), a survey of waste service companies was conducted in addition to the factory survey of dischargers, yet it was not possible to clarify the final destination of all wastes discharged. Notably, along with intermediate treatment and reuse/recycle, it was not possible to clarify the final destination of residues. Namely, this means that the factories which discharge the waste are not sufficiently aware how waste they've discharged is treated or where it is taken for final disposal. It is suggested that the cause for this is a lack of concern by the factories regarding off-site disposal.

It will be necessary for IPAAM to corroborate with SUFRAMA in raising the interest of those discharging waste in appropriate off-site disposal through guidance and education measures.

c.2 Lack of an established waste manifest system

A significant factor in the inability to clarify the final destination of all wastes discharged, in addition to the apparent faltering interest in off-site disposal shown by factories as mentioned above, is that the State of Amazonas has no established waste manifest system. Despite the obligation in the State of Amazonas to produce and submit waste manifest-related paperwork, IPAAM has not specified a format that should be used for a waste manifest. As a result, generators and receptors each report to IPAAM using their own forms. For IPAAM, they receive these forms and file them for environmental (operation) licensing, but there is no database set up for their original purpose of waste management. Thus, the waste manifests which are submitted are hardly used for management or analysis.

IPAAM regards establishing a waste manifest system as an urgent issue.

c.3 Insufficient submission of waste inventories

The first imperative of CONAMA Resolution 313 is to understand the current conditions of industrial waste management in order to construct an appropriate IW management system for the State environmental agencies in charge of IW administration. For that reason, factories are requested to submit waste inventories. This calls for each State environmental agency to manage and analyze these waste inventories, grasp the actual conditions of IWM, and formulate a plan to resolve particular problems that are revealed.

The State of Amazonas is enforcing CONAMA Resolution 313 by obligating all PIM factories to submit a waste inventory. Nevertheless, it remains that only 1/4 of factories

submit one. Lack of compliance by factories is naturally the cause, but it is also due to a lackluster administrative system of guidance and enforcement. Furthermore, as follows, another factor is the inadequate system to manage and apply the waste inventories that are received.

c.4 Insufficient management of waste inventories

In the State of Amazonas, CONAMA Resolution 313 went into effect in October 2002, obligating PIM factories to submit a waste inventory. In response, every year about 1/4 of factories submit the waste inventories to IPAAM, the State environmental agency, and SUFRAMA, the superintendent of the designated industrial area.

CONAMA Resolution 313 also calls for IPAAM, the State environmental agency which manages and analyzes the submitted inventories, and IBAMA, the Brazilian Institute for the Environment and Renewable Natural Resources, to collaborate within 3 years (by October 2005) to formulate a "State Industrial Waste Management Plan". However, at IPAAM, the waste inventories received are filed as is, and there is no database for analysis. Thus, the waste inventories that have been submitted are, for the most part, left neither managed nor analyzed. As a result, not only is there no state industrial waste management plan, but the actual conditions of industrial waste disposal remain unclear. Hence, IPAAM is hastening to prepare a system to manage and analyze the waste inventories.

SUFRAMA enters the waste inventories they receive into a database and calculate the generation amount. However, there is zero input concerning what waste is disposed of on-site, how much is discharged off-site or how it is disposed. In addition to a general need for SUFRAMA to strengthen its ability to manage and analyze the inventories, the major reason for this is likely that the elaborate reporting forms and procedures (such as the waste types, disposal method, units and so forth) prescribed by CONAMA Resolution 313 are exceedingly complex for those expected to comply. For that reason, at least in the State of Amazonas, a system should be set forth which establishes one specified waste inventory format, which, once submitted, is promptly entered into the database.

d. Use of pollution control facilities

According to the factory survey, the use of preventive devices for air pollution and industrial effluent treatment facilities is quite low at 13.5% and 26.6%, respectively. Nevertheless, the necessity of such devices should be duly appraised and evaluated based on an investigation into the manufacturing processes of the factories. Therefore, the current installation rate cannot be evaluated based on these figures alone.

On the other hand, the installation rate of treatment facilities for effluent (wastewater) from non-manufacturing processes is 54.3%, which is relatively high in comparison to the rate for industrial effluent treatment facilities. However, a Manaus City regulation established on December 31, 2007 (Law No. 1,192/2007) obligates any business with 40 or more employees to install treatment facilities for general effluents. Taking into consideration a 1 year grace period, over half of the factories have been obligated to install these devices since 2009. The PIM factories are relatively large in scale with the average number of employees of 264 persons. Pursuant to this, there is no small number of factories that are operating in defiance of the city regulation and polluting the *igarape* with effluent.

In order to improve these circumstances, the Municipal Secretariat of the Environment (SEMMA) will need to collaborate with IPAAM to bring offending factories into compliance with the regulation. Also, IPAAM will have to conduct monitoring at the factories, investigate the manufacturing processes and so forth, and scrutinize the necessity for

pollution control facilities other than those for general effluent treatment, giving advice on countermeasures to carry forward regulation. In addition, it is necessary for SUFRAMA and IPAAM to collaborate to gain an understanding factories' current use of pollution control facilities and proceed to obtain environmental licensing for PIM as called for by the State Public Ministry.

3.3.2 Off-Site IWM Issues

a. Insufficient understanding of actual conditions concerning waste service companies

The most pressing issue to do with off-site industrial waste management is the fact that actual conditions concerning waste service companies (WSCs) are largely unknown.

a.1 Uncertainty as to the number of WSCs

Waste service companies are required to obtain an environmental license from IPAAM in order to carry out their operations. Therefore, IPAAM is managing WSCs through the issuance of operation licenses. According to the JICA preliminary study team dispatched to set down the project specifications for the current study, the list given to them by IPAAM listed 90 WSCs. Thus, based on that list, this study would carry out a survey of 90 WSCs.

However, at the start of the survey of waste service companies, the list of WSCs given by IPAAM contained 84 companies. The local consultant consigned in the study contacted all 84 companies on the IPAAM WSC list to request their cooperation with the study, but the number of companies actually carrying out these services was limited to 63% of the total, or 53 companies. Furthermore, the number of companies the study was able to survey was 35.

Consequently, the local consultant (OPCA) met with factories and WSCs and, based on what they learned, independently located 55 waste service companies and surveyed a total of 90 companies. The 90 companies that were surveyed are arranged in the table below to show those which had obtained an environmental license for these operations.

Table 27: Possession of Environmental (Operation) License among 90 WSCs Surveyed

WSC Classification	Number of WSCs
With Environmental License	67*1
Without Environmental License	23*2
Total	90

Note: *1: Of these 67 companies, 35 were on the IPAAM WSC list, and 32 were added by the local consultant
*2: These 23 companies were found by the local consultant

As shown above, the survey of waste service companies showed that the number of companies in the State of Amazonas working on waste services was not fully understood. It also revealed that there were a number of entities conducting waste services without having obtained the proper license.

a.2 Discord between WSC operations and environmental licenses

The replies received from WSCs concerning their operations are shown in the table below. Multiple answers were allowed according to a company's operations so that the total amounts to 127.

Table 28: WSC Replies concerning Type of Operation

Possession of Environmental License	1) Collection / Transportation	2) Intermediate Treatment	3) Final Disposal	4) Reuse / Recycling	Total
With	41	9	10	42	102
Without	7	0	0	18	25
Total	48	9	10	60	127

The study team worked with the local consultant regarding the 67 WSCs with licenses that were surveyed to look over the descriptive content of the environmental licenses. As a result, the following table shows the categorization of work conducted by those licensed WSCs accordingly.

Table 29: Categorization of Waste Services of 67 Companies with Environmental Licenses

Possession of Environmental License	Collection / Transportation	Intermediate Treatment	Final Disposal	Reuse / Recycling	Unable to categorize*1	Total
With EL	26	24	0	21	4	75

Note: *1: An actual visual check of the licenses was unable to confirm the corresponding work conducted by the WSCs; the content of the licenses were as follows: 1. Distribution and supply of water (2 companies), 2. Spray and cleaning with insecticide, 3. Retailer of wood products

It is clear from the 2 tables above that the description of work permitted in the environmental license diverges greatly from work actually done. Furthermore, other problems as follows were ascertained in relation to WSC licenses.

- There is no final disposal site with an environmental license, including the Manaus city landfill, in the State of Amazonas. There are 9 companies carrying out final disposal operations regardless.
- A case where waste treatment such as incineration are carried out although the environmental license permits waterworks but not other such waste treatment activities. In this case, it is clear that the WSC should obtain a license.
- Of the 17 companies in the reuse/recycle category, 11 companies are under an environmental license code other than waste services. Specifically, companies whose main activities are paper or aluminum manufacturing are reusing or recycling waste as part of their activities. In such a case, a license for the reuse/recycling of waste should be obtained in addition to their current license, or a new licensing structure should be looked into.
- A large number of activities classified as intermediate treatment should be considered reuse/recycling.

a.3 Presence of unregistered entities

As previously stated, there are a number of currently unregistered entities conducting waste services without having obtained an environmental license. In this study, at least 23 were found. Further, given that the number of companies that have obtained a license and are operating waste services is unclear, conditions are not conducive for the government administration responsible for managing waste services to sufficiently regulate these unregistered entities. Moreover, the WSC users (i.e. factories) are not provided information from the government not only about which companies are accountable, but also information on which companies have obtained the proper environmental license.

As can be seen from this, there are at present various problems with the system to register WSCs. A large part of the problem is that the current environmental licensing system has waste services dispersed across a wide range of activities. As such, IPAAM must quickly construct a uniform management structure for WSCs and develop a corresponding database.

b. Secure Final Destination

b.1 Final disposal site without operation license

Based on the results from the survey of waste service companies, 9 companies are involved in final disposal activities. However, there is no final disposal site in the State of Amazonas which has obtained an environmental license, including the municipal landfill. At the end of 2009, there are 2 locations, one owned by Manaus city and another privately held location, where industrial waste from PIM is brought for final disposal. Nevertheless, neither of these possesses an operation license for final disposal.

Regardless of this situation, as shown in Figure 9: All Industrial Wastes (IW) generated from PIM (2009), the final destination of at least 21.7% or more of the industrial waste generated is the landfill. Taking the unclear circumstances of disposal of residues generated from intermediate treatment and reuse/recycling into consideration, a great amount of industrial waste is being disposed in a landfill without an environmental license. In other words, because a landfill without an environmental license is the primary final destination of industrial waste generated in PIM, most of the PIM factories do not satisfy the conditions required for ISO 14000.

Meanwhile, even though the construction and operation of a licensed landfill site has been a considered for PIM waste management for many years, little progress has been seen. In order to build a robust IWM system for PIM, it is necessary for stakeholders to come together and proceed to construct a final disposal site with an operational license as soon as possible.

Construction of a final disposal site will become possible for the first time through a process that includes site selection, environmental study, EIA, public hearing, and consensus building with residents. Thereby, a considerable amount of time is required prior to construction. Until then, the question of how to secure final destination is be a distinctly large issue for forming an appropriate waste management system for PIM.

b.2 Promoting Co-processing

Co-processing is the use of waste as raw material, as a source of energy, or both to replace natural mineral resources (material recycling) and fossil fuels. Instances where no residues are generated are regarded as Final Destination. In the target study area, co-processing activities are undertaken where one company is manufacturing and selling asphalt filler mixed with 5% waste in addition to the cement factory. That seller, however, did not agree to comply with the WSC survey, so specifics are unclear.

Meanwhile, the amount of waste put toward co-processing by the sole cement factory located in the MFZ is considered extremely limited at 5,274 ton/year. Given that the production volume at same cement factory in 2005 was 627,000 ton/year (Cement Factory 2005 Annual Report: Sindicato Nacional da Industria do Cimento 2005), it can be deduced the ratio of waste treatment was no more than 0.84% of their production volume. In Japan, the ratio of waste treatment to production volume is 43.5%. In the State of Amazonas, the disposal amount using co-processing where no residues are generated at the cement factory is greatly limited.

Co-processing at a cement factory is a desirable form of final destination from an environmental conservation perspective. For IPAAM to make a breakthrough concerning the non-licensed landfill problem, it must collaborate with SUFRAMA to promote co-processing.

c. Poor Business Environment for Industrial Waste Disposal

As shown in Table 29: Categorization of Waste Services of 67 Companies with Environmental Licenses, putting aside the quality of services on offer, the structure for receiving wastes discharged from factories is sufficient, apart from final disposal. With 440 factories operating in PIM, comparatively, the number is more than enough. However, based on observations during the survey of waste service companies, it is hard to say the quality of service is ample. In particular, there were a number of problems observed concerning pollution control devices such as countermeasures for incinerator gas emissions. Namely, the conditions observed are not conducive to attracting investment for waste service companies to conduct sound waste treatment and disposal practices. The reason for this is that the environment, as pointed out below, is not suitable for industrial waste disposal business to conduct treatment appropriately.

- A large amount of industrial waste is being disposed of in the Manaus City landfill which does not collect a disposal fee.
- There are a large number of waste service companies that do not have an environmental license (i.e. unregistered entities) which are disposing waste for low fees.
- Administration does not have a clear picture of actual waste service company practices, including registered entities, so that regulation of unregistered and unsound entities is greatly confined.
- Under these conditions, competition between waste service companies is fierce, and disposal fees are extremely low. Thus, attracting investment for the construction and operation of appropriate treatment and disposal facilities is extremely limited.
- Also, some entities which discharge waste lack concern for whether the waste is disposed of properly.

In order for IPAAM to realize appropriate off-site treatment of factory waste, it must collaborate with SUFRAMA to facilitate a good business environment for industrial waste disposal.

3.3.3 Issues on Administration of IWM

As mentioned above, current conditions leave administration at risk, as it is responsible for the instruction, education and regulation of stakeholders concerning management at IW

generation sources, and the monitoring and management of appropriate disposal of discharged waste. The primary issues are given below.

a. Organizational Structure

a.1 Legal System

In Brazil, the administration for industrial waste management in each State is under the jurisdiction of the State environmental authority. In Amazonas State, this is IPAAM, the Institute of Amazonas Environmental Protection. The legal system for administration of IWM, according to Federal law, follows State laws.

A comprehensive basic law concerning waste management is currently under deliberation at the national legislature, but the Federal legal system serving the nation is quite elaborate. Also, the Amazonas State government primarily follows the Federal legal system and prepares the necessary State laws, so the required legal system to carry out IWM is prepared. The problem is development of the tools and the organizational structure needed to enforce the law.

a.2 Organizational Structure

At the national level, the organizational structure responsible for IWM has been duly developed. At the same time, strengthening is needed for the organizational structure at the State level which is responsible for actual administration of industrial waste management according to the law. In particular, there are shortfalls in the number of staff concerning industrial waste management.

In the State of Amazonas, the office responsible for IWM administration is the Environmental Monitoring Management Section (GMAM) of IPAAM. Although the office has a staff of seven, the work in which they are engaging is not IWM, but such work as the management of environmental licenses.

Also, as of December 2009, there is neither a unit nor in-house staff in charge of IWM at SUFRAMA, which manages the Industrial Pole of Manaus (PIM).[14]

b. Improvement and Upgrading of Management Tools

It is necessary for the administration to use a variety of tools in order to enforce sound waste management. Based on the current situation, improvement and upgrading the following tools will be vital.

- Improvement of the database for factories, which are the generation source of IW
- Improvement of the database of waste inventories which show the amount and composition of IW generated at factories as well as management conditions
- Improvement of the waste manifest system in order to track and monitor where and how IW discharged from factories is being disposed.
- Development of a database to register and manage industrial waste service companies

b.1 Improvement of Factory Database

SUFRAMA has developed a factory database for those that have entered PIM in order to award various amenities as appropriate, and is updating this database as needed.

[14] At present in December 2009, an industrial waste management unit has not officially been launched. It is planned for 2010 and 3 staff members will be assigned.

Nevertheless, a number of problems were identified, as follows, in this study when conducting the surveys on medical institutions and construction waste.

Of the factories on the SUFRAMA Factory List[15], 18 of the 475 in operation are located outside of the MFZ, the target area of the study. Consequently, the study confirmed whether any of the 457 factories located in PIM within the MFZ had medical facilities (i.e. clinics) or, in the past year, had had any construction works. The results are as follows.

- Factories which responded by telephone: 334
- Factory closures: 17
- Factories which declined to answer: 25
- Factories which could not be contacted by telephone: 81

Including the factories that could not be contacted by telephone (which assumes that some of these incidences were on account of number changes), the study reported that 440 PIM factories are operating in the MFZ area, excluding the 17 which had closed.

As shown above, the SUFRAMA factory database had not been updated to reflect the 17 factory closures. Furthermore, it is possible that the data was insufficient for the 81 factories that were not reachable by telephone.

The most important data for management of the industrial area (PIM) is that on which factories are operating, so it is necessary to keep that data as up-to-date as possible.

b.2 Improvement of Waste Inventory Database

Waste inventories are a critically important tool to understand the actual conditions of industrial waste management and formulate a plan for IW management. However, the following problems were identified concerning the waste inventories.

- Although all PIM factories are obligated to submit a waste inventory, the number of factories doing so stands at approximately one-forth.
- IPAAM does not have a database to manage and analyze waste inventories which are submitted.
- SUFRAMA is entering the submitted waste inventories into a database and calculating the generation amount. However, there is no recognition of which industrial wastes generated are disposed of on-site and which are discharged off-site for disposal, or how they are disposed. It is likely that the major cause for this is the complicated forms designated in CONAMA Resolution 313 and conflicting reporting methods (e.g. waste type, disposal method, units, etc) used by those reporting.

In order to resolve the above issues, it is necessary for IPAAM and SUFRAMA to improve the database of waste inventories as detailed below.

- The first step is to establish an easily understandable reporting format (waste type, disposal method, units, etc) based on the factory survey undertaken in this study, by refining the submittal of waste inventories into one unified method.

[15] Profile of the Companies with Projects Approved by SUFRAMA, December 2008 (Perfil Das Empresas Com Projetos Aprovados Pela SUFRAMA Dez/2008)

- Forthrightly prepare a system in which the submitted waste inventories are promptly entered into the database.
- At the same time, instruct and train all PIM factories on the unified reporting method and direct all factories to submit a waste inventory.

b.3 Improvement of Waste Manifest System

The waste manifest system is an indispensable administration tool used to monitor waste treatment and disposal after factory discharge. In the State of Amazonas, the creation and submittal of waste manifest documents is mandatory. However, IPAAM has not designated a specific waste manifest format that should be used. Thus, it is not possible to clarify the final destination of all wastes which are discharged. Improvement of the waste manifest system is a pressing issue for IPAAM, and it will be necessary to take the following steps.

- Create a uniform waste manifest format to be used, taking into consideration examples from States further along in development, such as Rio de Janeiro.
- On that basis, collaborate with those States to put the waste manifests on-line.
- Concurrently, arrange the data garnered from the waste manifest system into a database.

b.4 Development of Registry and Management Database for WSCs

In the State of Amazonas, waste service companies (WSC) are registered and managed using the environmental licensing system. However, the current system has a number of problems, and it is not possible to gauge the actual number of operators engaged in waste services. Also, there are some entities operating which are not yet registered, but it is not possible to expose those unsound operators. In order to improve this situation, it is necessary to forthrightly develop a database to register and manage industrial waste service companies as follows.

- Arrange the environmental licenses currently related to various waste services into one large category for waste-related services.
- Additionally, sub-divide waste-related service licenses into categories: collection and transportation, intermediate treatment, reuse/recycle, and final disposal.
- On that basis, require the waste service companies currently dispersed over a variety of activities to apply to acquire the new operation license.

b.5 Improvement of Data Management System

Simply constructing a database will not bring about its essential function. It is also necessary to continuously maintain the database, and work to expand and develop the management system. In particular, with the database at IPAAM serving as the seat for waste management, the following improvements will need to be made.

- Promptly develop a system in which it is possible to interface with the data contained in other organizations' databases.
- Provide the necessary personnel to manage the database and keep the data up-to-date.
- Consolidate a process in which the data can be shared, such as creating waste codes.

c. Strengthening Regulation

As mentioned above, the current organizational structure and management tools are not sufficiently developed, and thus regulations against illegal dumping, non-registered operators,

improper treatment and disposal and such fall short. In the State of Amazonas, it is assumed that private-sector vitality will serve to bring about the facilities necessary for the appropriate treatment and disposal of industrial waste. As this will take a considerable investment from the private sector to construct treatment and disposal facilities, it is important that those investors can gauge recovery on their investment. The most important factor in doing so is to step up control of illegalities such as non-registered operators and illegal dumping as well as unsound treatment and disposal routes and eliminate them. Along with development of management tools and organizational structure, it is necessary to strengthen the structure of regulation implementation.

d. Pending Need for Cooperative Framework for Administration, Dischargers and Waste Service Companies

d.1 Cooperation between Administrative Entities

Although administration of industrial waste management in the State of Amazonas is led by IPAAM, a variety of administrative entities are involved. Therefore, IPAAM will need to cooperate with these other entities in order for them to establish an appropriate system for industrial waste management. For SUFRAMA, which manages PIM, collaboration with related organizations, starting with IPAAM, is necessary if PIM is to acquire an environmental license as requested by the State Public Ministry.

In particular, because the landfill in the State of Amazonas serving as the final destination for industrial waste for much of the waste disposed does not possess an environmental license, much of the waste is not being disposed of properly in the strictest sense. Furthermore, a large part of industrial waste final disposal is dependent on the city landfill run by the Manaus Municipal government. In order to make a breakthrough in this area, it is desirable that the related organizations, such as IPAAM (managing waste service companies), SUFRAMA (managing factories), Manaus City (managing the landfill), State Public Ministry (exposing unsound disposal), and FIEAM (the State industrial federation), establish a close, collaborative relationship.

d.2 Cooperation between Administration and Dischargers of Waste

Despite the obligation of all PIM factories to submit a waste inventory, the rate of submittal stands at one-forth. The cause is the factories' poor awareness of compliance, but also a lack of promotional activities to train and instruct factories on the administration's part. It is essential to form a collaborative structure between administration and the dischargers of waste if one hopes to expand the submittal rate of waste inventories and ensure that an improved waste manifest system functions. In order to develop a cooperative structure, the administrative parties should proactively carry out the following efforts on behalf of the factories which discharge waste.

- In order to facilitate the 3Rs and sound treatment on-site, encourage factories to form industrial waste measures such as a system of comprehensive responsibility and technology management system. To do so, administration should take up instruction and training of such personnel and be proactive in the provision of information about front-runners amongst factories regarding the 3Rs and sound treatment and disposal.
- Provide instruction and training on the method to create a waste inventory and waste manifest.
- Provide information on waste service companies that have acquired an environmental license to facilitate sound off-site treatment and disposal.

d.3 Cooperation between Administration and WSCs

During the survey of waste service companies (WSCs) as part of this study, 18 of the 53 companies which hold environmental licenses declined to cooperate with the study, despite encouragement by IPAAM. The reason may lie in a lack of awareness among the WSCs, but also points to the tenuous nature of the relationship between administration and WSCs. Also, with the existence of non-registered entities, licensed operators may harbor a sense of distrust regarding the poor business environment. In order make a newly developed registration system for WSCs function and expunge the existence of non-registered entities, it is essential for administration to form a collaborative relationship with licensed companies. To do so, the following efforts should be sought proactively at the behest of the administration on behalf of registered companies.

- Actively publicize a new WSC registration system to waste service companies. On this basis, provide instruction and training on how to prepare the application form for registration.
- Support the establishment of a technical management system amongst waste service companies in order to facilitate reuse/recycle and sound treatment and disposal. To do so, the administration should provide opportunities for instruction and training of such personnel and actively promulgate information concerning reuse/recycle and sound treatment and disposal.
- Develop a database to register and manage WSCs forthrightly and consolidate efforts to regulate non-registered entities. Furthermore, publicize information on WSCs which hold environmental licenses to the factories, their clients. Through these activities, the business environment of WSCs will improve.

d.4 Cooperation between 3 Entities: Administration, Dischargers and WSCs

In order to establish a system of sound industrial waste management, it is essential that a collaborative relationship is formed between the three entities of factories, which discharge waste; waste service companies, which properly manage the waste discharged; and administration which monitors, guides, instructs, manages and regulates the previous two. At present, one would be hard-pressed to say that this collaborative structure is satisfactory. Thus, the related parties must make the above-mentioned improvements.

Moreover, in order to further develop the collaborative structure as mentioned above, it is important that administration, dischargers and WSCs create a place where they are able to exchange opinions and information, etc.

4 Master Plan on Industrial Waste Management

4.1 Projection of Future IW Generation

4.1.1 Scope of Projection

a. Target Industry Types

In this report, the following 19 industry classifications used by SUFRAMA for PIM factories were used as the targets for the future estimate of IW generation.

b. Targeted Industrial Waste

The industrial wastes targeted for generation estimates are those required by CONAMA Resolution 313 to be included in a waste inventory. For this report, the following three main categories were used to estimate generation amount.

- General Industrial Waste
- Health-care Waste
- Construction Waste

c. Estimation Period for Generation Amount

The estimation period for the generation amount will be until the Master Plan target year 2015.

4.1.2 Methodology of Estimating Future IW Generation

a. Formula used to Estimate the Generation Amount

Estimation of future IW generation amount was made based on the following equation.

$$IWG = \sum_{i=1}^{n} \sum_{j=1}^{m} (Mi \cdot Gij)$$

Basically, the future IW generation amount is calculated using **the generation rate (G)** from each generation source, multiplied by **the number of basic units (M)** from each generation source. The number of basic units (M) can be the production amount, production value, etcetera, but in this study, number of employees was used for reasons given below.

The following table shows how each item of the above formula was established in terms of the previously mentioned 3 types of industrial waste.

Table 30: Explanation of Items of Estimation Formula for Future IW Generation Amount

Formula Items	General IW	Health-care Waste	Construction Waste
IWG	Generation Amount of General IW (ton/year)	Generation Amount of Health-care Waste (ton/year)	Generation Amount of Construction Waste (ton/year)
i	Factory type	Only one generation rate (GR) is used for all PIM factory	Only one generation rate (GR) is used for all PIM factory
j	Type of general IW	Type of health-care waste	Type of construction waste
M	Number of employees	Number of employees	Number of employees
G	Waste generation rate (ton/year/person)	Waste generation rate (ton/year/person)	Waste generation rate (ton/year/person)
n	Factory type number (19 types)	Factory type number (only one type)	Factory type number (only one type)
m	Waste type number (29 types)	Waste type number (5 types)	Waste type number (4 types)

b. Setting the Waste Generation Rate (GR)

The waste generation rate (GR) is given for each type of waste for all three types of industrial waste[16]. The GR used is ton per year per person (ton/year/person). The GR was established based on data that the study team gathered when carrying out three surveys: factories, medical institutions, and construction waste. Here, to estimate waste generation amount, it is assumed that until 2015 there is no change in the GR.

c. Future estimation for number of employees

The future estimation of number of employees is an important variable when estimating the waste generation amount. The variable for number of employees was selected, particularly, for the following reasons.

1. In the factory survey, factories were more likely to release information about number of workers rather than production amounts, so number of workers was used as the basic unit of measure in the study.
2. It is estimated that "the increase in waste generated from factories tends to be closer in relation to growth in number of workers rather than growth in production."
3. Manufacturers and other industries will increase production according to a rise in demand to expand their profits, but they attempt to control production costs per item as much as possible through improved productivity. These efforts include improving worker productivity, economizing energy use and resources (raw materials).
4. Economizing on energy and resources is, in due course, tied to the reduction of waste generated through production activities. Therefore, assuming such efforts are made, the future amount of waste generated is estimated as a factor in improved productivity included in "growth in number of employees" rather than output growth.

However, the only data available is that for the total number of employees in PIM overall, as the corresponding data for the categories in each of the 19 types of industry does not exist. Accordingly, analysis of the correlation between total number of employees in PIM, 2004 ~

[16]Given for 19 factory types for general IW.

2008, and estimated industrial growth resulted in an average annual growth in overall PIM production value of 6.6%, thus confirming that average annual growth of direct employment in the same period will remain at 5%.

Based on these results, the forecast for employees in each type of industry was estimated using the following method.

1. Using "Data of industrial output by types of industry during 2004-2008" (SUFRAMA), and assuming the change in industrial growth for 2004-2008 continues in the future (business-as-usual scenario), future industrial growth for 2009-2015 was estimated for each of the 19 industry types.
2. The correlation between the change in number of employees in PIM (annual average of 5.0% growth, 2004-2008) and change in production value (annual average of 6.6% growth, 2004-2008) was estimated, showing that PIM labor productivity will improve 1.5% annually on average.
3. Based on the assumption above, using the 2009 data for number of employees in each of the 19 industry types, and 2009 ~ 2015 estimated industry growth for each industry type, the number of employees in each sector was estimated for 2015 using the following formula:
4. Number of Employees (2015) = Number of Employees (2009)× {2015 industrial growth/(2009 industrial growth×1.0156)}
5. Results were similarly sought for each of the 19 types of industry.

The forecast for number of employees was estimated using the above conditions with the results as shown in the following table.

Table 31: Estimated Forecast for Number of Employees[17]

Factory Code	2009			2015		
	Industrial growth	Number of Employee	Unit Industrial growth	Industrial growth	Number of Employee	Unit Industrial growth
	(mil. Real)	(employee)	(mil. Real /employee)	(mil. Real)	(employee)	(mil. Real/employee)
F01	173	2,975	0.058	113	1,794	0.063
F02	---	---	---	---	---	---
F03	62	843	0.074	52	642	0.081
F04	16,242	37,765	0.430	17,934	38,157	0.470
F05	40	348	0.115	34	270	0.126
F06	1,455	5,464	0.266	2,062	7,086	0.291
F07	4,217	6,003	0.702	8,080	10,521	0.768
F08	279	698	0.400	515	1,178	0.437
F09	49	445	0.110	72	600	0.120
F10	363	1,789	0.203	473	2,131	0.222
F11	0.9	133	0.007	0.5	63	0.008

[17] This chart was made by the Study Team based on "Data of industrial output by types of industry during 2004-2008, SUFRAMA". In that statistics material, the totals are given for industrial growth of F18 and F19. Here, in order to calculate industrial growth per worker, the total production growth of both F18 and F19 were divided by the total number of workers.

F12	101	538	0.188	81	393	0.206
F13	5,742	1,355	4.238	8,558	1,847	4.634
F14	3,138	9,625	0.326	4,257	11,958	0.356
F15	13	20	0.650	11	15	0.711
F16	40	589	0.068	65	878	0.074
F17	14,771	43,937	0.336	25,334	69,030	0.367
F18	9,355[*1]	440	2.553	6,623[*1]	285	2.791
F19		3,225	2.553		2,088	2.791
Total	56,041	116,192	0.482	74,265	148,936	0.527

4.1.3 Estimation of Future IW Generation Amount

Future IW generation rate is the product of the above-mentioned generation rate of industry/industrial waste by type (general IW, health-care waste, construction waste) and the number of employees by industry. The results are as follows.

a. General Industrial Waste Generation

The generation amount of general IW in 2009 was estimated at 591.5 ton/day. Further, the 2015 general industrial waste amount generated was estimated by multiplying each type of waste in each sector (Factory Category) by the future index 737.7 ton/day. It is estimated that in 2015 there will be about 1.3 times the present amount of general IW.

Table 32: Forecast Generation Amount of General IW by Factory Category (2015)

Factory Category		Non-Production		Production Process		All Process	
		Non-HIW	HIW	Non-HIW	HIW	2009	2015
F01	Beverages	6.6	0.1	0.5	0.1	12.2	7.3
F02	Leather	-	-	-	-	-	-
F03	Printing	0.1	-	3.0	1.6	6.2	4.7
F04	Electrical	51.3	9.1	95.2	20.4	174.1	176.0
F05	Lumber	0.3	0.1	0.7	0.2	1.7	1.3
F06	Machinery	10.8	4.4	33.0	4.7	40.9	52.9
F07	Metal	21.5	4.1	85.9	6.0	67.0	117.5
F08	Nonferrous Metal	0.6	-	2.7	-	2.0	3.3
F09	Furniture	0.7	0.2	0.1	0.4	1.0	1.4
F10	Paper	67.1	0.4	29.2	2.7	83.3	99.4
F11	Rubber	0.1	-	0.2	-	0.6	0.3
F12	Food	-	0.1	15.2	0.3	21.3	15.6
F13	Chemical	0.7	-	5.5	0.5	4.9	6.7
F14	Plastic	9.5	25.6	15.2	2.3	42.4	52.6
F15	Textiles	-	-	-	-	0.1	0.1
F16	Clothing	1.1	0.3	2.1	0.6	2.7	4.1
F17	Transportation	26.0	2.6	89.2	68.8	118.8	186.5
F18	Construction	0.3	0.1	0.7	0.2	2.1	1.3
F19	Other	1.4	-	4.0	1.3	10.2	6.7
Total		198.1	47.1	382.4	110.1	591.5	737.7

As shown in the table above, 93% of the total general IW will be generated in the following 6 factory's categories:

Factory Code	Type of Industry	Waste Generation in 2009 (ton/day)	Waste Generation in 2015 (ton/day)	Increase Rate (%)
F04	Electrical industry	174.1	176.0	1.1
F17	Transport Machinery	118.8	186.6	57.0
F10	Paper industry	83.3	99.4	19.3
F07	Metal industry	67.0	117.5	75.3
F14	Plastic Industry	42.4	52.6	24.1
F06	Machinery	40.9	52.9	29.3
Total		526.5	685.0	30.1

Among the 6 large generation sources the highest increase rate is F07: Metal Industry, 75.3%, followed by F17: Transport Machinery, 57.0%.

The following two tables show forecast of generation amount of general Non-HIW and HIW in 2015, respectively:

Table 33: Forecast Generation Amount of General Non-HIW by Type of Waste (2015)

Unit: ton/day

Waste Code	Description of Non-HIW	Generation Amount	
		2009	2015
NH01	Kitchen waste (include waste from animal such as bone, skin, hair)	26.0	32.8
NH02	Wood	29.2	34.0
NH03	Paper	120.0	137.2
NH04	Plastic or polymers and resins	54.5	62.8
NH05	Textile and fiber	1.0	1.1
NH06	Animal oil, Vegetable oil	0.1	0.1
NH07	Rubbers and Leather	0.2	0.2
NH08	Ash/dust from coal-fired power plants, etc.	0.7	0.7
NH09	Metals and metal alloys such as aluminum, copper, bronze	163.6	218.0
NH10	Ceramic & Glasses	13.4	14.8
NH11	Stone, sand or material that have composition of soil such as tile, brick, gypsum, cement	1.7	2.6
NH12	Mixed waste (This code shall be applied in case wastes are discharged without separation.)	1.5	1.1
NH13	Others	59.9	75.1
Total		471.8	580.5

Table 34: Forecast Generation Amount of General HIW by Type of Waste (2015)

Unit: ton/day

Waste Code	Description of Non-HIW	Generation Amount	
		2009	2015
HW01	Inorganic acid	0.2	0.3
HW02	Organic acid	-	-
HW03	Alkalis	-	-
HW04	Toxic Compounds	2.8	3.6
HW05	Inorganic Compounds	0.2	0.3
HW06	Other Inorganic	-	-
HW07	Organic Compounds	18.9	22.5
HW08	Polymeric Materials	1.0	1.4
HW09	Fuel, Oil and Grease	20.0	27.0
HW10	Fine Chemicals and Biocides	-	-
HW11	Treatment Sludge	20.6	24.9
HW12	Ash from incinerator	0.2	0.3
HW13	Dust and Air pollution control (APC) products	1.0	1.8
HW14	Other Hazardous substance (besides HW01-HW13)	34.4	50.7
HW15	Mixed Waste	14.7	16.9
HW16	Hazardous materials from Non-production process	5.7	7.5
Total		119.7	157.2

As shown in the Table 33:, 72% of the general Non-HIW will be main 3 types of waste, i.e. NH09: Metal Scrap, NH03: Waste Papers and NH04: Waste Plastics. Among the 3 main types of general Non-HIW the highest increase rate is NH09: Metal Scrap, 33.3%, followed by NH04: Waste Plastics, 15.2%.

Factory Code	Type of Industry	Waste Generation in 2009 (ton/day)	Waste Generation in 2015 (ton/day)	Increase Rate (%)
NH09	Metal Scrap	163.6	218.0	33.3
NH03	Waste Papers	120.0	137.2	14.3
NH04	Waste Plastics	54.5	62.8	15.2
-	Other than the above 3 Types of Waste	133.7	162.5	21.5
Total		471.8	580.5	23.1

As shown in the Table 34:, 47.3% of the general HIW will be main 3 types of waste, i.e. HW09: Fuel, Oil and Grease, HW11: Treatment Sludge and HW07: Organic Compounds. Among the 3 main types of general HIW the highest increase rate is HW09: Fuel, Oil and Grease, 353%, followed by HW11: Treatment Sludge, 20.9%.

Factory Code	Type of Industry	Waste Generation in 2009 (ton/day)	Waste Generation in 2015 (ton/day)	Increase Rate (%)
NH09	Metal Scrap	163.6	218.0	33.3
NH03	Waste Papers	120.0	137.2	14.3
NH04	Waste Plastics	54.5	62.8	15.2

-	Other than the above 3 Types of Waste	133.7	162.5	21.5
Total		471.8	580.5	23.1

b. Health-care Waste

The generation amount of health-care waste in 2009 and 2015 is estimated at 391.2 kg/day and 500.5 kg/day, respectively. Health-care waste in 2015 will be generated at 1.3 times the current amount.

Table 35: Forecast Amount of Health-care Waste

Waste Category		Generation Rate	Generation amount	
		g/employee/day	2009	2015
			kg/day	kg/day
Group A	A.1	0.22	26.1	32.8
	A.2	0.00	0.0	0.0
	A.3	0.14	16.3	20.9
	A.4	0.36	42.4	53.6
	A.5	---	---	0.0
Group B		0.38	44.0	56.6
Group C		0.00	0.0	0.0
Group E		0.62	71.7	92.3
Group D		1.64	190.7	244.3
Total		3.36	391.2	500.5

c. Construction Waste

The amount of construction waste generated in 2009 and 2015 is estimated at 36.96 ton/day and 47.54 ton/day, respectively. The amount of construction waste generated in 2015 is estimated to be about 1.3 times the current amount.

Table 36: Generation Amount of Construction Waste according to CONAMA Resolution 307

Class	Class A	Class B	Class C	Class D	Total
Construction Waste Generation in 2009	36.79	0.17	0.00	0.00	36.96
Construction Waste Generation in 2015	47.28	0.26	0.00	0.00	47.54

d. Total Amount of Industrial Waste Generated and IWM Flow in 2015

The following table shows the industrial waste generation amount for 2009 and 2015.

Table 37: The Industrial Waste Generation Amount for 2009 and 2015

Waste		2009	2015
General Industrial Wastes (GIW)		591.5	737.7
	Non-HIW	471.8	580.5
	HIW	119.7	157.2
Health-care Waste		0.4	0.5
Constructions waste		37.0	47.5
Total		628.9	785.7

From the above results, it is estimated that the total generation amount for industrial waste in PIM in 2015 will be 785.7 ton/day.

If current IWM is continued in 2015, IWM flowchart will be shown in the following figure.

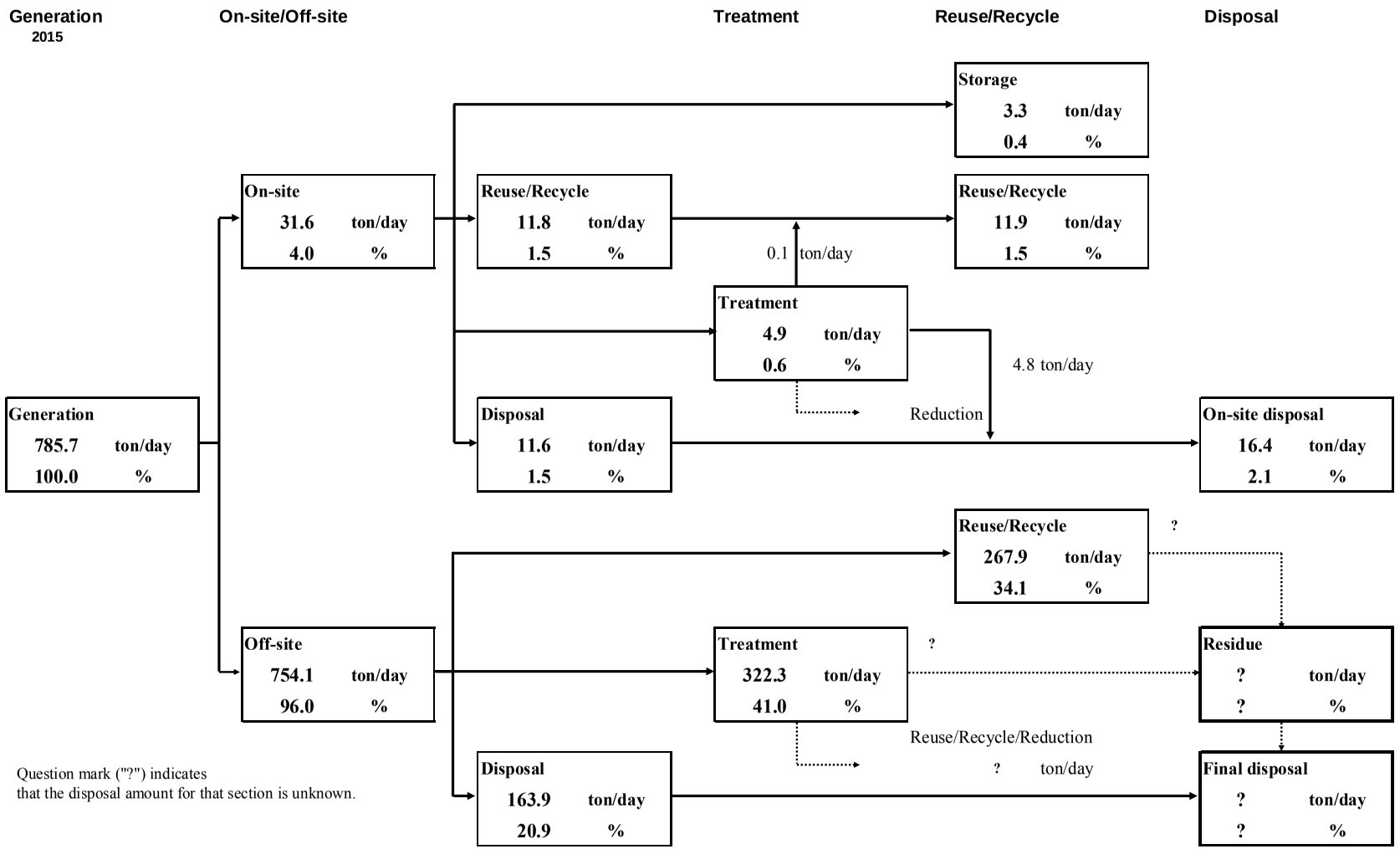


Figure 13: Industrial Waste Treatment and Disposal Flowchart in 2015

4.2 Master Plan

4.2.1 Background of M/P

The rate of reduction in preserved forest area in Amazonas State from 2000-2005 was the lowest amongst all in the Amazon region (0.4%). Further, the area of forest preservation in ratio to that of the entire state is second highest after the State of Amapá (97.9%).

The measures by SUFRAMA to promote PIM have contributed greatly to forest preservation. Yet, the development of PIM has raised concern over environmental degradation due to illegal dumping of industrial waste, etc. The graph below illustrates the situation.

As the PIM developed, the Public Ministry of Amazonas State recognized the existence of environmental deterioration from illegal dumping of industrial wastes, etc. and, on December 21, 2001, called for SUFRAMA to obtain an environmental license for PIM. This caused SUFRAMA and IPAAM to join efforts in creating an environmental conservation plan for PIM, including proper management of industrial wastes, needed to obtain such a license.

SUFRAMA, as the counterpart of this Study, will play the central roll in implementing the proposed M/P. As an organization, SUFRAMA is responsible for granting investment incentives with the aim of realizing socio-economic development by promoting commercial investment, starting with factories, agro-business and others, while also pursuing sustainable management practices to preserve the biodiversity widely found in the Occidental Amazon region.

Therefore, in addition to manufacturers, the M/P proposed in this Study seeks to attract waste service companies that will play a role in environmental preservation and promote proper treatment of waste. The M/P was formulated keeping in mind the concept of further growth of PIM while continuing to promote the preservation of the State's natural environment.

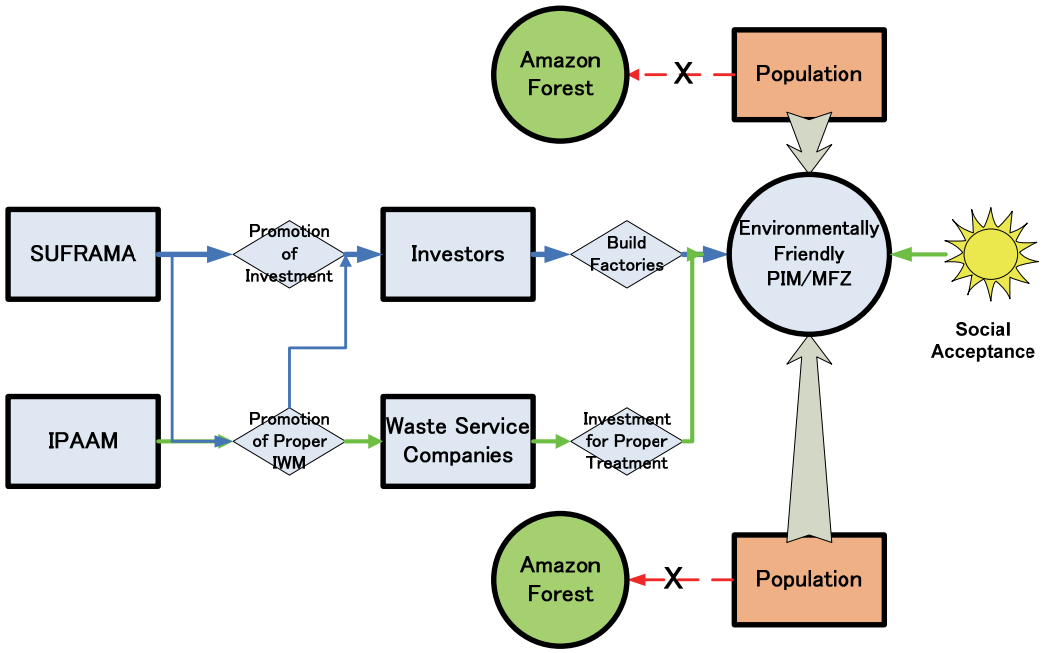


Figure 14: Relationship between PIM and Preservation of the Amazon Forest (After M/P)

4.2.2 Goal

The objective of the Master Plan (M/P) to be formulated in the study is to "Establish an appropriate industrial waste management system" by the target year 2015 for the study area, the Industrial Pole of Manaus (PIM).

Achieving this objective aims to meet the following overall objectives.

- That appropriate treatment and disposal of industrial waste and 3Rs (Reduce, Reuse, Recycle) will be implemented based on the industrial waste management master plan in the study target area.
- Through the appropriate treatment and disposal of industrial waste and implementation of the 3Rs, improper treatment and disposal of industrial waste will decrease and environmental impact will be reduced.

To realize the above conditions, companies, both domestic and foreign, will be encouraged to enter PIM and create new employment opportunities.

4.2.3 Issues to Overcome in order to Achieve Objectives

In order to achieve the M/P objectives, it will be necessary to solve the following issues related to the present system of industrial waste management.

a. Clarification of Industrial Waste Treatment and Disposal Practices

- Further information is needed from dischargers (factories) as well as waste service companies (WSCs) on the destination of residues after intermediate treatment, reuse and recycling. Without such information, it is not possible to clarify all aspects of industrial waste management in PIM (from generation to final disposal).
- The cause, despite the fact that IPAAM requires a waste manifest to be submitted in order to obtain an environmental license, is often a need for clear rules on the documents. Since the dischargers and the waste service companies each use and submit their own in-house forms, it is impossible for IPAAM to aggregate, analyze and manage the information contained in the manifests.
- Every PIM factory in the State of Amazonas must submit a waste inventory (WI). However, nearly 3/4 of factories do not submit WI.

b. Lack of a Landfill with Operation License

- The main final destination for industrial waste generated in PIM is, as of the end of 2009, two landfills; one owned by the municipality of Manaus and the other by a private company. However, neither is in possession of an operation license for the landfill. Since the landfills are the primary final destination for industrial waste generated in PIM, most factories in PIM are unable to satisfy the requirements to obtain ISO 14000.
- The construction and operation of a landfill which has obtained an operation license has been a long-time issue for PIM industrial waste management, but little progress has been made.

- In regards to final destination, co-processing treatments that do not produce a residue are extremely limited.[18]

c. Weak Administration for the Industrial Waste Management System

- More staff is needed for industrial waste management since, as of December 2009, there are no staff at SUFRAMA dedicated to this work[19], and although there are 8 staff at IPAAM, they are responsible not only for industrial waste management but also for environmental licensing management.
- The waste service companies (WSC) registration management system is considered the environmental license system, which needs to be more fully developed.
- Administration is unable to expose non-registered or illegitimate companies so needs a clearer picture of actual conditions related to waste service companies.
- Waste inventories (WI) are submitted, but there is a need to strengthen abilities to analyze and manage them.

d. Poor Business Environment for Industrial Waste Treatment and Disposal

The business environment is very poor to conduct proper industrial waste treatment/disposal due to the following conditions:

- The landfill in Manaus City is used to dispose of a large amount of industrial waste but the disposal fee is currently "free".
- Many WSC which have not obtained an environmental license (non-registered) are disposing waste at extremely low cost.
- The administration is extremely limited in its regulation of non-registered companies and improper treatment and disposal.
- Conditions are such that competition between WSC is fierce and the disposal costs are extremely low. Thus, there are tremendous limits on investment for constructing and operating a proper treatment and disposal facility.
-

4.2.4 Master Plan

An industrial waste management master plan (M/P) has been put together to address how the industrial waste management issues presented in this chapter should be ameliorated.

[18] The sole cement factory, Itautinga, in the Manaus Free Zone treats 5,274 tons of waste per year (ref: WSC Survey). Using the factory's 2005 production output of 627,000 ton/year (Cement Factory Annual Report 2005: Sindicato Nacional da Industria do Cimento 2005), waste treatment (use of waste for cement production) is a mere 0.84% of production. In contrast, the percentage of waste treatment to cement production in Japan is 43.5%.

[19] As of December 2009, the industrial waste management unit has not been officially launched. There are plans to dispatch 3 staff to establish the unit in 2010.

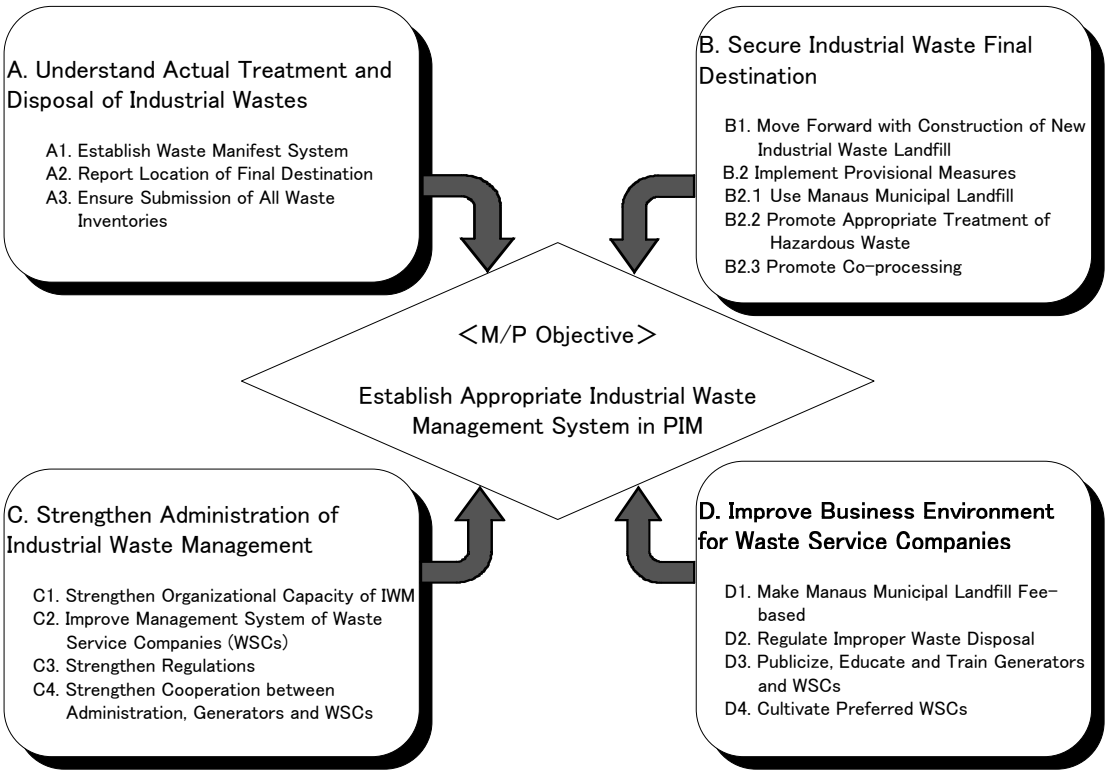


Figure 15: Summary of Master Plan Approach and Measure

Table 38: Summary of Master Plan

Approach & Measures	Objective	Content
Approach A. Understand Actual Treatment and Disposal of Industrial Waste CONAMA Resolution 313 looks toward IPAAM to clarify the full spectrum of treatment /disposal of industrial wastes in the state of Amazonas and formulate an improvement plan. However, this has not yet been executed. Understanding the full spectrum of treatment and disposal of waste generated from PIM is necessary /required for SUFRAMA to obtain an environmental license for DIs (Industrial Districts) as requested by the Public Ministry (PM) of Amazonas State.		
Measure 1. Establish Waste Manifest System	IPAAM understands waste management conditions from factory discharge to final destination and manages it.	IPAAM establishes a set format for a waste manifest in Amazonas State, collaborating with the INEA (State Institute of Environment) of Rio de Janeiro and others. At the same time, work toward putting the waste manifest on-line.
Measure 2. Report Location of Final Destination	Until the manifest system is established, IPAAM will understand and manage the final destination of factory waste.	IPAAM requires generators (factories) to specify the final destination of industrial wastes on the application for operational license. IPAAM requires all waste service companies to specify the final destination of wastes they are contracted to handle.
Measure 3. Ensure Submission of All	IPAAM, in cooperation with SUFRAMA, raises the number of waste inventories submitted	IPAAM, in cooperation with SUFRAMA, constructs a system to manage waste inventories (WI). IPAAM cooperates with related

Waste Inventories	from 1/4th to 100%.	organizations to spread the waste inventory database (WI_DB) developed in the study. IPAAM standardizes the WI reporting form in order to standardize input into WI_DB, and prepare user guidelines. IPAAM instructs factories to appoint a waste management officer that will prepare the waste inventory and submit to IPAAM. IPAAM holds explanatory meetings for how to fill out waste inventories to ensure waste management officers at all factories understand the reporting forms. Furthermore, IPAAM, in cooperation with SUFRAMA, arranges on-line preparation of WI and distributes the same input format to each factory.
Approach B. Secure Industrial Waste Final Destination There are two landfills used as Final Destination for industrial waste generated in PIM, however neither has the proper operation license. Deciding how to secure Final Destinations is a major issue for PIM industrial waste management.		
Measure 1. Move Forward with Construction of New IW Landfill	Construct a new industrial waste disposal site as the primary final destination for industrial waste generated in PIM as soon as possible.	SUFRAMA, IPAAM and Municipality of Manaus cooperate to create a system where waste generators bear the necessary disposal fee for the proper disposal of industrial waste. IPAAM creates an environment that promotes proper treatment and disposal by implementing a policy to eliminate improper disposal and prevent illegal dumping. In addition to beneficial policies in the tax system, SUFRAMA, IPAAM and Municipality of Manaus cooperate to consider subsidies or other funding schemes for the construction of the landfill. When planning the new industrial waste disposal site, IPAAM makes sufficient social and environmental considerations.
Measure 2. Implement Provisional Measures until New Landfill is Operational		
Measure 2.1. Use of Manaus Municipal Landfill	Use Manaus Municipal landfill as Final Destination until the new landfill is operational.	SUFRAMA, IPAAM and FIEAM cooperate to construct a dedicated site for Non-HIW & Non-inert industrial waste at one section of the landfill in the Municipality of Manaus (ATRINI: Non-HIW & Non-inert Temporary Disposal Site). Municipality of Manaus will charge generators a disposal fee for Non-HIW & Non-inert IW, which will be used to cover costs for construction and sustainable operation and management of ATRINI. To promote the construction of ATRINI, SUFRAMA will work with the State Public

		Ministry (PM) to form a TAC (Terms of Agreement of Procedure) with Manaus City, IPAAM and other stakeholders. After the Non-HIW & Non-inert Temporary Disposal Site (ATRINI) is constructed, Manaus City will only dispose of IW at ATRINI, which is strictly separate from the disposal site for municipal waste.
Measure 2.2. Promote Appropriate Treatment of Hazardous Waste	IPAAM indicates measures and promotion methods for the appropriate treatment of hazardous industrial wastes, and instructs waste dischargers and waste service companies on those methods.	Promote co-processing which utilizes waste as fuel and /or raw material, such as treatment at a cement factory. For hazardous industrial waste inappropriate for co-processing, detoxify at an IPAAM approved treatment facility and disposal of residue in ATRINI. For HIW that cannot be treated, it will be taken to a treatment and disposal facility in another state, or properly stored on-site at the factory until a proper facility is prepared in Amazonas State.
Measure 2.3. Promote Co-processing	IPAAM indicates promotion methods for co-processing, which is ideal for appropriate treatment /disposal of industrial waste.	Indicate cement factory treatment methods for industrial waste and the measures necessary to do so. In order to promote cement factory co-processing, it is necessary to foster companies (blenders) that will be able to blend the several kinds of wastes to be accepted by the cement factories.
Approach C. Strengthen Administration of Industrial Waste Management There are personnel and technical vulnerabilities in the current system for IWM centred on IPAAM. Strengthening the administration of this system is a critical issue.		
Measure 1. Strengthen Organizational Capacity of IW Management	Indicate a measure to strengthen IPAAM and SUFRAMA, which are responsible for IWM in Amazonas State.	Appoint an officer in charge of IWM at the Environmental Monitoring Management Section (GMAM) at IPAAM. The IWM officer will work with Information Analysis Management (GEAI) to develop and manage a database in which to enter and manage licenses of waste service companies (WSC_DB). SUFRAMA will establish an Industrial Waste Management Group (IWM Group) and officially appoint IWM officers. The IWM officers, in cooperation with IPAAM, will improve and complete the user guidelines for the waste inventory database (WI_DB) developed in the study. IPAAM, in cooperation with SUFRAMA, analyzes the data in the WI_DB to submit a PIM IWM Report to IBAMA and the State Public Ministry.
Measure 2. Improve Management System of Waste	Know the WSCs holding environmental licenses and the activities therein and indicate a plan to	IPAAM enters WSCs currently using various activity codes under the newly established standardized codes (33 - -) and manage these.

Service Companies	eliminate non-licensed companies and activities.	IPAAM, in cooperation with SUFRAMA, systemizes conditions to obtain a license to operate as waste treatment company. IPAAM instructs WSCs to obtain an operational license for collection and transportation, intermediate treatment, reuse and recycling, and final disposal as appropriate with their actual activities. IPAAM improves and completes the database of WSCs (WSC_DB) and user guidelines developed in the study and enters approved companies' information. IPAAM makes information on these approved WSCs available to waste generators. IPAAM regulates both against generators contracting non-licensed companies and licensed companies conducting inappropriate treatment and disposal activities.
Measure 3. Strengthen Regulations	Indicate measure for regulating inappropriate treatment/disposal.	IPAAM makes use of the database and its licensing and management system to promote regulation against improper treatment/disposal by WSCs. IPAAM promotes regulations against improper treatment/disposal through securing contractual agreements between waste generators and only licensed companies.
Measure 4. Strengthen Cooperation between Administration, Generators and WSCs	Make a measure for administration, generators and waste service companies to collaborate in order to realize the "establishment of appropriate industrial waste management system".	IPAAM, in cooperation with SUFRAMA, promotes cooperation between administration bodies. IPAAM, in cooperation with SUFRAMA and FIEAM, promotes cooperation between administration and waste generators. IPAAM, promotes cooperation between administration and waste service companies. IPAAM, in cooperation with SUFRAMA and FIEAM, strengthens cooperation between administration, generators, and waste service companies (WSCs).
Approach D. Improve Business Environment for Waste Service Companies It is necessary to promptly improve the business environment currently restricting waste service companies and promote the proper treatment and disposal of industrial wastes.		
Measure 1. Make Manaus Municipal Landfill Fee-based	Make the Manaus Municipal landfill, which accepts the largest amount of industrial waste, fee-based by collecting a fee necessary for appropriate disposal.	SUFRAMA in cooperation with IPAAM will work with Manaus Municipality so that a dedicated site for Non-HIW & Non-inert IW can be constructed and make the necessary efforts to achieve construction. Once it is constructed, SUFRAMA and IPAAM will work to ensure that Manaus City strictly manages the site to keep municipal waste separate from Non-HIW & Non-inert IW, and also so that a fee is

		collected to recover the necessary investment and operation costs.
Measure 2. Regulate Improper Waste Disposal	Once the administration prepares a system for IWM, indicate a regulation measure against the improper treatment/disposal for industrial waste generators and WSCs to properly conduct these services.	IPAAM will work with SUFRAMA for waste generators to recognize the need for costs corresponding with proper treatment and disposal. IPAAM will strengthen its regulation against non-licensed entities. IPAAM will strengthen its regulation against improper treatment/disposal by licensed companies.
Measure 3. Publicize, Educate and Train Generators and WSCs	Indicate measure to publicize, educate and train waste generators and WSCs.	IPAAM actively publicizes information on WSCs to waste generators (factories). Also, IPAAM provides training and guidance on technical information to promote the 3Rs in factories. IPAAM holds seminars for WSCs and provide training and guidance on technical information for appropriate treatment and disposal.
Measure 4. Cultivate Preferred Waste Service Companies	Indicate measure to cultivate preferred waste service companies.	IPAAM proactively injects good examples from advanced states such as Sao Paulo and improve the business environment for WSCs. IPAAM considers introducing the system now used by many Prefectures in Japan for “Promotion of Preferred Waste Service Companies”.

4.3 Implementation Plan

4.3.1 Implementation Method

The purpose of the Master Plan (M/P) formulated in this study is to “establish an appropriate industrial waste management system” for the target study area. Also, the target year of the M/P is in 5 years, 2015. Therefore, the improvement plan contained in this report is for improvements to be made over a 5-year period. Here, methods are given for actions to be taken as part of an improvement plan during this 5-year period by the various related organizations, led by SUFRAMA and IPAAM.

a. Improving the administrative system for industrial waste management

There are a variety of issues surrounding industrial waste management in PIM. A certain amount of time will be required to resolve each of these issues, and according to each issue, a variety of procedures will need to be applied. As a first step, the study team suggests assigning priority to each issue in which to proceed with improvements.

The top priority is improving the administrative management system, for the reasons given below.

- The laws and regulations necessary to realize the "establishment of an appropriate industrial waste management system" are already in place. However, under the present industrial waste management system in the study area, these laws and regulations are not properly observed, and therefore, addressing improper waste disposal has been neglected.
- A large contributor to this problem is that the administrative management system has not been reinforced to ensure the observance of laws and regulations. One example of this is, although there is a registration system for waste service companies according to the environmental licensing system, circumstances are such that the organization (IPAAM) that manages waste service companies, can not even confirm the number of such companies in the Amazonas State.
- Without understanding how many waste service companies there are, or what activities they are conducting, it is impossible to establish an appropriate industrial waste management system. Namely, this makes it impossible to eliminate improper disposal or companies that have not obtained an environmental license (non-licensed companies).

After improving the administrative system, reinforcing the law enforcement system and eliminating improper disposal and Non-Licensed companies should come next.

The following is a list of administrative management system improvements that should be made, in order of priority.

1. Making use of the waste service company database (WSC_DB) developed in the study, construct a system to manage registration of WSCs.
2. Making use of the waste inventory database (WI_DB) developed in the study, have a firm understanding of actual waste management at generation sources (i.e. factories).
3. Have a firm understanding of actual waste disposal after it is discharged by stepping up the Waste Manifest System (WMS).
4. In order to carry out the above, strengthen the administrative organizations, IPAAM and SUFRAMA, and revise the legal rules and technical capabilities in order to make them coherent with the innovations.

For "the establishment of an appropriate industrial waste management system", the relationship between improving the administrative system for industrial waste management and legal enforcement is shown in the following figure.

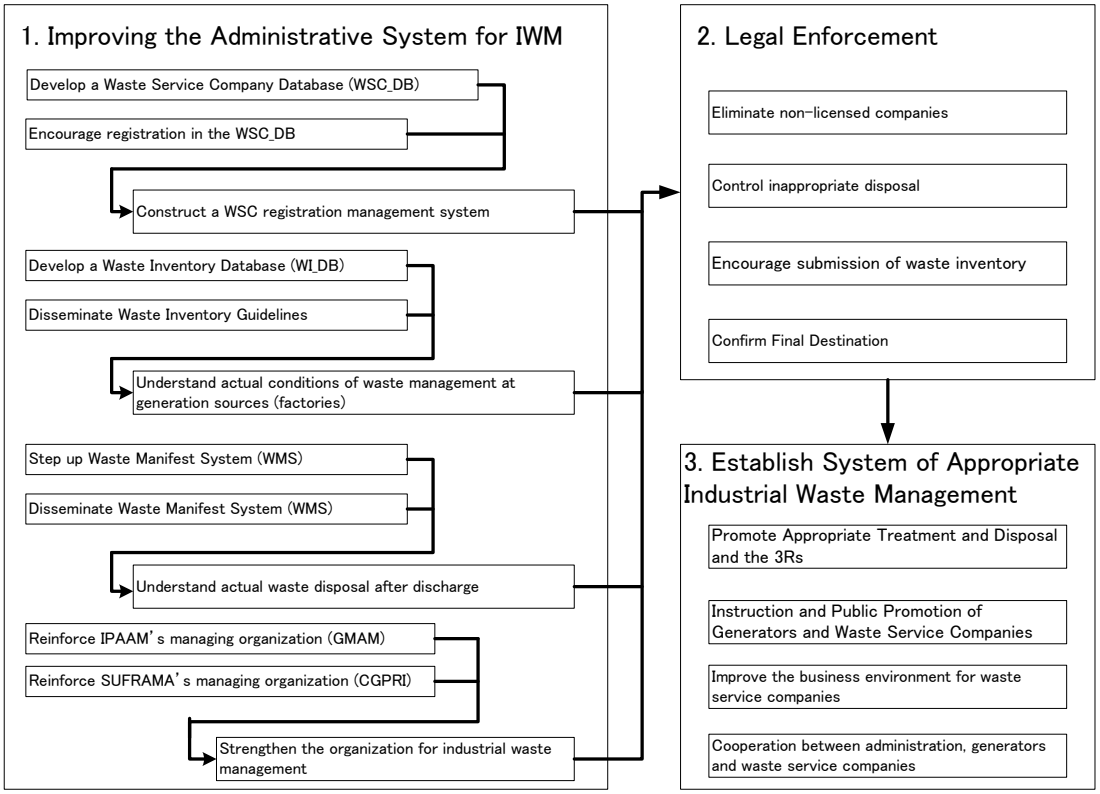


Figure 16: Improving the Administrative System of IWM and Establishing a System for Appropriate IWM

b. Legal Enforcement

As written above, once the administrative system for industrial waste management is improved, it is necessary to strengthen the enforcement of laws and regulations and provide guidance to generators of industrial waste and the waste service companies enlisted to dispose of that waste appropriately. It will be worth demonstrating to business entities the environmental responsibility of the wastes Generator, Transporter and Receptor; and why the integrated information and control system recommended herein facilitate the definition of their responsibilities.

b.1 Elimination of Non-Licensed Companies

Non-licensed companies can mainly be classified into two categories.

1. Those carrying out waste related services without having obtained an environmental license
2. Those which have obtained an environmental license, but are carrying out activities other than those for which they are licensed.

Under the current conditions, in which there is insufficient understanding of how many licensed waste service companies there are, what activities they are licensed for and what activities they are actually engaged in, it is very difficult to eliminate non-licensed companies. It is recommended that, to ameliorate these conditions, IPAAM eliminate Non-Licensed companies (including those conducting activities other than those for which they are licensed), by following the steps below.

1. Immediately make the waste service company registration management system developed in this study a legal requirement and require companies to obtain an operation license for waste services as a condition to engaging in waste related services.
2. Then, instruct those companies currently conducting waste services which have obtained an environmental license[20] to acquire an operation license according to their activities, for collection and transportation, intermediate treatment, recycling or final disposal, respectively. IPAAM will grant a specific license for each activity so that the general licenses are no longer too varied; such criteria may be very useful when renewing the license.
3. When approving the operation licenses, any discrepancy between the activities applied for and actual activities are confirmed. The approved companies should be registered in the waste services companies data base (WSC_DB) developed in this study, according to the guidelines of the WSC_DB, and the information registered about the WSC should be made public.
4. By publicizing information about these WSCs, waste generators will have access to the basic information they'll need, such as which companies have a license and what activities they are licensed to conduct. In addition, IPAAM shall remind the waste generators that the main responsibility of proper IWM lies with them, whereas the transporter/receptor has only joint responsibility. Also the generator, as well as the environmental authority, must audit IW disposal activities of the transporter/receptor.
5. Providing waste generators with information about sound operators they can hire will push out both non-licensed companies and those conducting non-licensed activities. At the same time, non-licensed companies conducting waste services without an environmental license[21] will be instructed to acquire the appropriate license.

The data on waste service companies entered in March 2010 into the WSC_DB, developed in this study, is that of the 67 companies which were confirmed in the survey of waste service companies to have operational licenses. In addition, the data entered concerning the activities of those 67 companies are not the activities they are licensed for, but the actual activities they are undertaking. Accordingly, once IPAAM establishes its license/registration system, it will be necessary to promptly instruct those companies to obtain licenses in compliance with their actual activities.

The above-mentioned procedure is summarized in the following figure.

[20] 67 such companies were identified in the survey of waste service companies.
[21] 23 such companies were identified in the survey of waste service companies.

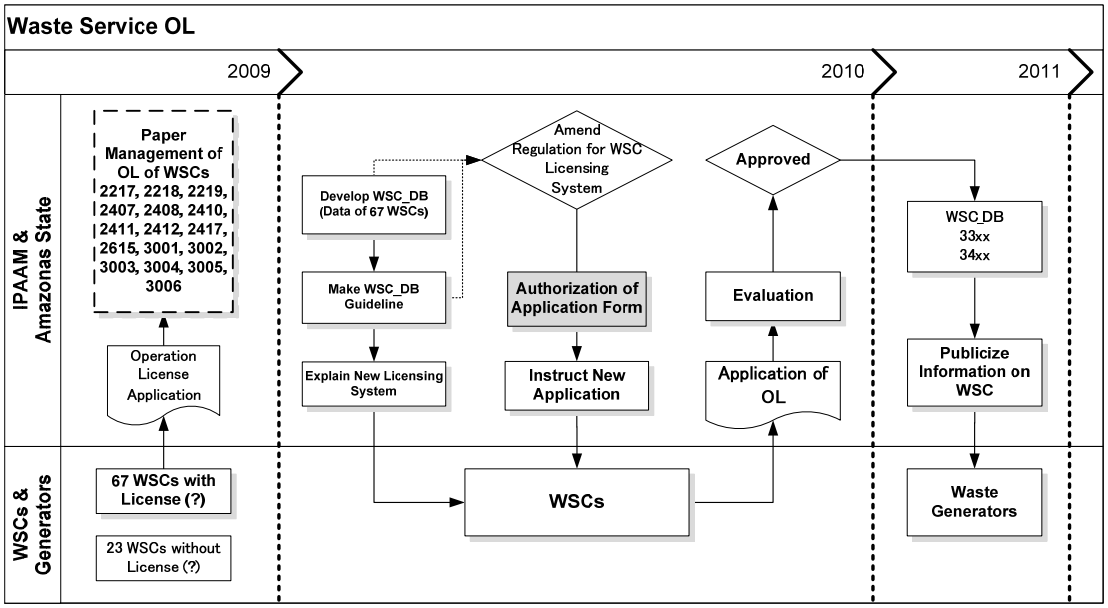


Figure 17: Proposed Schedule of Establishment of WSC_DB

b.2 Controlling Inappropriate Disposal

By eliminating non-licensed companies and non-licensed activities through the above procedures, it is possible to focus on monitoring the activities of companies that have acquired licenses for collection and transportation, intermediate treatment, recycling and final disposal, respectively. Accordingly, IPAAM will be able to check whether companies that have obtained operation licenses are conducting business according to the appropriate standards and carry out regular monitoring activities to control improper treatment and disposal. Nevertheless, IPAAM should retain surveillance over any kind of landfill in order to avoid the dumping of improper wastes and make sure the corresponding manifest is being used.

It is equally important to monitor the companies which co-process industrial wastes into usable construction-related products, in bulk or not. This will assist in preventing those companies from utilizing wastes or processes different from those for which they are licensed, and ensure the correct use of the manifests.

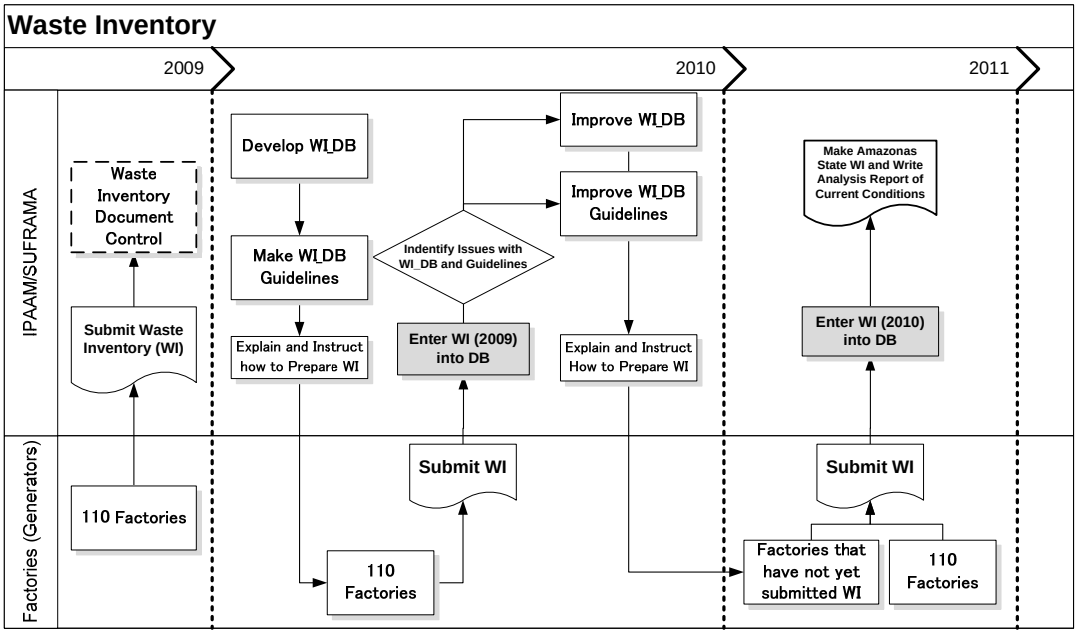
b.3 Encourage Submission of Waste Inventory

In accordance with CONAMA Resolution 313, in the State of Amazonas, all PIM factories are required to submit a waste inventory. However, only about 1/4 of the factories have complied with submitting their waste inventory. Meanwhile, IPAAM and SUFRAMA have made little progress in analyzing the waste inventories which have been submitted. Therefore, they have not yet submitted a report on waste inventories to the Brazilian Institute for the environment and Renewable Natural Resources (IBAMA)[22]. Based on these conditions, it is recommended that IPAAM and SUFRAMA follow the steps given below to encourage factories to submit the waste inventories.

[22] CONAMA Resolution 313, Article 6 obligates the environmental agency in each state to submit the report.

1. In order to encourage the submission of waste inventories, the first step is to put a system in place to aggregate and analyze them in order to gauge the current conditions of industrial waste management and formulate an improvement plan, as required by CONAMA Resolution 313.
2. To do so, guidelines were written to instruct how data will be entered in a uniform fashion into a waste inventory database (WI_DB), developed in this study.
3. In order to analyze the aggregated data from the waste inventories entered into the WI_DB to understand current conditions on industrial waste management in PIM, it is essential to standardize the data entry methods. To do so, it is presumed that the person at each factory in charge of writing the waste inventory will collaborate in producing the inventory and have a good understanding of how to fill out the forms. Therefore, a certain amount of time will be necessary until the uniform data input is achieved for all PIM factories.
4. A number of improvements will need to be made to the WI_DB and related guidelines developed in this study in order to sufficiently comply with the requirements of CONAMA Resolution 313. IPAAM/SUFRAMA will first focus on the factories that submitted waste inventories in 200923, provide them with guidance concerning how to write the inventory for the WI_DB format, and then analyze the inventories that are submitted. This process will clarify any issues related to factories properly making the WI so that the WI_DB and guidelines can be improved. In other words, this will improve the WI_DB and guidelines developed in this study for data on actual conditions at PIM factories.
5. After the improvement of them, public information and guidance will be provided for all PIM factories so that the waste inventories will be submitted.
6. SUFRAMA should require companies, in the requirements to receive tax benefits, to link to the respective DB and the manifests system, as well as to submit a Wastes Management Plan.

[23] In 2008 110 factories have submitted.



WI (Waste Inventory), **WI_DB** (Waste Inventory Database)

Figure 18: Promote Submission of Waste Inventories

b.4 Confirm Final Destination

In order to "establish a system for appropriate industrial waste management", it is necessary to construct a tracking system that ensures wastes are properly treated and disposed of after being discharged from the generation source until they reach their final destination. To do so, IPAAM requires a waste manifest be submitted when granting environmental (operation) licenses. However, no specific format or system has been designated so tracking efforts have not been established satisfactorily. In order to confirm proper treatment and disposal until final destination, it is recommended that IPAAM uses the following measures.

1. Immediately establish and normalize waste manifest documents and a system for the State of Amazonas.
2. Until the documents and system are established and normalized, in order to clarify responsibility of the factories which discharge wastes, and for their own legal protection, instruct them to demand that the collector submit the waste destination certificate together with the respective units of measurement (in weight).
3. Once the documents and system are ready, instruct all related parties, from the generator to final destination, to submit the waste manifest documents.

The Wastes Manifest System (WMS) should include both public and private entities which generate or receive wastes, with the exception of municipal wastes.

4.3.2 Implementation Plan

The implementation plan for the Master Plan (M/P) formulated in this study is summarized in the table at the end of this section.

SUFRAMA and IPAAM, as the counterpart organizations of this study which will implement the M/P, will consign the technical system of industrial waste management, namely the provision of facilities and equipment needed for treatment and disposal, to private interests. Accordingly, the M/P notes the appropriate components for the technical system to be provided by the private sector and puts the management system of the administration at the heart of providing guidance to correctly manage its operation and maintenance.

Based on this basic idea of the M/P, the implementation plan gives preference to the provision of the administration's management system. Furthermore, in this study, the following tools, which are seen as essential to develop the management system, were developed by the end of May 2010 and transferred to the appropriate organization:

- Development of a Waste Service Company Database (WSC_DB) as a tool to organize and manage waste service companies, as well as WSC_DB operation guidelines.
- Development of a Waste Inventory Database (WI_DB) to grasp the actual conditions of industrial waste management at generation sources (factories), as well as WI_DB operation guidelines.

Therefore, the first step of preparing the administration's management system has already begun. Furthermore, other parts of the M/P have also been initiated already. Moreover, particular issues which will require extra attention in the implementation plan (as shown in the figure below) are outlined, taking into consideration progress that has been made already in some areas.

a. (A) Understand Actual Treatment and Disposal of Industrial Waste

a.1 Measure 1) Establish Waste Manifest System

IPAAM will deal with the following based on the recommendations for the M/P

- Establish a standard format and system for the waste manifest in Amazonas State by the end of the year 2010.
- Plan the development of the online waste manifest, making use of the PROSAMIM budget. With that, the online waste manifest system is to be developed in the year 2011.

a.2 Measure 2) Report Location of Final Destination

As above, after a waste manifest system (WMS) for Amazonas State is formulated in 2010, the new system will make it possible to verify the site of final destination in 2011.

a.3 Measure 3) Obtain Complete Records of Submitted Waste Inventories

A trial test of the WI_DB system was conducted in May 2010. Based on the results of this trial, IPAAM will work with SUFRAMA to improve the WI_DB system and users guide from early 2011 and finalize them. Then, all PIM factories will be asked to make their waste inventories according to the WI_DB system and be submitted.

b. (B) Secure Industrial Waste Final Destination

b.1 Measure 1) Move Forward with Construction of New Industrial Waste Landfill

In relation to the introduction of a fee-based system at Manaus City Landfill, In January 2010 the Municipality of Manaus established the Municipal Law on Urban Cleansing Services (No. 1411, January 20, 2010). This law makes it possible to charge a higher fee for most

industrial wastes than for municipal waste[24]. Consequently, this prepares the conditions for private companies to invest in the construction of a new industrial waste landfill.

According to IPAAM, the environmental study for non-hazardous (Class II) waste has been completed and private companies are now preparing to hold a public hearing. Therefore, this implementation plan calls for the new industrial landfill plans to be approved in 2011, complete construction in 2012 and begin operations in 2013.

b.2 Measure 2) Implement Provisional Measures until New Landfill is Operational

b.2.1. Measure 2.1) Use of Manaus Municipal Landfill

According to IPAAM, at the end of June 2010, a committee was established comprised of IPAAM, SEMMA, the Municipal Urbanization Department of Manaus, the Airport Authority, and others, to consider the possibility of constructing a dedicated section for non-hazardous, non-inert industrial waste (ATRINI). ATRINI will be constructed based on the decision of this committee.

The plan shows that ATRINI would begin operations in mid-2011, and once the private landfill mentioned above begins operations, ATRINI would be closed in early 2013. It will be necessary to rectify these plans as fit according to their respective progress.

b.2.2. Measure 2.2) Promote Appropriate Treatment of Hazardous Waste

The measures to appropriately treat hazardous wastes were formulated by the study team with the support of the C/P, taking into consideration current conditions of treating industrial waste in Manaus. Based on these measures, IPAAM will formulate a plan for the appropriate treatment of hazardous wastes with special attention to current conditions. However, to implement the plan, first IPAAM must enforce the waste service companies (WSC) licensing management system and ensure that all WSCs obtain the proper license, therefore bringing sufficient transparency to what services are actually being performed.

b.2.3. Measure 2.3) Promote Co-processing

The process to promote co-processing is similar to the promotion of appropriate treatment of hazardous waste, above.

c. Strengthen Administration of Industrial Waste Management

c.1 Measure 1) Strengthen Industrial Waste Management Organizations

Measures to strengthen IPAAM and SUFRMA, the main organizations managing industrial waste, is already underway, to be completed in 2010.

c.2 Measure 2) Improve Management System of Waste Service Companies

The most important item to improve the management system of waste service companies is to firmly establish the system to register WSCs. This is best done as soon as possible, but the State Legislature will vote in October 2010, so the plan calls for this system to be established

[24] This is an impressively large law containing 198 provisions and is primarily concerned with the overall municipal cleansing services. The specifics of these provisions will take time before they are finalized, but it has been decided that a fee-based system will be introduced for the collection and disposal services of municipal waste. Furthermore, some wastes will be designated not as municipal waste but as large volume or special waste: 50 liters or more per day of non-hazardous, inert (Class 2-B) waste, 200 liters/day or more of non-hazardous non-inert (Class 2-A) waste, and hazardous (Class I) waste. In those cases, a city-approved waste service company will be able to charge a higher fee than for municipal waste.

sometime in 2011. Once the system is in place, the WSC_DB will be constructed immediately and certain information about the licensed companies will be made public.

c.3 Measure 3) Strengthen Regulations

Once the information on WSCs is made public, IPAAM will put regulations in place to deal with non-licensed companies, as well as licensed companies which carry out improper waste disposal. Furthermore, IPAAM will work with SUFRAMA, FIEAM and others to regulate waste generators against outsourcing to non-licensed companies.

c.4 Measure 4) Strengthen Cooperation between Administration, Generators and Waste Service Companies

The measures recommended by the Study Team to strengthen cooperation between administration, generators and WSCs were formulated with the counterpart, taking into consideration the current conditions in Manaus. Based on this policy, IPAAM will discuss with related organizations the need to establish (1) a Coordination Committee for Proper Industrial Waste Management Promotion and (2) a Proper Industrial Waste Management Promotion Committee sometime in 2011 to act as the center for these relations.

d. Improve Business Environment for Waste Service Companies

d.1 Measure 1) Make Manaus Municipal Landfill Fee-based

As mentioned above, based on the Municipal Law on Urban Cleansing Services, the Municipality of Manaus is currently deciding the details supporting the provisions, establishing a city landfill fee, and selecting collection and disposal services for large volume and special wastes which will be treated as industrial waste. It is assumed that these decisions will be completed in 2010 and that the municipal landfill can introduce a fee-based system in 2011. It will be necessary to rectify these plans as necessary based on the progress of other plans, such as the construction of ATRINI.

d.2 Measure 2) Regulate Improper Waste Disposal

Until improper waste disposal is sufficiently regulated, both waste generators and waste service companies will need to be informed and instructed on the necessity for proper disposal and the details of the WSC licensing management system. On that basis, improper waste disposal will be regulated.

d.3 Measure 3) Inform, Educate and Train Generators and WSCs

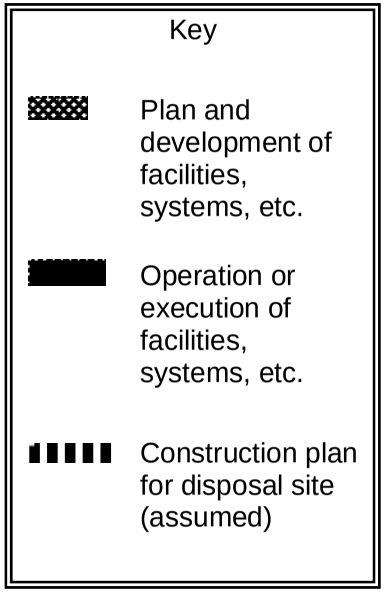
IPAAM will need to develop itself as an organization to inform, educate and train generators and WSCs on industrial waste management. On that basis, they will formulate a plan to carry out these tasks and develop the information, education and training tools needed, and then carry out the plan.

d.4 Measure 4) Cultivate Preferred Waste Service Companies

The first step to cultivate preferred waste service companies is to properly understand the good examples of waste management which currently exist in Brazil. On that basis, a plan to cultivate preferred WSCs will be formulated and carried out. When formulating the plan, consideration should be given to the good examples from Brazil and Japan introduced during the study.

Table 39: Implementation Plan

Notation	Implementation Plan	Activities	Executing Organization	Year 2010	2011	2012	2013	2014	2015
A. Understand Actual Treatment and Disposal of Industrial Waste									
A.1	Establish Waste Manifest System	Establish a standard format and system	IPAAM						
		Implement new waste manifest system (WMS)	IPAAM						
		Develop online WMS	IPAAM, INEA, etc.						
		Implement online WMS	IPAAM, INEA, etc.						
		Verify final destination through the operation licenses (OL) of generato	IPAAM, Generators						
A.2	Report Location of Final Destination	Verify final destination through OL of WSCs	IPAAM, WSC						
		Verify final desination through new WMS	IPAAM						
A.3	Obtain Complete Records of Submitted Waste Inventories	Develop the Waste Inventory Database (WI_DB) system	JICA Study Team, C/P						
		Test the WI_DB system	IPAAM, SUFRAMA						
		Improve and finalize the WI_DB system and users guide	IPAAM, SUFRAMA						
		Full implementation of the WI_DB system	IPAAM						
		Understand conditions of IWM for the State, and make report	IPAAM, SUFRAMA						
		Formulate State waste management plan	IPAAM						
B. Secure Industrial Waste Final Destination									
B.1	Move Forward with Construction of New Industrial Waste Landfill	Explore introduction of fee-based system at Manaus Municipal landfill	Municipality of Manaus						
		Introduce fee-based system at Manaus Municipal landfill	Municipality of Manaus						
		Explore options to assist in the contruction of new landfill	SUFRAMA, IPAAM, etc						
		Establish measures to prevent improper disposal and illegal dumping	IPAAM						
		Plan the new industrial waste landfill	Private Enterprise, IPAAM						
		Construct the new industrial waste landfill	Private Enterprise						
		Operate new landfill	Private Enterprise						
B.2 Implement Provisional Measures until New Landfill is Operational									
B.2.1	Use of Manaus Municipal Landfill	Plan section for non-hazardous non-inert industrial waste (ATRINI)	Municipality of Manaus, IPAAM, etc.						
		Construct ATRINI	Municipality of Manaus						
		Operate ATRINI	Municipality of Manaus						
B.2.2	Promote Appropirate Treatment of Hazardous Waste	Formulate policy for appropriate treatment of hazardous wastes	JICA Study Team, IPAAM						
		Formulate plan to promote appropriate treatment of hazardous wastes	IPAAM						
		Implement plan to promote appropriate treatment of hazardous wastes	IPAAM						
B.2.3	Promote Co-processing	Formulate policy to promote co-processing	JICA Study Team, SUFRAMA, IPAAM						
		Formulate plan to promote co-processing	IPAAM						
		Implement co-processing promotion plan	IPAAM						
C. Strengthen Industrial Waste Management System of Waste Service Companies (WSC)									
C.1	Strengthen Industrial Waste Management Organizations	Formulate policy to strengthen IWM organizations	JICA Study Team, IPAAM, SUFRAMA						
		Strengthen IPAAM's system for IWM	IPAAM						
		Strengthen SUFRAMA's system for IWM	SUFRAMA						
		Enforce industrial waste management	IPAAM, SUFRAMA, etc.						
C.2	Improve Management System of Waste Service Companies	Develop WSC licensing management system and database (WSC_DB)	JICA Study Team, IPAAM						
		Establish WSC licensing management system	IPAAM, etc.						
		Implement WSC licensing management system	IPAAM						
		Construct WSC_DB and publicize WSC information	IPAAM						
C.3	Strengthen Regulations	Regulate improper disposal activities by licensed/non-licensed WSCs	IPAAM						
		Regulate against outsourcing to non-licensed companies	IPAAM, SUFRAMA, FIEAM						
C.4	Strengthen Cooperation between Administration(A), Generators(G) and Waste Service Companies(WSC)	Formulate policy to strengthen cooperation between A, G and WSCs	JICA Study Team, IPAAM						
		Establish Coordination Committee for Proper IWM Promotion	IPAAM, SUFRAMA, FIEAM, etc.						
		Establish Proper IWM Promotion Committee	IPAAM, SUFRAMA, FIEAM, Factories,WSC, etc.						
		Implement policy to strengthen coordination between A, G and WSCs	IPAAM, SUFRAMA, FIEAM, Factories, WSC, etc.						
D. Improve Business Environment for Waste Service Companies									
D.1	Make Manaus Municipal Landfill Fee-based	Make preparations to introduce fee at Manaus Municipal landfill	Municipality of Manaus						
		Make Manaus Municipal landfill fee-based	Municipality of Manaus, etc.						
D.2	Regulate Improper Waste Disposal	Inform and educate waste generators	IPAAM, SUFRAMA						
		Inform and educate waste service companies	IPAAM						
		Strict oversight of improper disposal by licensed/non-licensed WSCs	IPAAM						
D.3	Inform, Educate and Train Generators and WSCs	Strengthen IPAAM's IWM system	IPAAM						
		Formulate plan to inform, educate & train generators and WSCs	IPAAM						
		Implement plan to inform, educate & train generators and WSCs	IPAAM						
D.4	Cultivate Preferred Waste Service Companies	Study the good examples of advanced States	JICA Study Team, IPAAM						
		Formulate plan to cultivate preferred WSCs	IPAAM						
		Implement plan to cultivate preferred WSCs	IPAAM						



4.3.3 Project Evaluation

The following section is analysis of the results expected with the implementation of the Master Plan (M/P).

a. Expansion of the Market for Industrial Waste Treatment

Assuming these conditions continue, the Master Plan formulated in this study estimates the following generation, treatment and disposal amounts for PIM industrial waste in the year 2015.

Table 40: Amount of PIM IW Generated, Treated and Disposed of in 2015

Item	Non-HIW		HIW		All Industrial Waste	
	Amount (Ton/Day)	%	Amount (Ton/Day)	%	Amount (Ton/Day)	%
Generation Amount	628.2	-	157.5	-	785.7	-
On-site Treatment and Disposal	26.2	4.2	5.4	3.4	31.6	4.0
Reuse/Recycle	8.1	1.3	3.8	2.4	11.9	1.5
On-site Storage	2.9	0.5	0.4	0.3	3.3	0.4
On-site Disposal	15.2	2.4	1.2	0.8	16.4	2.1
Off-site Treatment and Disposal	602.0	95.8	152.1	96.6	754.1	96.0
Reuse/Recycle by Contractor	238.3	37.9	29.6	18.8	267.9	34.1
Intermediate Treatment by Contractor	227.8	36.3	94.5	60.0	322.3	41.0
Direct disposal of at landfill	135.9	21.6	28.0	17.8	163.9	20.9

Based on the results of future estimation, the amount of industrial waste taken to the landfill in 2015 will be approximately 163.9 ton/day, or about 60,000 ton/year.

Meanwhile, the M/P proposes that Non-HIW & Non-inert IW is no longer brought to the landfill for municipal waste. Also, it proposes that HIW is reduced or detoxified through intermediate treatment, such as co-processing, or through reuse /recycling and intermediate treatment, and the residues disposed of at Non-HIW & Non-inert IW landfill.

The M/P aims to build a system of appropriate regulation and management for IW treatment and disposal, as is currently implemented in advanced states such as Sao Paulo, and in addition to that, to cultivate waste service companies that will carry out appropriate treatment and disposal of industrial wastes.

With that, the following table is an estimate of the industrial waste final disposal market in PIM in 2015, based on the current final disposal fees (not including collection and transportation costs) for Non-HIW and HIW at the industrial waste landfill in Sao Paulo State (not including intermediate treatment).

Table 41: PIM 2015 Market Scale for IW Disposal

	Amount (Ton/Day)	Annual Disposal (Ton/Year)	Disposal Fee (Real/Ton)	Total Market Size (Based on Fee) (Real/Year)
Non-HIW	135.9	49,603.5	100[*1]	4,960,350
HIW	28.0	10,220.0	250[*2]	2,555,000
Total Industrial Wastes	163.9	59,823.5	-	7,515,350

[*1] 100 Real/ton is the median disposal fee of 80 – 120 Real/ton charged for Non-HIW in Sao Paulo State.

[*2] 250 Real/ton is applied for the HIW disposal fee in Sao Paulo State.

The market scale for industrial waste disposal in the Industrial Pole of Manaus in 2015, based on fees, is estimated to be about 7.5 million Real per year.

Actually, it is also possible that part of industrial waste (e.g. Residues from treatment) currently contracted to reuse/recycling companies and intermediate treatment companies could be taken to the new landfill (which is 215,423 tons/year, about 3.6 times the 59,824 tons/year of landfill waste), if management and regulation for the proper treatment and disposal of industrial waste are strengthened, and companies conducting improper activities are eliminated through careful implementation of the M/P.

b. Expansion of Potential to Attract "High Value-Added Industry" and "Export Industry" to the Industrial Pole of Manaus through Appropriate Industrial Waste Management System and the Provision of Infrastructure for Treatment and Disposal

In order for the Industrial Pole of Manaus to be an important center of economical and industrial activity that supports the social and economic development of the Amazonas State, it must produce higher economic profits by providing industrial infrastructure that can attract "high value-added industries" such as high-tech/IT equipment, and form connections to the international market by attracting the "export industry".

The high value-added "high-tech/IT industry", symbolized by the semiconductor industry, uses a number of chemical substances and rare metals in its manufacturing process and produces wastes in the form of waste oil, solvents and sludge, which includes materials containing hazardous properties. Thus, there is the possibility that preparing the environmental infrastructure to properly treat and disposal of these types of wastes is an important condition in factory location for these high-tech industries.

The exporting industry, which targets the international market, particularly in industries targeting export to advanced countries in the OECD, contains strict environmental policy obligations based on bilateral free trade agreements, ISO14001 and so forth for the production and manufacturing processes, which includes the proper treatment and disposal of wastes. In these exporting industries, since locating a factory in a region that does not guarantee the proper treatment and disposal of industrial waste is a huge risk, it is a critical requirement for those who hope to attract these industries to prepare a proper waste management system and the infrastructure for treatment and disposal.

This point was considered in the M/P formulated in this study by promoting a proper industrial waste management system and provisions for treatment and disposal infrastructure

in PIM. This will contribute to greatly increasing the potential to attract industry with greater economic profit.

c. Improvement of Production Efficiency through Waste Reduction Efforts (Efficiency of Resource and Energy Usage)

Implementing the M/P and reinforcing industrial waste management, waste generators, starting with factories, will have to bear an additional cost for the proper treatment and disposal of waste to act in accordance with standards prescribed in the regulations. In Manaus, where the current cost burden is zero, it may be possible to implement a burden of 100 – 250 Real per ton as currently charged in Sao Paulo City. To do so, it is likely that waste generators will have to be strongly motivated to reduce or minimize their wastes as much as possible.

However, reducing or minimizing wastes produces the merits of raising material and energy efficiency in the manufacturing process, improving production and reducing costs, so they may make the efforts to this effect. Furthermore, it is possible to establish a stable operation foundation that can withstand price fluctuations in materials and energy, and changes in product demand.

As the M/P recommends, if the factories and businesses located in PIM are strongly motivated to control the generation of waste, this could lead to opportunities to increase factory production. In this regard, as was historically proven in Japan in the past, when the country's industries improved their production efficiency and reduced production costs, it was able to surpass the critical risk factors such as rising oil prices and currency appreciation.

As one of the BRIC emerging economies, Brazil is expected to lead the world's economic future and form a powerful industrial infrastructure based on resource and energy efficiency on par with the developed countries, which is essential to ensure sustainable future development.

4.3.4 Guidelines to Improve Industrial Waste Management in PIM

The guidelines for improving industrial waste management in PIM are available in the Supporting Report, Chapter 5. A summary of the guidelines is given here.

a. Guideline Objectives

The aim of the guidelines is to support the Master Plan objective to "establish an appropriate industrial waste management system in the Industrial Pole of Manaus (PIM)". To achieve this objective, the 3 entities of Generators, Receptors and Administrators shall achieve the following requirements:

1. Establish a management system for industrial waste Generators: Establish an appropriate management system at generation sources (such as factories) for dischargers of industrial waste.
2. Establish a management system for industrial waste service companies, i.e. Receptors: Establish an appropriate management system for industrial waste that has been discharged for waste service companies.
3. Establish a management system for industrial waste Administrators: Establish the administrative system for industrial waste management to promote, guide, monitor

and regulate proper management for dischargers of industrial waste and waste service companies.

b. Composition of the Guidelines

The management system for industrial wastes is composed largely of three actors: the waste generators, waste service companies and administrators. In order to establish this system, administrators, taking the central position, require the tools to properly manage it. Thus, to succeed in "establishing an appropriate industrial waste management system in the Industrial Pole of Manaus (PIM), the 3 tools included in the Master Plan must be applied to their maximum utility.

1. Waste Inventory Database System (WI_DB System)
2. Waste Service Company Database System (WSC_DB System)
3. Waste Manifest System (WM System)

The following figure shows the relationship of the three actors and these three tools, with Administrators at the center.

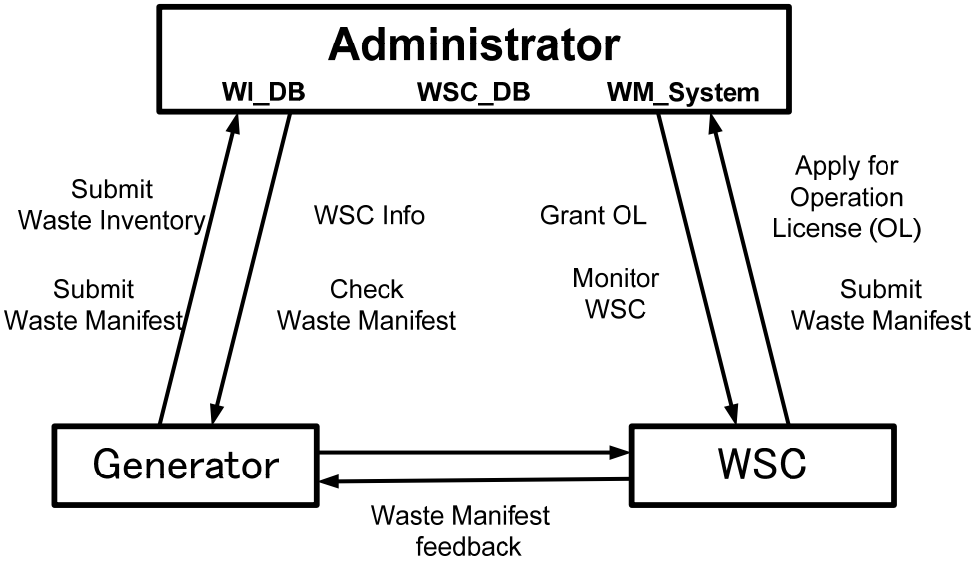


Figure 19: Interaction between Administrators, Generators and Receptors to implement industrial waste management

Of the three tools given above, the WI_DB System and WSC_DB System were developed during the study by the Japanese Experts in cooperation with counterparts at IPAAM and SUFRAMA, whereas IPAAM is currently working on developing the Waste Manifest System.

These guidelines are meant to promote the improvement of industrial waste management through the effective use of these tools by waste dischargers, waste service companies (WSC) and administration. The guidelines are composed as shown below:

1. The management of industrial waste by the three parties (Generators, Waste Service Companies and Administrators), as well as items common to the three tools
2. Guidelines for waste dischargers

3. Guidelines for WSCs
4. Guidelines for administrative entities

These guidelines were formulated for the PIM factories that discharge industrial waste in the target study area, the waste service companies (WSCs) which handle the discharged waste, and the administration that handles overall industrial waste management. However, they were created as much as possible so that they may serve as reference material for other industrial complexes or areas where factories are concentrated. Accordingly, stakeholder organizations such as SUFRAMA or the Ministry of Environment, are expected to share these results with elated organizations, such as industrial groups and so forth, nationwide.

5 Recommendations

The purpose of the Master Plan (M/P) formulated in this study is to "establish an appropriate industrial waste management system" for the target study area in 5 years, in the year 2015. This is a highly ambitious timeframe to achieve this plan, and thus a number of difficult issues will need to be solved in order to implement it. The JICA Study Team offers the following recommendations concerning how related organizations should approach solving those issues.

5.1.1 Use of Waste Inventory

a. Effectiveness in using the Waste Inventory

Through the proper completion of the waste inventory (WI), and aggregation, analysis and management of the data, CONAMA Resolution 313 aims to effectuate the following outcomes in relation to related stakeholders.

Generators (Factories):

Factories are able to grasp actual on-site management conditions of all waste generated from factory activities and to bring to light any issues concerning the management system. In addition, this also allows factories to grasp the management conditions of off-site waste disposal and prevent the occurrence of any improper treatment or disposal.

WI Management (IPAAM):

By aggregating and analyzing the data contained in the waste inventories submitted by factories, it is possible to understand the current conditions surrounding industrial waste management in PIM and Amazonas State, as well as any issues that may exist. This makes it possible to formulate an appropriate improvement plan to resolve those issues.

Supervisor of the Industrial Pole of Manaus / Industrial Districts (SUFRAMA):

Once the management conditions of industrial waste generated in the Industrial Pole of Manaus (PIM) and the Industrial Districts are understood, this will fulfil one of the conditions required by the Amazonas State Public Ministry in order for the Industrial Districts (DIs) to acquire environmental licensing. Also, by clarifying the management conditions of industrial waste, it is possible to offer the information required by investors planning to enter PIM.

b. Aim of the Waste Inventory Database (WI_DB) System

The proper completion and use of waste inventories will bring about the above outcomes. However, at present, almost none of the above outcomes have been realized. The reason for this, as judged by the Study Team, is that concerned stakeholders do not have a strict understanding of the intent of CONAMA Resolution 313. Therefore, the WI_DB system was developed in the Study in order to resolve the issues concerning waste inventory, as outlined below:

- By standardizing the measurement units used in the WI, generators are able to easily process the report content as data, converting as much as possible into code and avoiding any discrepancies due to differences in measurement units.

- By making it as easy as possible to compile the information sought by CONAMA Resolution 313, it will eliminate differences in reporting methods and content.
- If generators correctly enter the data according to the WI_DB system user's guide, it will be possible for each factory to depict the on-site and off-site disposal of its waste. In other words, the proper completion of the WI will contribute to some extent in factories establishing a waste management system.
- Furthermore, this will allow those managing WI (i.e. IPAAM) to easily aggregate and analyze the waste inventories submitted by each factory.

c. Roles of IPAAM and SUFRAMA for the Effective Use of the WI_DB System

IPAAM has the legal right to instruct generators (factories) on the submission of the waste inventory (WI), and the legal obligation to aggregate, analyze and report the submitted WI to the federal government (IBAMA). Therefore, SUFRAMA has neither the right nor the obligation to engage on behalf of the government in dealing with WI. Nevertheless, it is recommended that IPAAM and SUFRAMA take the following measures given that IPAAM does not currently have sufficient capacity to instruct or manage WI, and since SUFRAMA has voluntarily attempted to aggregate and analyze the WI that have been submitted thus far. In addition, the results from aggregating and analyzing the WI serve as important information to be used to manage PIM/DI and acquire its environmental license.

1. Until IPAAM is competent to carry out instruction and management of the WI, it will enter into an agreement with SUFRAMA in which IPAAM will entrust part of their right and obligation concerning the WI as follows. SUFRAMA will diligently carry out the work entrusted to them by IPAAM.
   - Factories (generators), which are responsible for completing the WI, will be instructed on how to accurately prepare the data and report the results according to WI_DB system user's guide.
   - Responding to factories that have questions regarding preparation of the WI with the necessary correspondence and instruction.
   - Distribute the file for the WI_DB system according to factory requests.
   - Aggregate and analyze the aggregated information on the WI submitted by factories.
   - Analyze any issues concerning the current WI_DB system and user's guide revealed through the process of aggregating and analyzing the WI submitted by factories, and make the necessary improvements.
2. IPAAM will cooperate with SUFRAMA using the improved WI_DB system and user's guide to instruct and assist all PIM factories to submit their waste inventories.
3. In addition, IPAAM and SUFRAMA will work together to analyze the aggregated WI, and then IPAAM will prepare the report to submit to IBAMA.

d. Disseminating the WI_DB System to other States and Industrial Parks

As shown in the following image, the WI_DB system developed in the study will clarify the waste management conditions at each factory (see a.1, below). This is made possible if each factory correctly fills out files on the system (if the factories complete the waste inventory).

Then, based on what is known about these conditions, it is possible for each factory to formulate a management plan for industrial waste (see b.1).

Next, the factories will use the system files to prepare their WI, and if the individual results are compiled for the industrial park, it is possible to know the waste management conditions for it (see a.2). Then, based on what is known about the waste management conditions of the industrial park, it is possible to each industrial park to formulate their own industrial waste management plan (see b.2).

If the same is done in each State, it is even possible to clarify the waste management conditions for the country (see a.3, a.4), and formulate an industrial waste management plan (see b.3, b.4).

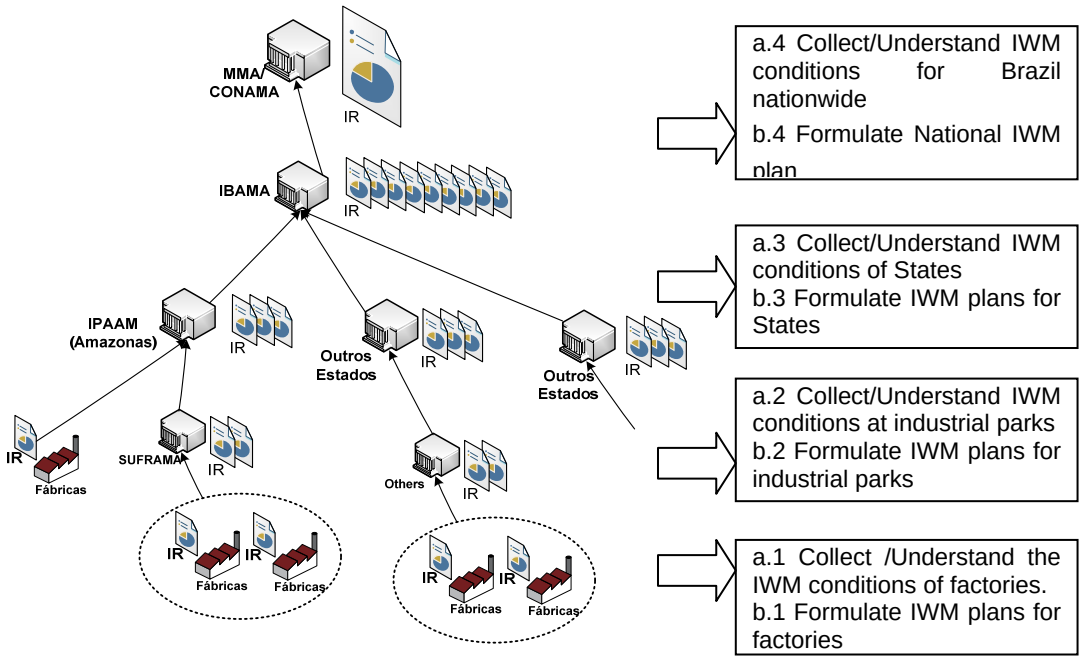


Figure 20: Using the WI_DB system and its relationship to understanding waste management at the factory, industrial park, state and national levels

As shown above, the Study Team considers the WI_DB system developed in this study as a highly effective tool to establish waste management systems in other States and industrial parks in Brazil, as intended by CONAMA Resolution 313. Consequently, the concerned organizations are recommended to promote dissemination of the WI_DB system and promulgate the intent of CONAMA Resolution 313 nationwide, contributing to conditions where industrial waste management systems can be established in each State.

1. First, Amazonas State will demonstrate that, using the developed WI_DB system as intended by the study team, it is possible to know the waste management conditions of each factory, related groups of factories and the State. In particular, this will confirm whether or not the waste stream can be drawn up. If so, the system will be spread to other States as follows.
2. The Ministry of Environment (MMA) collaborates with the Ministry of Development, Industry and Foreign Trade (MDIC) and the Brazilian Cooperation Agency (ABC) to hold a seminar for stakeholders in each State to disseminate the WI_DB system.

3. When holding the seminars, seek cooperation with SUFRAMA and IPAAM which are experienced in using the WI_DB system.
4. SUFRAMA and IPAAM, in response to a request by the Ministry of Environment (MMA) will actively dispatch technicians with experience in using the WI_DB system.

5.1.2 Construct a System to Manage the Licenses of Waste Service Companies

a. Aim of Waste Service Company License Management System

The background and aim of the waste service company license management system recommended in the Study are given below:

1. Currently, operation licenses for waste service companies (WSCs) are registered under various licensing codes. Because of that, it is not easy for IPAAM, which manages the licenses, or for generators (factories), which entrust the treatment and disposal of their wastes to waste service companies, to know the exact number of entities with licenses or what activities licensed entities are permitted to undertake.
2. The recommended system to manage the licenses of waste service companies would use a new environmental license code specifically for WSCs (four-digit codes starting with 33**, for municipal waste, and 34**, for industrial waste), integrating WSCs with two environmental license codes.
3. Also, the content of the license are divided into 4 major categories: 1) collection and transportation, 2) intermediate treatment, 3) recycling, and 4) final disposal. The content of each of these activities are further specified and managed in the waste service company database (WSC_DB).
4. On that basis, the information generators (factories) need to select the companies to which they will entrust disposal of their waste will be available on the IPAAM website.
5. Once the above is established, generators will be able to entrust the disposal of their wastes to trusted companies, and IPAAM will be able to eliminate companies without licenses and monitor that those which do have licenses are conducting appropriate activities.

b. Issues for the Use of a Waste Service Company License Management System and Strategy for Resolutions

As mentioned above, the waste service company license management system recommended in the Study is of great importance to "establish an appropriate industrial waste management system" in the target study area. However, it is not possible for the system to function unless waste service companies are required to obtain an operation license according to the proposed system. Therefore, it is suggested that the concerned organizations observe the following:

1. IPAAM will quickly revise its current licensing system and undertake measures so that the recommended license management system is part of the legal system. This means that it is necessary to carry out the required steps to deliberate the

recommended license management system in the State Legislature (such as formulating a proposed revision of the law).

2. IPAAM will cooperate with SUFRAMA to move ahead with activities to promote the necessity of the recommended license management system to stakeholders.
3. Once the recommended license management system has become integrated into the system, IPAAM will immediately proceed with registration, and construct the WSC_DB.
4. Once the WSC_DB is constructed, IPAAM will make certain information about the newly licensed waste service companies, such as contact information and what licenses they hold, available on its website.

5.1.3 Other

a. Use of the Guidelines to Improve Industrial Waste Management

The guidelines to improve industrial waste management in PIM were produced to support the aim of the M/P to "establish an appropriate system to manage industrial waste in the Industrial Pole of Manaus." The guidelines summarize the required actions to achieve the M/P objectives upon the understanding of waste generators, waste service companies and administration. It is suggested that those three parties make effective use of the guidelines to improve industrial waste management and establish an appropriate system of industrial waste management in PIM.

b. Form a Memorandum of Understanding concerning Implementation of the Master Plan

The authority to enforce the laws necessary to implement the M/P lies primarily with IPAAM. However, the various organizations will need to cooperate in a number of ways, as outlined below, for stakeholders to comply with the law in accordance with instruction and guidance by IPAAM and fulfill their respective obligations.

- SUFRAMA will grant various investment incentives to direct PIM factories to comply with regulation. Also, for waste service companies, SUFRAMA will attract the construction and operation of appropriate treatment and disposal facilities.
- The City of Manaus will make the current landfill fee-based, and promote the construction of a new landfill that is able to obtain an environmental license.
- The Public Ministry of Amazonas State will support IPAAM to enforce laws and regulation.
- Generators and wastes service companies will comply with laws and regulation and construct the respective systems for industrial waste management.

It is recommended that IPAAM clarify the roles and responsibilities of the related organizations and form a Memorandum of Understanding between those concerned with implementing the M/P.

c. Preparing the Electronic Waste Manifest System

An electronic waste manifest system is extremely effective to trace the route of waste after it is discharged from a factory until its final destination. However, this requires not only development of the system, but also various types of expertise in how to properly operate the

system. Therefore, in order to prepare such a system, it is recommended that IPAAM explore policy measures as follows.

1. Cooperate with other states that have already prepared an on-line waste manifest system, such as Rio de Janeiro State, and develop a system in Amazonas25.
2. In order to use the on-line waste manifest system properly once it has been developed, seek cooperation to dispatch engineers with actual operation experience.

d. Formulating an Environmental Management Plan for the Industrial Districts (DI) and Acquiring an Environmental License

At present, SUFRAMA has been advised by the Public Ministry of Amazonas State to obtain an environmental license for the Industrial Districts (DIs). In order to do so, it is necessary to formulate an environmental management plan, including the proper management of industrial wastes, for the DIs as a whole. SUFRAMA is recommended to cooperate with IPAAM to reach a policy as follows:

1. In this study, the results of a factory survey of 187 factories have been compiled into a database. That database is currently kept and managed by Modernization and Informatics General Coordination (CGMOI, under SAD) at SUFRAMA.
2. The factory survey results for 187 factories contain data on factories outside of the DI. The system engineer of CGMOI would extract only the DI survey results and compile these in order to understand the IWM conditions of the industrial districts.
3. Also in the factory survey, data was gathered not only on IWM, but also on pollution control facilities. These survey results can also be extracted and compiled only for the DI.
4. The environmental management conditions of DI will become clear through the above steps. In addition, an environmental management improvement plan for DI can be formulated by making use of the industrial waste management plan produced in this study.
5. Collaborate with IPAAM to further refine the environmental management improvement plan for DI and submit it to the Public Ministry of Amazonas State.

e. Promote Appropriate Treatment and Disposal and the 3Rs

In March 2010, the National Congress approved the Substitute of Draft Bill No. 203, National Policy on Solid Waste, which stresses appropriate treatment and disposal, and the 3Rs. Regardless of on- or off-site disposal, strengthening regulation is the most effective means to promote proper treatment and disposal, and the 3Rs.

Namely, if the administrative side (IPAAM) develops a management system and strengthens control of appropriate treatment and disposal, the off-site disposal fee will be raised. By raising the off-site disposal fee, it will not be possible for generation sources (i.e. factories) to commission 95% or more of the waste generated, as it is now. The result is that PIM factories, like those in Japan, will promote on-site 3R and reduce the amount disposed of off-site.

Also, in response to regulations and putting various environmental measures in place, disposal costs will rise even for off-site treatment and disposal. With that, waste service

[25] Rio de Janeiro State Institute of Environment (INEA) has essentially already agreed to cooperate and dispatched an expert to present at the second workshop held on November 27, 2009.

companies will want to reduce the disposal costs by reducing the amount of residues after treatment or by actively reusing or recycling residues. In states with more advanced destination practices, such as Rio de Janeiro, co-processing is widely used, mainly by cement factories which do not generate any waste after processing.

In order to encourage co-processing at cement factories, in addition to introducing a disposal fee, waste blending techniques that do not affect product or cement quality will need to be introduced. With that, to encourage even better treatment and disposal techniques and 3R measures, IPAAM should be encouraged to not only strengthen regulation, but to actively provide information to both waste generators and WSCs about appropriate treatment and disposal and the 3Rs, and offer training and guidance where needed. Furthermore, ideally, IPAAM would hold a training seminar for both waste generators and WSCs with the cooperation of stakeholders from states and countries with more advanced practices.

Finally, IPAAM should instruct the companies to elaborate their Wastes Management Plan, the basic instrument used to devise rational and economic handling and destination, including the procedures to minimize the wastes and costs they bear.

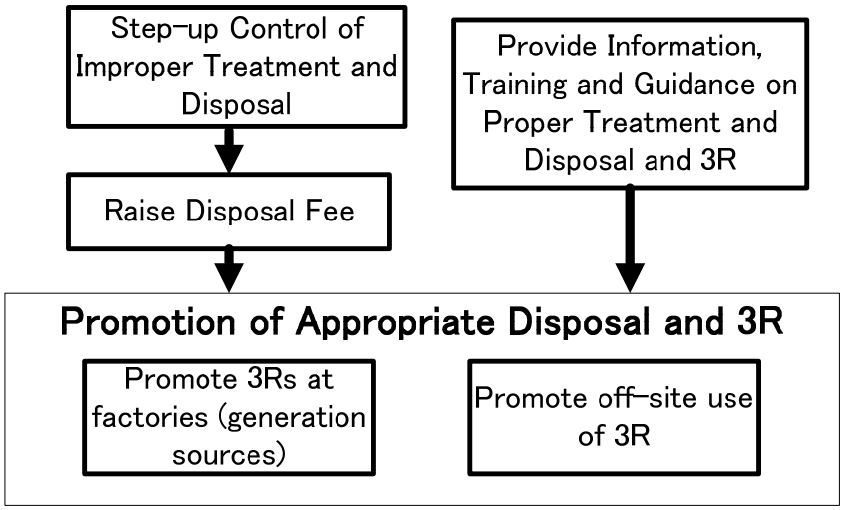


Figure 21: Promotion of Appropriate Disposal and 3R

f. Improve Business Environment for Waste Service Companies

The Waste Service Companies (WSC) are responsible for the proper treatment and destination of the wastes from the factories, and need to make satisfactory investments and bear the operational and maintenance costs to treat and dispose of industrial wastes entrusted to them according to proper standards. However, due to the presence in the study target area of non-licensed companies which conduct improper disposal to undercut actual costs, and the fact that the landfill accepts wastes at no charge, the conditions make it infeasible for the WSC to bear the costs brought by good practices. In order to improve the current business environment, IPAAM and SUFRAMA should cooperate and introduce the following measures to encourage WSCs to engage in proper treatment and disposal:

1. Secure demand for industrial waste services by eliminating the non-licensed companies and controlling improper treatment and disposal. For that, IPAAM and SUFRAMA should proactively publicize the information on the registration of WSCs in the database of waste services companies (WSC_DB), and inform the generators (factories) that this information is available.

2. Next, establish a sole and exclusive area at the Manaus City landfill for fee-based disposal of Class II-A/Non-hazardous/Non-inert IW, and promote separate disposal of Non-hazardous/ Non-inert IW and municipal waste in separate site.
3. Encourage the co-processing in clinker ovens as a good alternative for the destination of hazardous IW, as well as the establishment of blending plants for the wastes to be co-processed.
4. Instruct waste generators to contract WSCs registered in the WSC_DB for disposal, and provide technical information to promote on-site 3R, including training and guidance.
5. Also, hold training seminars for WSCs to instruct and guide them with information an appropriate treatment and disposal techniques.
6. Furthermore, adopt the good examples[26] from other advanced states such as Sao Paulo to improve the business environment for related industries. In Japan, many prefectures have recently introduced a "reward system for preferred waste service companies" which has been effective. In Brazil, the examples of business award and promotion are trophies and Green Stamps.

g. Cooperation between Administration, Generators and Waste Service Companies

Finally, in order to attain the "establishment of an appropriate industrial waste management system", it is essential that administration, generators and waste service companies all collaborate. In order to strengthen collaboration between these three sides, IPAAM is recommended to take the following measures.

1. Further strengthen the ties between related administrative organizations by establishing a (tentatively named) Coordination Committee for Proper Industrial Waste Management Promotion (hereafter referred to as the CCPIWMP). It is presumed that the CCPIWMP would be developed by members of the Technical Sub-Committee (TCSC) who participated in the weekly meetings during this study. The CCPGRIA will discuss the duplicated licenses, inspection, surveillance and punishment by IPAAM and SEMMA.
2. The CCPIWMP would be central to encouraging cooperation amongst and reinforcing ties between administration, waste generators, and waste service companies. To do so, the administrative side would hold a (tentatively named) Proper Industrial Waste Management Promotion Committee (hereafter simply referred to as the PIWMPC).meeting of these entities for them to come to an understanding on various issues and strengthen ties.

The administrative side would publicize, educate and train waste generators on the necessity of appropriate disposal, making them aware of their responsibilities for appropriate disposal and ensuing expenses. Then, educate and train WSCs on appropriate disposal methods, impressing upon them the necessity to implement appropriate disposal techniques.

[26] Sao Jose Dos Campos Landfill Example: In 2007, Sao Jose Dos Campos City refused to accept hazardous wastes as well as non-hazardous industrial wastes. The factories requested that non-hazardous industrial waste be accepted at a private hazardous waste landfill. Accordingly the municipal regulation has provided a new business opportunity for the private entity, and has contributed to the city to avoid mixed disposal of low-risk municipal waste with non-hazardous industrial waste that was at high risk of being mixed with hazardous waste.