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

MAIN REPORT

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 Main Report.

The exchange rate used in this report is as follows.
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(March 2010)

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.

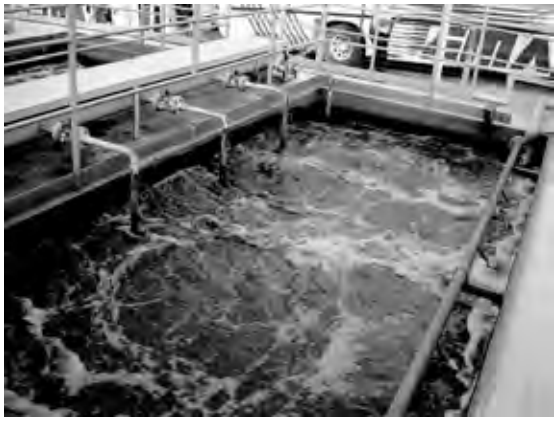
Tourist activities also make up a large portion of Manaus' appeal as people come to explore the riches of the Amazon forest.

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 separate codes for municipal and industrial 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

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

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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
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 Free Trade Zone	Superintendência da Zona Franca 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 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 added 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's construction of 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 the 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 of Igarapé 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 pushed toward the necessity to formulate 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, SUFRAMA has sought assistance 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 is planned for completion 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.

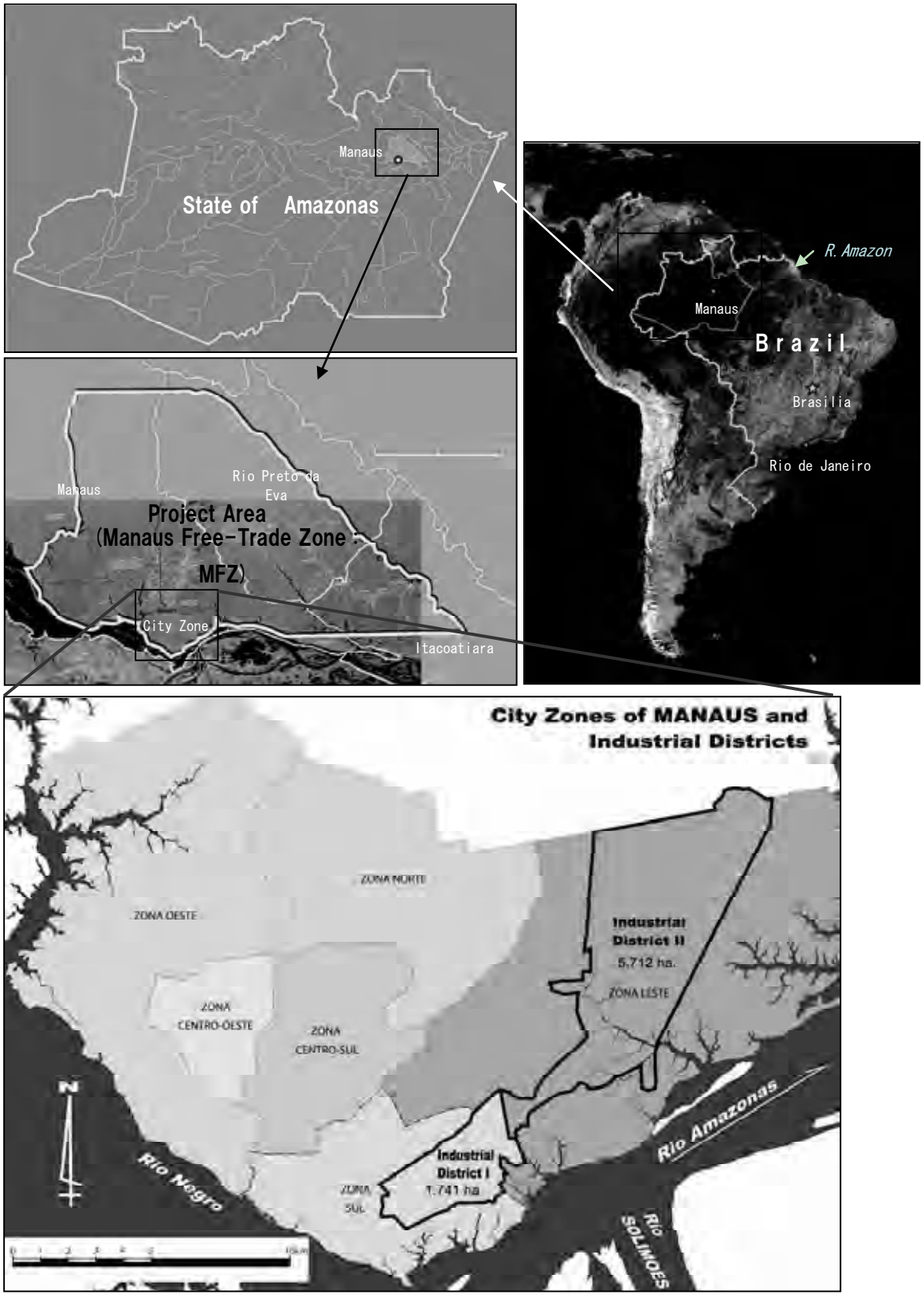
1.1.3 Study Area

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 1-1: 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 1-1: 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 1-2: 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.	CNEN-NE-6.05	All factories and organizations licensed by the Ministry of Science and Technology or the National Nuclear Energy Commission

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

	Waste which (1) emits beta or gamma rays, and (2) emits alpha rays, 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.		for Radioactive to 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 in accordance to the basic policy as follows.

The study team will implement the study 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**
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 formulation and smooth implementation of the M/P will happen through close cooperation between the Brazilian counterpart and the study team. The Brazilian side, however, must 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, this should have a multiplied effect nation-wide. However, in order to actualize this effect, the Brazilian side will have to be proactive in their approach and 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 26 participants in 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 plot out 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 industrial waste master plan (M/P) formulated.

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 1-3: 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 achieve the 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 a seminar were held to offer an opportunity for discussion, as outlined below.

Table 1-4: Workshops and Seminar 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 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.

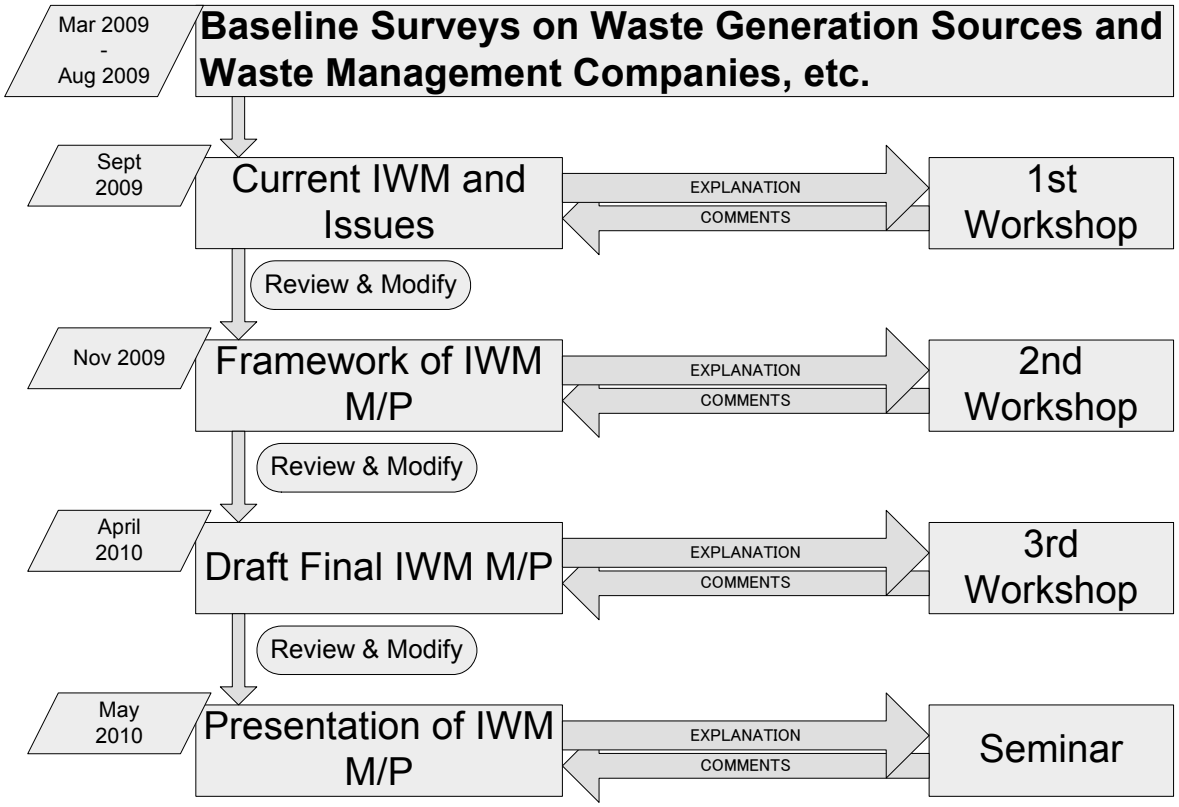


Figure 1-2: Formulation of the Master Plan through Workshops and Seminar

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 1-5: 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 1-6: 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 1-7: Japan Training Participants

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

1.2.3 Organizations of the Study

a. Organization Structure of the Study

SUFRAMA has designated members that make up 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 has 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.

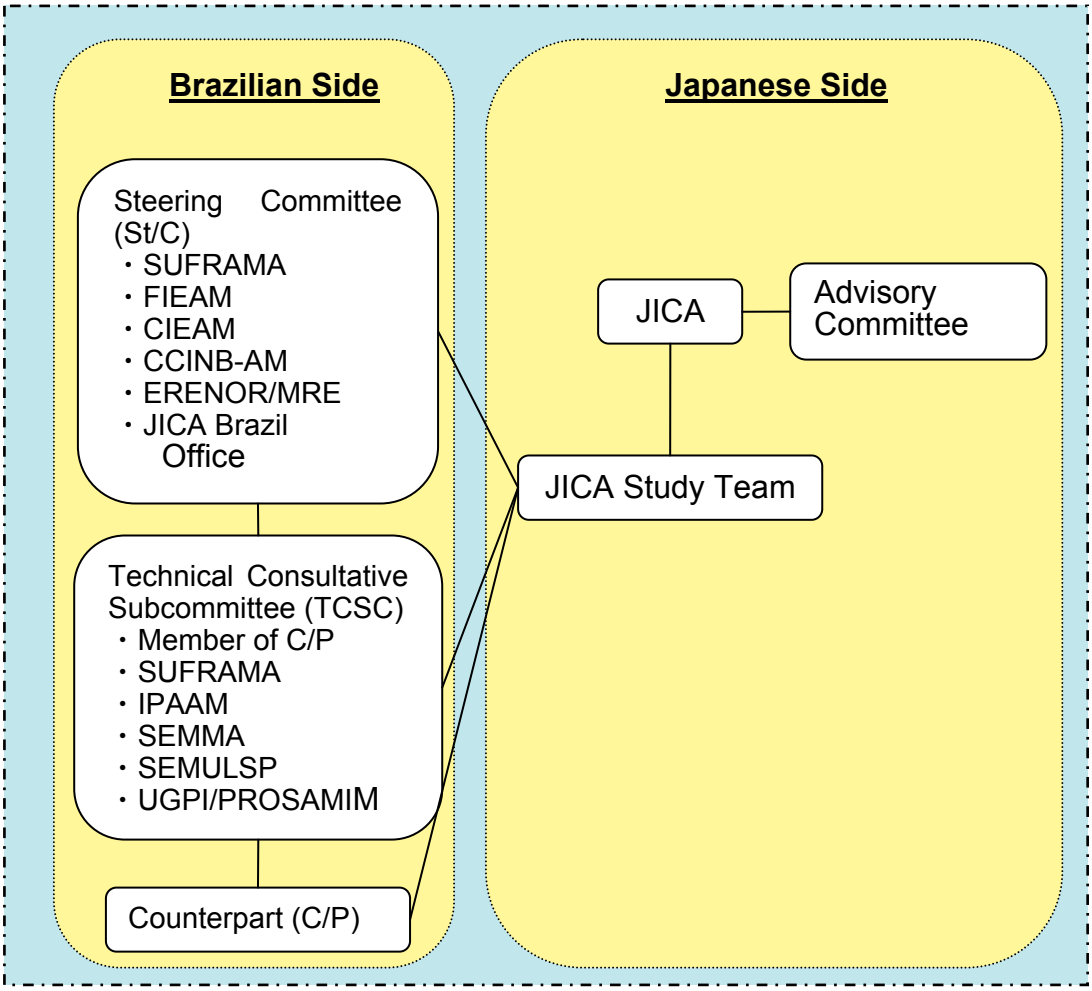


Figure 1-3: Organizational Structure of the Study

b. Brazilian Side

b.1 Members of Counterpart (C/P) Team

Members of Counterpart (C/P) Team are as follows:

Table 1-8: Members of Counterpart (C/P) Team

No.	Name	Position	Organization
01	Keithy Garcia	Technical Advisor	SUFRAMA
02	Mônica E. C. Barros	Attorney	SUFRAMA
03	Armando Bandeira Jr.	Technician	SUFRAMA
04	Armando Rubens Lima	Technician	SUFRAMA
05	Neyla Saraiva	Fishing Engineer	SUFRAMA
06	Adamilton Mourão	Administrator / Architect	SUFRAMA
07	Maria Helena P. Roza	Engineer	SUFRAMA
08	Diego Alves Amoêdo	Electronic Engineer	SUFRAMA
09	Márcia Ribeiro	Administrator	SUFRAMA
10	Miber Jucá	Technician	SUFRAMA
11	Érica Lira	Secretary	SUFRAMA

12	Anita Zambrano Acuña	Assessor	ERENOR
13	David Rocha Silva	Electronic Engineer	SUFRAMA
14	Rita de Cássia de Vasconcelos Dias Mariê	Engineer	SUFRAMA

b.2 Members of the Steering Committee (St/C)

Members of the Steering Committee (St/C) are shown in the following table.

Table 1-9: Members of the Steering Committee (St/C)

No.	Name	Position	Organization
01	Maria Gracilene Roberto Belota	General Coordinator	SUFRAMA
02	Luis Flávio Simões	Project Coordinator	SUFRAMA
03	Carlito Holanda	Coordinator	SUFRAMA
04	Flávio José Dutra	Executive Director	FIEAM
05	Alexandre Kadota	Adjunct Director	FIEAM
06	Ronaldo Mota	Executive Director	CIEAM
07	Mário Susumu Okubo	Vice-President	CCINB-AM
08	Iuquio Ashibe	Vice-President	CCINB-AM
09	Gustavo Resende Mendonça	Cooperation Technician	ABC/MRE
10	Wófsi Yuri G. de Souza	Cooperation Technician	ABC/MRE
11	Henrique Jenné	Chief	ERENOR
12	Mauro Inoue	Project Coordinator	JICA Brazil Office

b.3 Members of Technical Consultative Subcommittee (TCSC)

Members of Technical Consultative Subcommittee (TCSC) are as follows:

Table 1-10: Members of Technical Consultative Subcommittee (TCSC)

No.	Name	Position	Organization
01	Maria Gracilene Roberto Belota	General Coordinator	SUFRAMA
02	Luís Flávio Simões	Project Coordinator	SUFRAMA
03	Carlito de Holanda Sobrinho	Coordinator	SUFRAMA
04	Neliton Marques da Silva	President-Director	IPAAM
05	Antonio Ademir Stroski	Assessor	IPAAM
06	Marcelo Dutra	Secretary	SEMMA;SEMULSP
07	Clive Reis do Nascimento	Assessor	SEMULSP
08	Jane Crespo	Environmental Sector Coordinator	UGPI/PROSAMIM
09	José Lúcio Rabelo	Institutional Sectorial Coordinator	UGPI/PROSAMIM

c. Japanese Side

c.1 Members of the JICA Advisory Committee

The members of the JICA Advisory Committee are as follows:

Table 1-11: Members of the JICA Advisory Committee

Role	Name	Affiliation
Chairman	Dr. Mitsuo Yoshida	Japan International Cooperation Agency (JICA), Senior Advisor (Environment, Waste, Geology)
Committee Member	Dr. Haruo Matsumura	Japan Industrial Waste Technology Center, International Cooperation, Director

c.2 Members of the Study Team

The members of the Study Team are as follows:

Assignment	Name
Leader / Institutional Development	Susumu Shimura
Waste Generation Source Management (1)	Tamotsu Suzuki
Waste Generation Source Management (2)	Ichiro Kono
Industrial Waste Disposal Planning	Jose Felicio Haddad
Economic and Financial Analysis	Satoshi Sugimoto
Environmental / Social Consideration	Masaharu Kina
Promotion of Waste Management Industry	Shoji Nakamura
Promotion of Waste Management Industry	Minoru Sawachi
Administrative Coordinator	Steven Sundstrom

1.2.4 Study Schedule

a. Overview of study work 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.

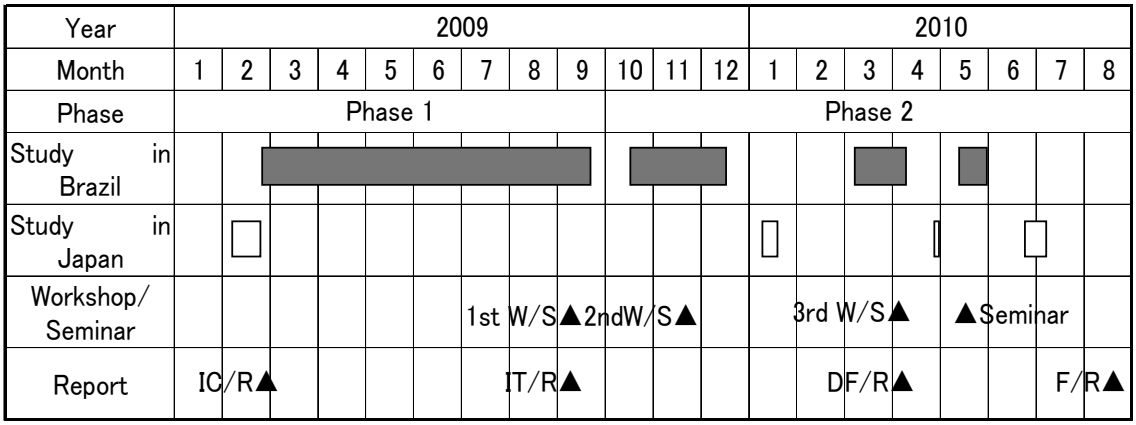


Figure 1-4: Overview of study work schedule

b. Plan of Operation

The primary work items to be carried out in the study, as aligned with the above work schedule, are given below.

Phase 1: Study of Current Conditions

A. Preparatory Work (Feb 2009)

A.1 Collection and Analysis of Data and Information

A.2 Overall Examination of Basic Policies, Content and Methods of Study

A.3 Preparation of Inception Report

A.4 Preparation for First Works in Brazil

B. First Works in Brazil (Feb – Sept 2009)

B.1 Presentation of IC/R and Discussion of Study Plan

B.2 Conduct Study on Current Conditions

B.2.1 State of Study Area (PIM, Manaus, Amazonas)

B.2.2 State of Environmental Management

B.2.3 State of Waste Management and Issues to be Solved

B.3 Supplement Studies on Current Conditions

B.3.1 Survey of Waste Management Companies

B.3.2 Survey on Generation Sources

B.3.3 Conducting the Survey on Environmental and Social Considerations

B.3.4 Development of a Waste Management Database

B.4 Preparation, Submission and Discussion of Interim Report

B.5 Workshop (1)

Phase 2: Formulation of the Industrial Waste Management Master Plan and Guidelines

C. Second Works in Brazil (October – December 2009)

C.1 Formulating the Master Plan

C.1.1 Estimating Amount of Industrial Waste Generated

C.1.2 Goal Setting

C.1.3 Basic Strategy Formulation

C.1.4 Formulating a Draft Master Plan

C.2 Development of a Waste Exchange Database

C.3 Workshop (2)

C.4 Conducting IEE

C.5 Creation of Framework for Draft Guidelines

D. First Works in Japan (December 2009)

D.1 Submission of 1st Draft Final Report and 1st Draft Guidelines

E. Third Works in Brazil (March – April 2010)

E.1 Follow-up Study on the Master Plan

E.2 Follow-up Study on Draft Guidelines (DG/L)

E.3 Submission of 2nd Draft Final Report (DF/R) and 2nd Draft Guidelines

E.4 Workshop (3)

F. Second Works in Japan (April 2010)

F.1 Completion of Draft Final Report

G. Fourth Works in Brazil (May 2010)

G.1 Discussion on Draft Final Report and Draft Guidelines

G.2 Seminar

H. Third Works in Japan (June 2010)

H.1 Submission of Final Report and Proposed Guidelines

The work schedule is detailed in the following figure.

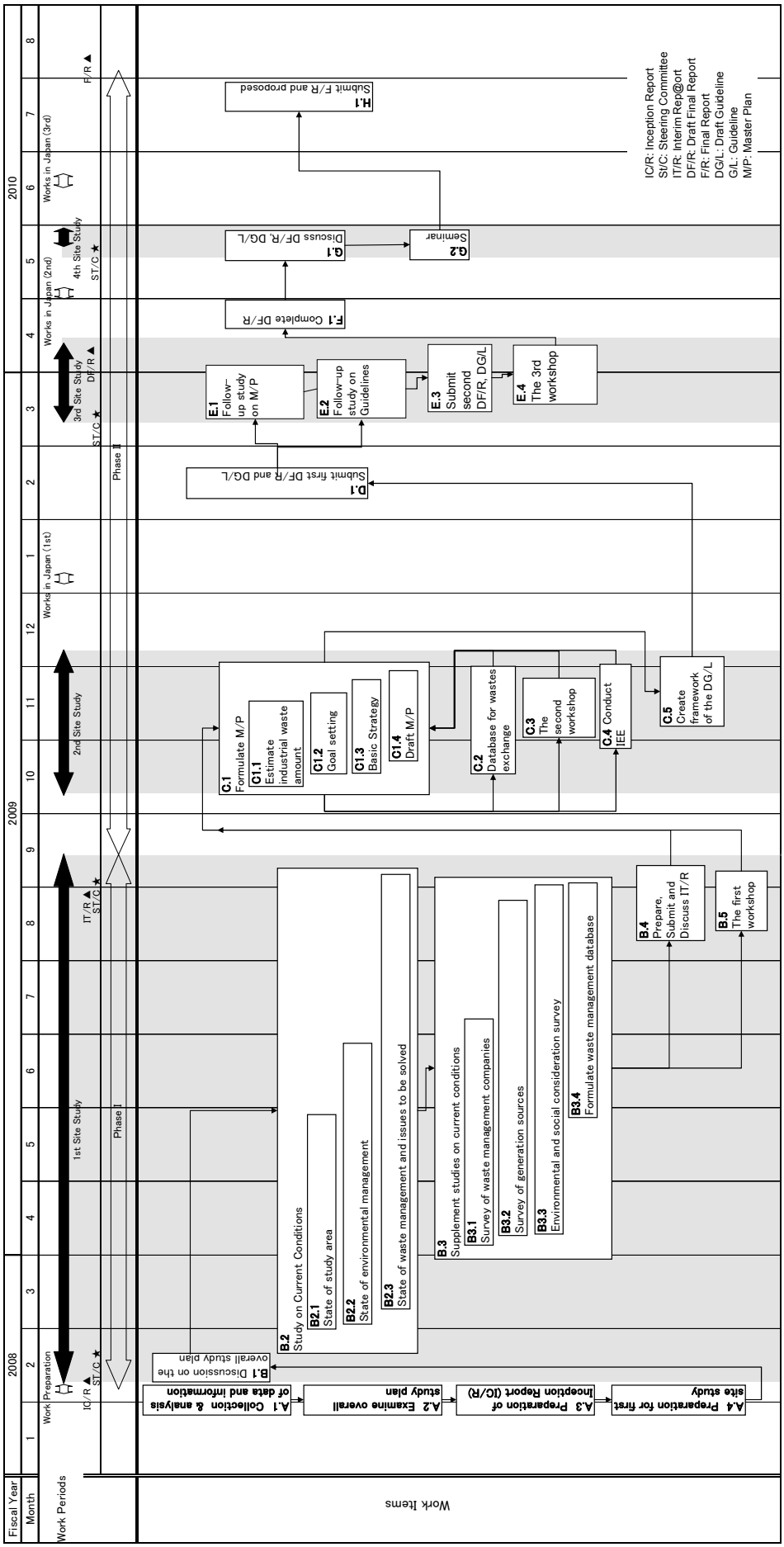


Figure 1-5: Detailed Work Schedule

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. Agreement was sought with 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 small 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, those related to these databases (the factory employees in charge of making the WI at factories for the WI_DB, and waste service company (WSC) applicants for operation licenses (OL)) were invited to respective seminars to give an overview of the databases, explain the user functions and garner opinion. 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 agreement 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 value 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.

1.2.6 Reports

The following reports were prepared, presented, discussed and submitted to the Brazilian side:

Table 1-12: Reports Submitted

Report	Language/Format	No. of Copies
Inception Report <IC/R>	English	10
	Portuguese	10
	CD-ROM	1
Interim Report <IT/R>	English summary	10
	English main report	10
	Portuguese summary	10
	Portuguese main report	10
	CD-ROM	1
Draft Final Report <DF/R>	English summary	10
	English main report	10
	English supporting materials	10
	English databook	10
	Portuguese summary	10
	Portuguese main report	10
	Portuguese supporting materials	10
	CD-ROM	1
Final Report	English summary	20

＜F/R＞	English main report	20
	English supporting materials	20
	English databook	20
	Portuguese summary	40
	Portuguese main report	40
	Portuguese supporting materials	40
	CD-ROM	1

2. Profile of the Study Area

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 from the sea, 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, over half of which is the city of Manaus at 4,950 sq km. The area and population of these three local governments is as follows.

Table 2-1: 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	11,401	4,950	1,709,010	149.90
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

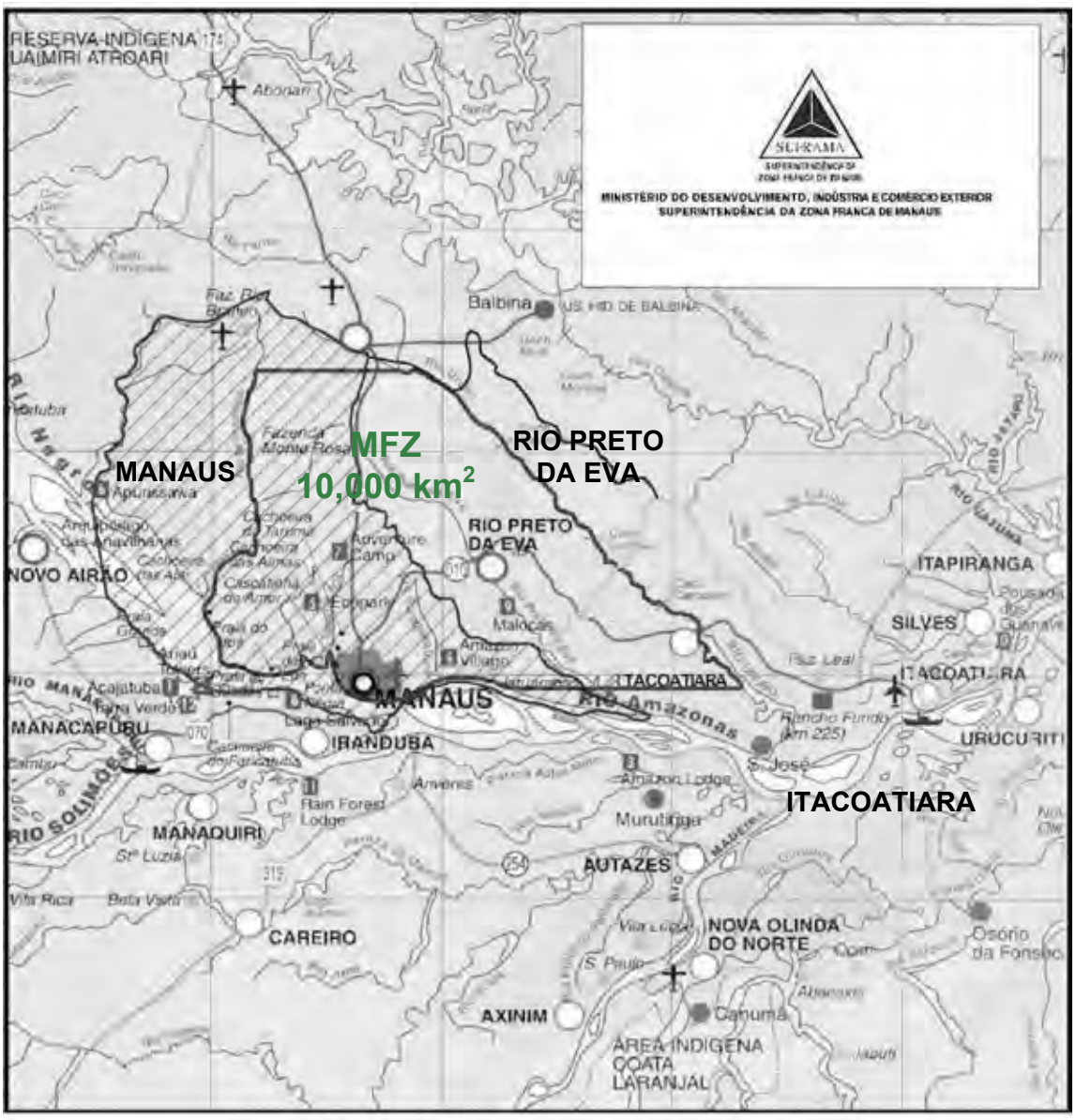
As shown in the above table, the area of the three cities where the MFZ is located is only 1.64% of Amazonas State, yet it contains over half (54.6%) of the population. This is a clear indication that industry in the state is centralized in PIM/MFZ.

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 2-2: 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



Source: SUFRAMA

Figure 2-1: Location Map of the Manaus Free Trade Zone (MFZ)

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. As shown in the map below (Figure 2-2: Manaus Industrial Districts (DI)), 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.

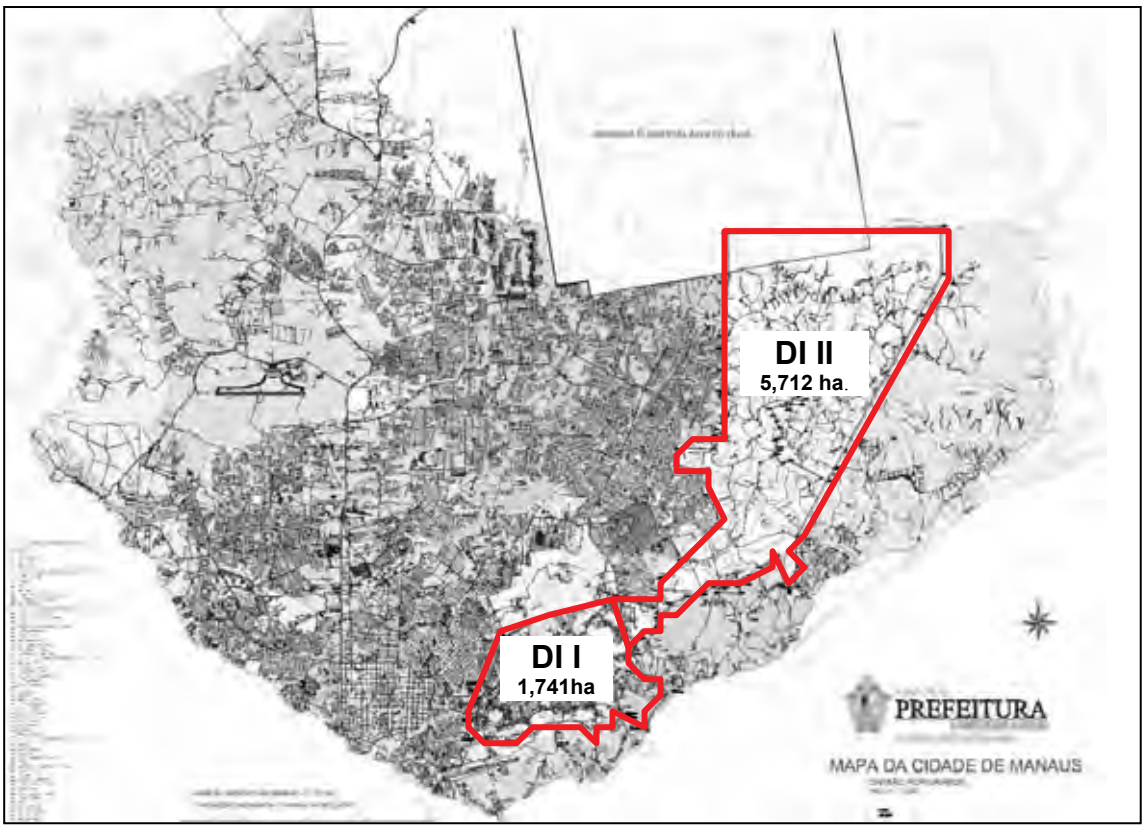


Figure 2-2: Manaus Industrial Districts (DI)

b. Infrastructure

The large river port and harbor serve as the transportation infrastructure of MFZ, where large ships can dock to unload their cargo. A transportation network has been developed upstream by the small and larger ports along the Amazon tributaries, the Rio Negro and Rio Solimões.

For air transport, Manaus is connected to a domestic and international network through Eduardo Gomes International Airport.

There is no railroad, so land transportation depends on delivery by road. Although plans for a mono-rail are in the works as part of preparations to host the World Cup in 2014, the main mode of transportation is bus. There is a road network of national, state and municipal roads, with an expressway pending completion. Also, a bridge is currently being constructed over the Rio Negro, but at present there is no land crossing over the Rio Solimões, where the Negro meets the Amazon.

The utilities in the city area of the MFZ are electricity, communications (telephone), water and sewer systems. However, only a combined sewer network is in place with no treatment facility, so untreated sewage is released through the Igarapé into the Amazon.

In the two industrial districts, SUFRAMA has built the trunk roads along which electrical lines have been laid, but water and sewer systems are only present at the more advanced factories.

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.

Table 2-3: Enterprises Approved by SUFRAMA (July 2009)

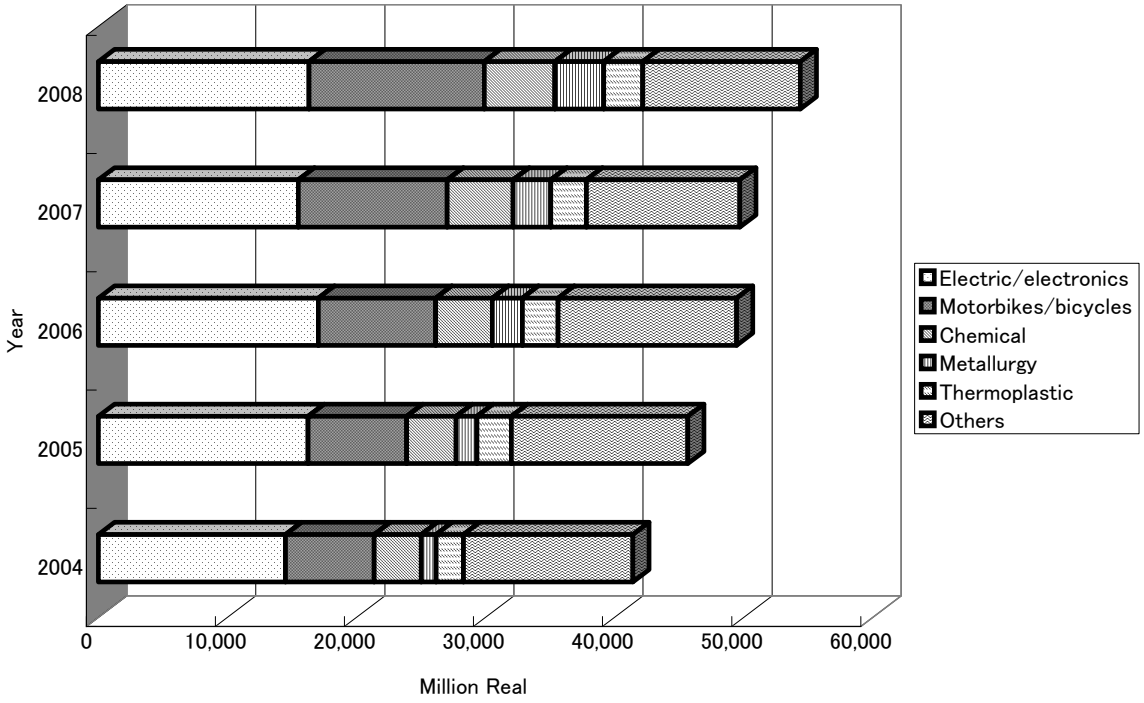
Projects	Enterprises in Operation			Enterprises in Preparation			Total		
	No. Enterprises	No. Workers	Total Investment (million US)	No. Enterprises	No. Workers	Total Investment (million US)	No. Enterprises	No. Workers	Total Investment (million US)
LEs*1	416	118,427	12,914	190	16,808	1,222	606	135,235	14,136
SMEs*2	78	2,072	40	52	1,158	30	130	3,230	70
Total	494	120,439	12,954	242	17,966	1,252	736	138,465	14,206

Source: SUFRAMA
Note: *1: LEs: Large enterprises (Part 1 of the SUFRAMA factory list, see Main report 3.3.3)
*2: SMEs: Small and medium enterprises (Part 2 of the SUFRAMA factory list, see Main report 3.3.3)

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 million (US$29.4 million). 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.



Source: SUFRAMA

Figure 2-3: Changes in Industrial Production Value in PIM/MFZ (2004-2008)

The following table shows the trade balance of the Industrial Pole of Manaus (PIM) in terms of overseas and domestic markets. 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.

Table 2-4: Trade Balance of the Industrial Pole of Manaus (2004-2008)

(Unit: 1,000 Real)

Year	International Trade			Domestic (Interregional) Trade			Total Balance (G=C+F)
	Export (A)	Import (B)	Balance (C=A-B)	Export (D)	Import (E)	Balance (F=D-E)	
2004	3,162,613	10,984,923	-7,822,310	38,242,181	11,153,510	27,088,671	19,266,361
2005	4,922,147	11,520,976	-6,598,829	40,741,403	12,447,164	28,294,239	21,695,410
2006	3,227,608	12,871,664	-9,644,056	46,213,521	13,070,188	33,143,333	23,499,277
2007	2,017,806	12,229,762	-10,221,956	47,664,327	12,812,249	34,852,078	24,640,122
2008	2,176,119	15,602,186	-13,426,067	52,194,955	14,216,217	37,978,738	24,552,671

Source: SUFRAMA

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

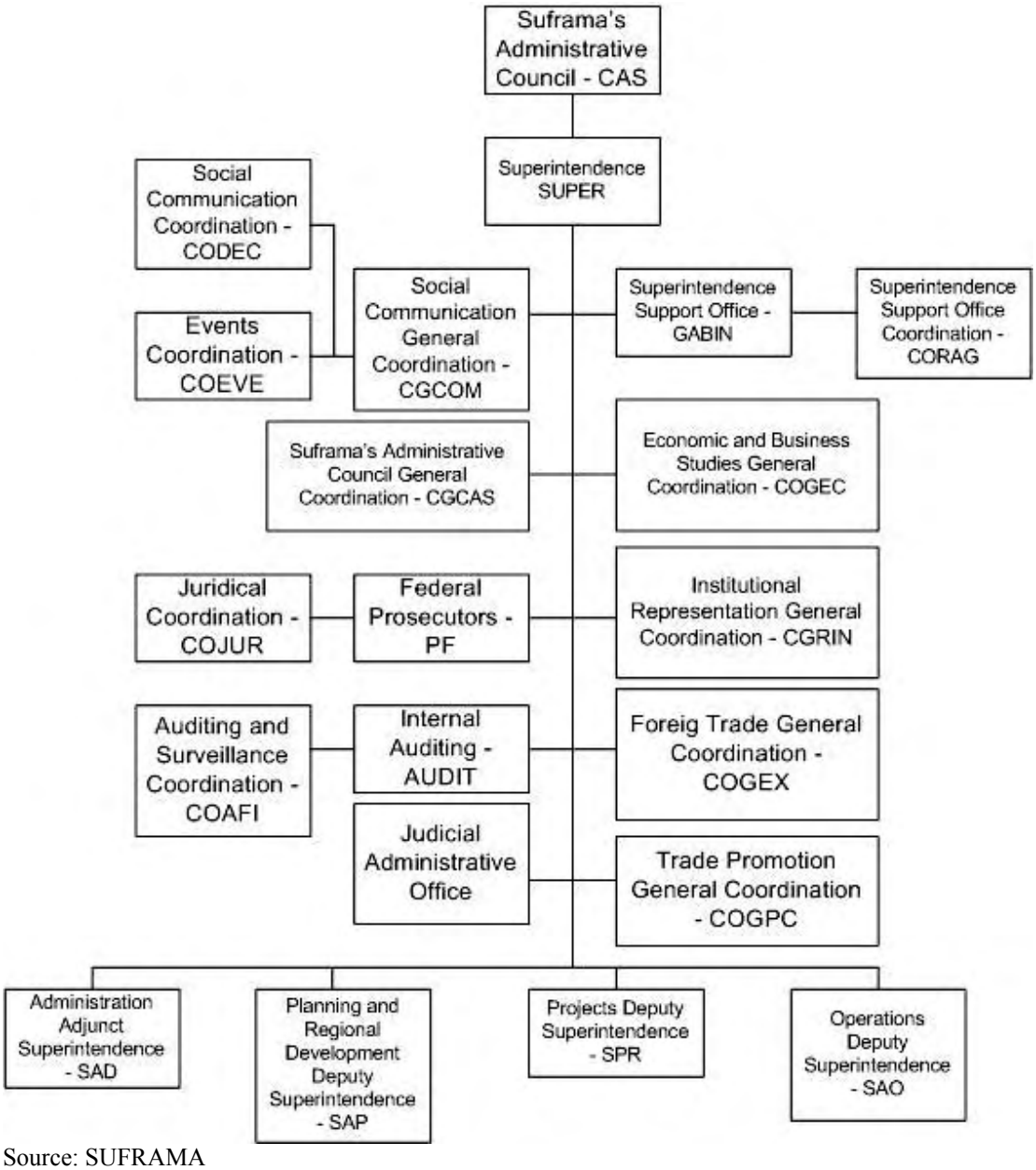
SUFRAMA is vitalizing the regional economy through creating employment opportunities and stimulating production toward socio-economic development not only in the MFZ in the State of Amazonas, but also in the other four states of the Occidental Amazon (Acre, Amapa, Rondonia, and Roraima).

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 2-4: 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 outsources 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.

Table 2-5: Expenditure and Number of Personnel at SUFRAMA (2008)

Description	Number of Persons	Personnel Expenditure (Real)

Public servants working in the units	356	21,869,733.95
Temporarily hired public servants	16	1,314,295.45
Outsourced workers (security guards and janitors)	273	5,362,162,.81
Outsourced administrative workers	523	46,453,864.44
Other outsourced workers	140	1,762,820.17
Trainees	40	137,298.47
Public servants borrowed from other organizations	3	238,915.77
Public servants loaned to other organizations	3	325,522.51
Total	**1,354**	**77,464,613.59**

Source: CGDER, SAP, SUFRAMA (2008)

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 following tables show the allocation of fiscal expenditure for each state and by sector. The largest expenditure went toward infrastructure development, accounting for some 73% of total expenditure for that period (2003~2008).

Table 2-6: Trend of SUFRAMA's Investment in PIM Development by State (2003-2008)

Unit: 1,000 real

States	2003	2004	2005	2006	2007	2008	Total
Acre	3,147	13,543	11,295	9,500	58,129	2,220	**97,834**
Amapa	0	8,400	415	0	2,300	9,000	**20,115**
Amazonas	3,410	35,964	10,547	16,123	28,192	1,800	**96,037**
Rondonia	0	18,450	11,053	4,900	25,145	3,870	**63,418**
Roraima	1,000	11,160	10,547	0	22,425	2,800	**47,932**
Entities	12,148	19,797	17,923	3,421	56,008	5,704	**115,002**
Total	**19,704**	**107,315**	**61,782**	**33,944**	**192,200**	**25,394**	**440,339**

Source: CGDER, SAP, SUFRAMA (2008)

Table 2-7: Trend in SUFRAMA's Investment in PIM Development by Sector (2003-2008)

Unit: 1,000 real

Types	2003	2004	2005	2006	2007	2008	Total
Production	0	1,939	2,135	4,191	5,562	5,200	**18,628**
Infrastructure	7,807	88,163	43,057	18,006	150,675	14,740	**323,447**
Investment Promotion	1,382	910	1,818	281	3,525	0	**7,917**
R & D	10,485	14,008	11,465	11,114	16,057	5,454	**68,584**
Human Resources Capacity Dept.	30	2,295	3,306	352	16,381	0	**22,363**
Total	**19,704**	**107,315**	**61,782**	**33,944**	**192,200**	**25,394**	**440,339**

Source: CGDER, SAP, SUFRAMA (2008)

2.1.5 Socio-Economic Issues

It will be necessary to resolve the following issues in order to secure the future development of MFZ.

a. Acquisition of Environmental License of PIM

Although SUFRAMA has invested basic infrastructure such as roads and electricity, PIM was developed on the premise that individual enterprises are responsible for obtaining environmental licenses to develop factory sites, construct buildings, effluent treatment facilities and other environmental protection measures before entering MFZ. Thus, with the exception basic infrastructure such as roads and electricity, there is no overall development plan for PIM. Such development measures were used for both industrial districts, so that with the exception of construction plans for roadways and electrical supply facilities, PIM and the two industrial districts (DIs) were developed without the necessary environmental protection plans to conduct environmental impact assessment (EIA).Thus, in order to understand the environmental protection plan of the DIs and PIM overall, it is necessary to combine the environmental licenses obtained when individual factories were constructed. Moreover, understanding the current environmental conditions of the DIs and PIM requires that each factory plan and their actual operation conditions be surveyed and the results synthesized. Such work is extremely labor intensive and SUFRAMA cannot perform it unassisted. Rather, the bulk of such analysis must be done by IPAAM, which issues the environmental licenses and rights for operation. Nevertheless, SUFRAMA must have a firm grasp of the structure for environmental protection of PIM/MFZ if it is to promote PIM to potential investors. Even if an individual business takes the necessary precautions for environmental protection, in the case that pollution of the overall PIM area is indicated, great damage is done to that company's activities. Furthermore, SUFRAMA has the right to withhold the special tax benefits to companies pointed out by IPAAM that they do not carry out sufficient environmental protection measures.

As shown above, in order to obtain the environmental licenses for PIM, SUFRAMA and IPAAM--given their respective responsibilities--must work together to formulate an environmental protection plan for the DIs and entire PIM and conduct an environmental impact assessment (EIA). In order to carry out such work, the data and information obtained in this study will serve as an important base.

b. Changes in the Industrial Structure of MFZ

Presently, assembly production is the central activity of the PIM factories, which import parts for products largely consumed in the domestic market. Thus, the trade balance of MFZ is running at a deficit. In order to improve the situation, the Ministry for Development, Industry and Foreign Trade and SUFRAMA are working to entice the parts industry, and moreover, are considering attracting the materials industry and others to further raise the added value of the area. An increase in the parts and materials industries will provide more economic benefit to the MFZ than by reducing the trade deficit and increasing added value. On the other hand, in contrast to the assembly industry, parts and materials include a large number of processes which impact the environment, such as materials processing, surface treatment, and exhaust and effluent treatment.

It is likely that changes to the industrial structure of MFZ will bring about significant changes in accordance with production to the type and quantity of industrial waste that is generated. That is, due to the fact that packaging waste, the current primary waste, is relatively easy to

recycle, one should expect higher environmental impact, difficulty in recycling, and more complicated treatment measures to arise.

c. Infrastructure Preparation

There are a number of infrastructure-related issues, as follows, in order to guarantee the future development of MFZ.

- Manaus is currently independent of the Brazilian national electricity grid, using thermal- and hydro-electric generation; however the generation cost for these is considerably higher than the national average. Presently, the federal government is providing compensation for this cost difference. Moreover, given the current power supply structure, there are frequent power outages in the dry season when power demand is high. Thus, there is a constraint apparent in introducing industries that consume a great deal of electricity, such as the materials industry.
- On-land public transportation is limited to roads, resulting in heavy traffic jams in Manaus City during the morning and evening rush times. For a large municipality with a population of over 1.7 million, dependence on a road network alone for on-land public transport indicates a significant restriction.
- Manaus City does not have a wastewater treatment facility and untreated effluent is released into the Amazon River. In order to attract tourism and sustain and improve the waterfront, a sewerage treatment facility is needed.

2.2 State of Environmental Management

2.2.1 Environmental Laws and Regulations

a. Federal Level

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. In addition to the National Environmental Policy Law (No. 6938/81) and the Brazilian Federal Constitution (1988), already mentioned, the major federal laws are:

- Environmental Crimes and Administrative Sanctions Act (Law No. 9605/98)
- Administrative Liability Act (Decree No. 3179/99)

b. State Level (Amazonas)

The main environmental management laws of the State of Amazonas are as follows:

- Amazonas State Constitution—chapter 11—Environment

- Fundamental State Environment Law (Law n. 1,532/82): State Policy for the Prevention and Control of Pollution, Improvement and Recovery of the Environment and Protection of the Natural Resources
- Decree n. 10,028/87: On the State Licensing System of Activities with Potential Environmental Impact and Application of Penalties and other Measures
- Law n. 2.513/98: Obligation for the registration of companies responsible for the transportation of hazardous cargoes or products in the State Environmental Organization
- Ordinance n. 1/2004: Environmental Licensing for Waste Generation Sources
- Law n. 3,135/07: Climate Change State Policy, Environmental Conservation and Sustainable Development of the State of Amazonas
- Law n. 1991, August 21, 2007: Establishes the National Policy on Solid Wastes and other Measures

c. Municipal Level (Manaus)

The main environmental management laws of Manaus City are as follows:

- Organizational Law of the Municipality of Manaus
- Law n. 605, 24 July 2001: environmental code of the municipality of Manaus
- Law n. 671, November 4, 2002: Regulates the Master and Environmental Plan, Establishes Guidelines for the Development of the City and other matters relating to Planning and Management in the Municipality

2.2.2 Environmental Organizations

a. National System of Environment

The National System of Environment (SISNAMA) is based on the National Environmental Policy Law and acts as the framework for implementing policy and regulation related to the environment in Brazil. The SISNAMA system is composed of the Ministry of Environment (MMA), National Council for Environment (CONAMA), Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA), and other environmental federal, state and municipal agencies which cooperate and complement each other to implement the national environment program.

b. Federal Level

Since Brazil is a federal republic, it has independent environmental organizations at the federal, state and municipal government levels which function to complement and cooperate with each other.

The following table summarizes the federal government organizations which establish and enforce environment related laws at the national level. A branch of the federal environment ministry exists in each state, which is responsible to implement environmental regulation according to federally established environmental policy guidelines and in charge of environmental concerns which are outside federal jurisdiction.

Table 2-8: 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. The Ministry of Environment (MMA) is composed of 5 secretariats at present: (1) Secretariat of Climate Change and Environmental Quality, (2) Secretariat of Biodiversity and Forests, (3) Secretariat of Water Resources and Urban Environment, (4) Secretariat of Extractivism and Sustainable Rural Development, and (5) Secretariat of Institutional Coordination and Environmental Citizenship. Also, related organizations are: (1) National Council for Environment (CONAMA), (2) National Council for Legal Amazon (CONAMAZ), (3) National Council for Water Resources, (4) Deliberative Council for the National Environment Fund, (5) Genetic Heritage Management Council, and others.
IBAMA: Brazilian Institute for the Environment and Renewable Natural Resources	Established as a combination of four organizations in 1989—SEMA (the Special Secretariat of the Environment), SUDHEVEA (Superintendency of Rubber Development), SUDEPE (Superintendency of Fisheries Development), and IBDF (Brazilian Institute of Forestry Development)—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.

c. Amazonas State

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

Table 2-9: 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. The Secretariat has four Deputy Executive Secretariats, each of whom governs one of four departments. The Department of Geographic Diversity and Water Sources is in charge of the State's waste management policy. There are also five Autonomous Entities, of which IPAAM is one. This organization structure is shown in the Figure 2-5.
IPAAM: Institute of Environmental Protection of the State of Amazon	The organization which enforces environmental policy in the State of Amazonas, established in 1995 after the reorganization of IMA/AM (The Amazonas State Environmental Protection and Natural Resources Development Institute (est. 1989)). 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. IPAAM carries out all factory management affairs, from monitoring to environmental licensing to on-site inspections. There are 6 technical staff in the industrial licensing department in charge of issuing licenses. The organizational structure is shown in the Figure 2-6.
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.

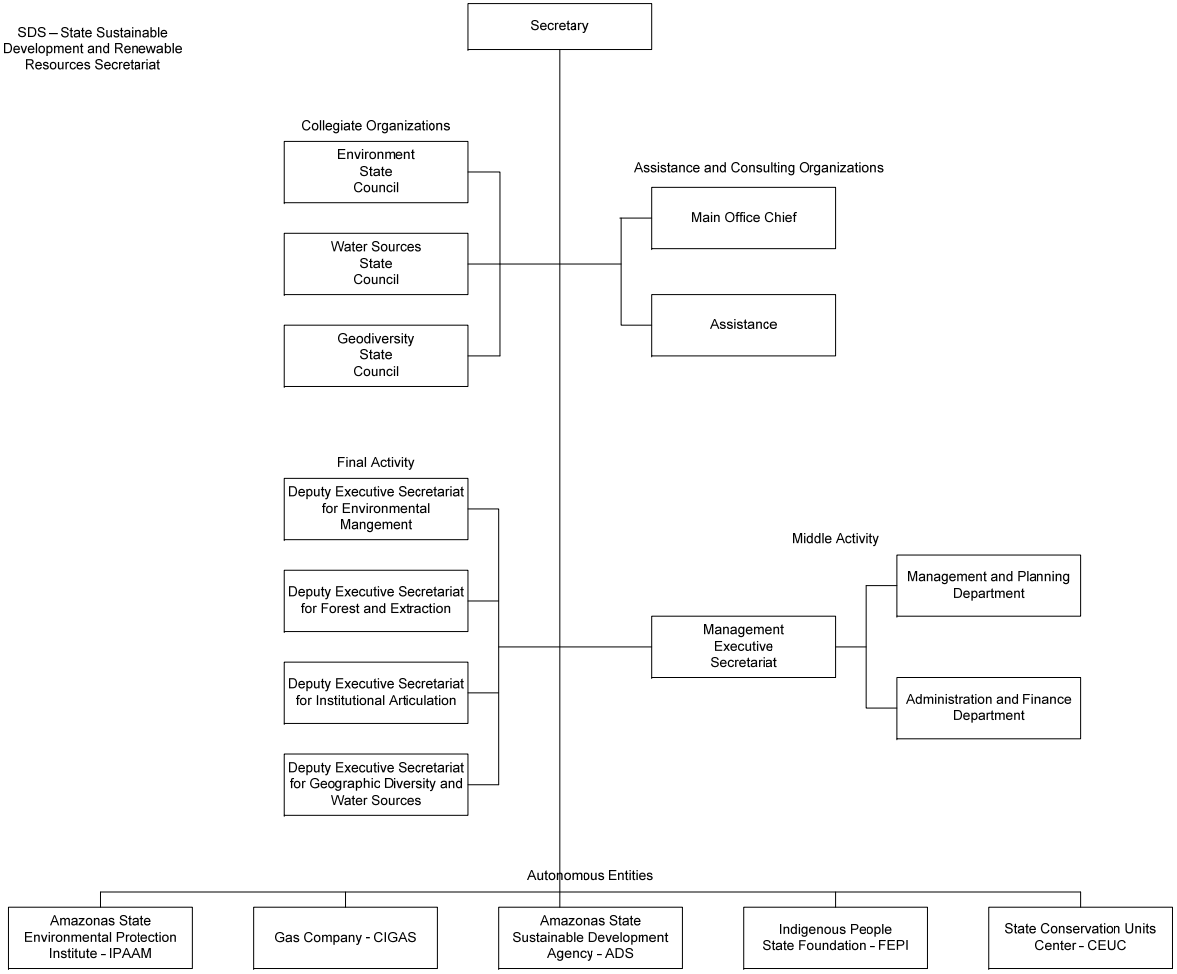


Figure 2-5: Organization Chart of SDS

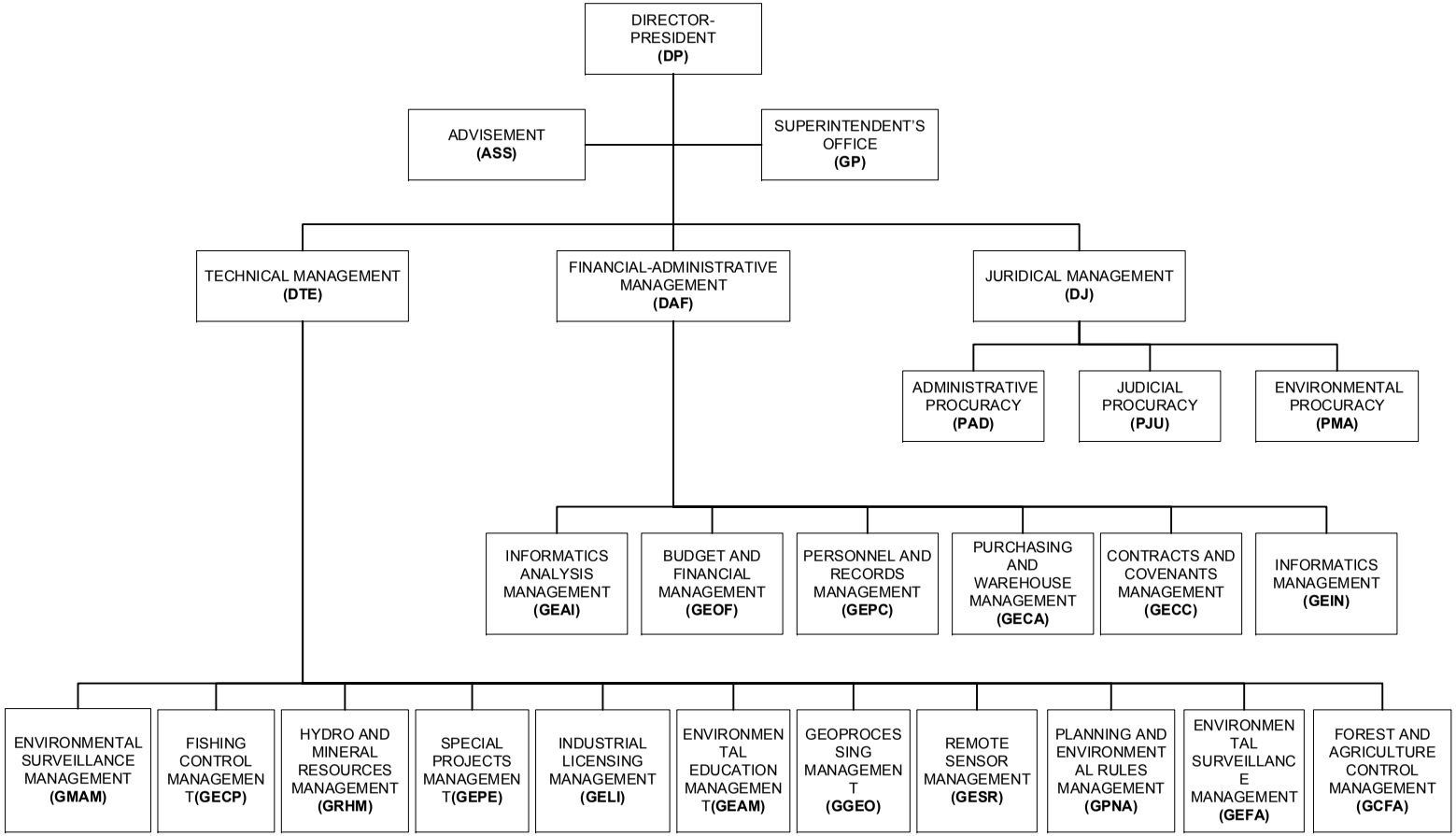


Figure 2-6: Organization Chart of IPAAM

d. Manaus City

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

Table 2-10: 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) system 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 Licensing System at the Federal Level

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.

Table 2-11: CONAMA Resolution 237/97 Environmental Licenses Description and Validity

Environmental License	Description	Period of Validity
Previous License (PL)	Granted in the planning phase of the enterprise or activity, approving its location and conception. It is not possible to start construction with the PL; must clear the PL requirements and then obtain an installation license (IL)	5 years
Installation License (IL)	Authorizes the installation of an enterprise or activity according to the specifications of the approved plans, programs and projects, including the environmental control measures and other conditions, of which new determinations are constituted	6 years

Operation License (OL)	Authorizes the operation of the activity or enterprise after the verification of the effective fulfillment of the content of prior licenses, with the environmental control measures and conditions determined for the operation	4~10 years

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 will determine the environmental license needed for the project[1], and may determine that the project is partially exempt from the process, when deciding the type of license (PL, IL, OL) required.

c. Environmental Licensing System in Amazonas State

c.1 Industrial Activities which require Environmental License

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[2].

- 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 stowage of agrochemicals
- Activities with potential environmental impact to landscape or nature

[1] The governing body may take into consideration the details and scale of a given project, as stipulated in Federal Law 7,804/90 and CONAMA Resolution 237/97, and alter the requirements at the preliminary discussion stage.

[2] Decree No 10028 of February 1987

- Activities with potential environmental impact to cultural assets, historical artifacts, etc.
- Activities IPAAM deems may have potential impact to the environment

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.

Table 2-12: Major classification code of activities with possibility of environmental impact

Code	Activities with potential environmental impact	Code	Activities with potential environmental impact
01＊＊	Extraction and treatment of minerals	17＊＊	Clothing, shoes, fabric and leather items manufacturing
02＊＊	Non-metallic material and product manufacturing	18＊＊	Food manufacturing
03＊＊	Metallurgy (ferrous, nonferrous)	19＊＊	Beverage production
04＊＊	Mechanical products manufacturing	20＊＊	Tobacco manufacturing
05＊＊	Electric & electronic products manufacturing	21＊＊	Printing
06＊＊	Transport machine manufacturing	22＊＊	Commerce and services
07＊＊	Lumber & wood product manufacturing	23＊＊	Construction and infrastructure
08＊＊	Furniture manufacturing	24＊＊	Auxiliary services including provision of electricity and water
09＊＊	Paper and cardboard manufacturing	25＊＊	Wholesale
10＊＊	Rubber manufacturing	26＊＊	Transportation and terminals
11＊＊	Leather products manufacturing	27＊＊	Economic and domestic activities services
12＊＊	Chemical product manufacturing	28＊＊	Medical and veterinary services including laboratory
13＊＊	Pharmaceutical products manufacturing	29＊＊	Stock-breeding, fishing and water-farming and vivariums and wild fauna stewardships
14＊＊	Perfume, soaps and candles manufacturing	30＊＊	Waste treatment and recycle
15＊＊	Plastic material and product manufacturing	31＊＊	Components and electronic devices manufacturing
16＊＊	Textile product manufacturing	32＊＊	Vegetable oil extraction

Source: Classification of pollution sources IN 001/06, published on 3/12/2007

c.2 Environmental Licenses related to Waste Management

The following table shows detailed codes in terms of waste management.

Table 2-13: Detailed code of activities with potential environmental impact related to waste management

Code	Activities with potential environmental impact（major classification）	Code	Activities with potential environmental impact（detailed classification）	
				Impact
22＊＊	Commerce and services	2217	Incineration service	Large
		2218	Co-Processing service of waste	Large
		2219	Collection center of pesticides	Medium
24＊＊	Auxiliary services including provision of electricity and water	2407	Collection and/or treatment of industrial solid wastes	Large
		2408	Final destination of municipality wastes	Large
		2410	Collection and transportation of inert solid wastes	Micro
		2411	Collection and/or storage and/or commercialization of sold wastes	Medium
		2412	Collection and/or treatment of industrial hazardous liquid wastes	Large
		2417	Disposal of industrial waste in landfill	Large
26＊＊	Transportation and terminals	2615	Transportation and storage of industrial hazardous solid wastes	Large
30＊＊	Waste treatment	3001	Treatment of solid industrial waste without chemicals	Medium
		3002	Treatment of liquid industrial waste	Medium
		3003	Treatment and solid industrial waste with chemicals	Large
		3004	Treatment of pallet	Medium
		3005	Recycle of paper and cardboard	Medium
		3006	Treatment of mineral wastes (Re-processing of wastes)	Medium

Source: Classification of pollution sources IN 001/06, published on 3/12/2007

Only recently has the reuse and recycling of wastes become prevalent in the state of Amazonas, and thus the only codes which have been set are for recycling paper and cardboard. According to the survey of waste service companies, the following codes are also used for the environmental license of companies engaged in reuse and recycling activities. As stated above, the current environmental licensing code system in terms of waste management does not identify all the waste service companies and improvement is needed in some areas.

Table 2-14: Major classification code of activities with possibility of environmental impact

Code	Activities with potential environmental impact（major classification）	Code	Activities with potential environmental impact（detailed classification）	
				Impact
02＊＊	Production of non-metal products and material	0213	Production of tile, block and other material	Medium
03＊＊	Smelting (Iron and steel making, non-ferrous	0301	Production of iron by reduction of iron ores (iron making)	Large

	metal production)	0315	Production of non-ferrous metal by primary smelting (non-ferrous metal smelting)	Large
		0326	Production of solder and other materials	Medium
07＊＊	Manufacturing wooden products	0711	Manufacturing of wooden products for home and industrial use	Small
09＊＊	Manufacturing of paper and cardboard product	0903	Manufacturing of general paper products	Large
15＊＊	Manufacturing of plastics product	1502	Manufacturing of industrial plastic products	Medium
		1503	Manufacturing of plastic products for home and individual use	Medium
		1505	Manufacturing of plastic products for package and printing use	Medium
		1506	Manufacturing of plastic pipes, tubes and connecting parts	Medium
		1507	Manufacturing of several types of plastic products	Medium

c.3 License Types and Fulfillment of Conditions

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.

c.4 Documents Required for Waste Management

The required documents and conditions are given in articles No.10 to No.13 of "Regulation No 10028. According to Lei No.1532"; these documents and conditions vary according to the particular activities. The following table shows the necessary documents and conditions in the case of storage, treatment and final disposal of wastes.

Table 2-15: Environmental Licensing Documents necessary for Storage, Treatment and Final Disposal of Wastes

Type of License	No	Type (B/C*)	Requirements
Previous License	1	B	Application for SELAPI and Previous License (IPAAM Form)
	2	B	Payment receipt of administration fee (IPAAM Form)
	3	B	Company contract or similar document in case of juridical person

	4	B	Copy of ID (identification) and CPF (registration) of the legal representative
	5	B	Permit by the Municipality informing that proposed location and activity are in accordance with the Municipal guidelines
	6	B	Certificate of possession of property sent by SUFRAMA, incase that the property is located in industrial district
	7	B	Certificate of possession of property, in case that the property is located in rural area
	8	B	Certificate of registration of land, plant and building
	9	B	Location map of the enterprise
	10	B	Report of process of the activity development which is signed by the responsible person of the company
	11	B	Location, installation floor plans of the facilities
	12	C	Environmental studies
	13	C	Others (specify)
Installation License	14	B	Application of installation license (IPAAM Form)
	15	B	Payment receipt of administration fee (IPAAM Form)
	16	B	Registration of activities: sanitary and industrial landfill (IPAAM form)
	17	B	Debts Clearance Certificate issue by Ministry of Finance of Amazonas, in case of enterprise
	18	B	Details of storage, treatment and final disposal including monitoring points
	19	B	Project plan approved by competent authority
	20	B	Detail drawing of installation of facilities and plants, including effluent discharge and exhaust gas emission points.
	21	B	Domestic and industrial wastewater treatment system approved by competent authority
	22	B	Preliminary license which satisfied all the requirement and restriction clauses
	23	C	Others (specify)
Operational License	24	B	Application of operation license (IPAAM Form)
	25	B	Payment receipt of administration fee (IPAAM Form)
	26	B	Registration of activities: storage, transportation of products and waste (IPAAM form)
	27	B	Previous License and Installation License which satisfied all the requirement and restriction clauses
	28	C	Others (specify)

Note: B: Basic requirement, C; Complementary requirement

Source: IPAAM homepage

The environmental studies necessary for the Previous License (item No 12) are simple compare to environmental impact previous studies (EPIA). Those who apply for an environmental license for activities of storage, treatment and final disposal of waste submit the documents from No 14 to No 23. Then, when IPAAM determines an EPIA is necessary, they must carry this out and submit it to IPAAM. A summary report of EPIA is an environmental impact report (Relatorio de Impacto Ambiental, RIMA). The RIMA is shown to the public, for example, on the IPAAM website. An EPIA is a detailed and lengthy report which includes all the data of the studies, whereas, on the other hand, the RIMA report will total approximately one hundred pages. In the case of the hazardous industrial waste landfill

project in Manaus, IPAAM judged that an EPIA was necessary, which was conducted, and the RIMA made available at the IPAAM website.

d. Environmental License Fee in Amazonas State

Normative Instructions 01/06 and 01/07 of IPAAM were substituted by Law no. 3219 of 28/12/2007, which regulates the granting of environmental licenses in the State of Amazonas and other measures. Through this law, the Government of Amazonas State establishes Environmental Licensing Fees in the State of Amazonas. Individuals or legal entities performing activities should pay environmental licensing fees to IPAAM. Only the State Executive Bodies and Agencies are exempt from environmental licensing fees.

The following activities are subject to PL: construction, installation, expansion, enlargement, alteration, rehabilitation, operation and operation of polluting activities, users of environmental resources, and companies that cause environmental degradation.

IPAAM provides basic criteria, by which studies will be required environmental impact assessment for environmental licensing, subject to federal and state laws. The Environmental Impact Assessment (EIA) will be prepared by qualified technicians; the costs shall be borne by the project proponent. The environmental impact assessment and other studies will be accessible to the public. The activities mentioned in this article that do not comply with environmental regulations will be sanctioned according to provisions of Law 1532 of 6 July 1982 and Decree No. 10028, of 4 February 1987.

The environmental licensing fees, subject to the provisions of Decree 10,028, of 4 February 1987 are as follows:

1) Previous License fee;

2) Installation License fee;

3) Operation License fee.

Exempt from environmental licensing fee in the State of Amazonas, are nonprofit associations operating in the field of solid waste recycling or committed to reducing pollution. The amounts of the prescribed fees for licensing can be charged in proportion to the duration of the environmental license.

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 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) System[1]

a. EIA-related Laws and Ordinances at the Federal Level

The environmental impact assessment (EIA) system 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. The following table presents major laws and ordinances related to the EIA system in Brazil.

Table 2-16: Major Laws and Ordinances related to the EIA System in Brazil

Regulation	Year Enacted	Description
1. Federal Constitution, Art. 225	1988	Ch 1, Art 225 concerning the environment, establishes guidelines for environmental conservation and protection of natural resources.
2. Federal Law		
2.1 Basic Environmental Law (n. 6,938/81)	1981	Prescribes national policy on environment, introducing environmental licensing system and the EIA system
2.2 Environmental Crimes Law (n. 9605/98)	1998	Provides a definition for environmental crime, the law rearranges violations and penal provision sections of the environment law.
3. CONAMA Resolutions		
3.1 CONAMA Resolution 01/86	1986	Contains an important provision which provides an overview of the environmental assessment system
3.2 CONAMA Resolution 06/86	1986	Provision of guidelines and forms to obtain environmental licenses
3.3 CONAMA Resolution 09/87	1987	Provision for involvement of private citizens and public consultation in the EIA process
3.4 CONAMA Resolution 237/97	1997	Revision of the environmental licensing system and EIA guidelines

b. Laws and Regulation pertaining to EIA in Amazonas State

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 2-17: Major Laws and Ordinances related to the EIA System 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	1987	Provision for the license system in Amazonas State pertaining to activities which have potential impact on the

[1] 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

License Decree (n. 10,028/87)		environment

c. 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 system between the two since the requirements (EIA/RIMA, EAS/RAS, AR, 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.

d. Projects which require EIA

d.1 The Federal Level

The projects which require EIA at the federal level are listed in the table below. These projects are listed in CONAMA Resolutions 01/86 and 05/87. However, a provision in CONAMA Resolution 237/97, Article 10, states that a business operator and the environmental agency will discuss the necessity of conducting EIA at a preliminary stage, so it is possible that the environmental agency could require EIA for projects other than those shown in the table below.

Table 2-18: Projects which require EIA at the Federal Level

Sector	Activity
Roads	Two-lane or above
Railways	
Ports	Mineral, petroleum and chemical products ports and terminals
Airports	Airports
Pipelines	Oil-pipelines, gas-pipelines, mine-ducts, sewerage systems
Power Transmission	Power transmission lines over 230KV
Hydraulic Works	Development of hydraulic works (hydroelectric dam of 10MW or greater, portable waters, irrigation, opening of ship passages, water source rectification, dredging rifts and estuaries, conversion of basins, embankments, etc;)
Fossil Fuel Extraction	petroleum, coal, etc
Mineral Extraction	
Waste	Sanitary landfills, processing and final destination of toxic or hazardous wastes
Power Plants	Primary energy source; 10MW or greater
Factories	Industrial and agro-industrial facilities (petro-chemicals, metallurgical, chlorine chemicals, alcohol distilleries, coal, extraction and cultivation of water sources)
Industrial Districts	Industrial districts and zones
Lumber	Forest stewardship activities, economic exploration of wood or

	firewood, in areas larger or smaller than 100 hectares, when it reaches significant areas in percentage terms or important from the environmental point of view.
Urban Projects	Above 100 hectares or in smaller areas holding relevant environmental interest, at the discretion of SEMA and competent municipal and state organizations;
Fuel	Any activity which uses or produces wood coal, in amount of 10 tons a day or greater
Agriculture	Agriculture or dairy projects 1,000 hectares or greater, or less when significant from the environmental point of view.
Archeological Sites	Projects with potential environmental impact in areas with ruins or relics

d.2 Amazonas State

The projects which require EIA in Amazonas State are listed in the table below. Those projects are defined in Decree No. 10,028/87.

Table 2-19: Projects which Require EIA at the State Level

No.	Activity
I	Roads
II	Railways
III	Mineral, petroleum and chemical products ports and terminals
IV	Airports, as defined by incise 1, article 48, of Law-Decree n. 32, of 18.11.66
V	Oil-pipelines, gas-pipelines, mine-ducts, collecting trunks and wastewater discharging systems
VI	Power transmission lines over 230KV
VII	Hydraulic works for the exploration of hydro resources such as: dam for hydroelectric, sanitation or irrigation purposes, opening of channels for navigation, drainage and irrigation, rectification of water sources, opening of bedsteads and passages, conversion of basins, embankments;
VIII	Extraction of fossil fuel (petroleum, schist, coal)
IX	Minerals extraction, including Class II, defined in the Mining Code;
X	Sanitary landfills, processing and final destination of toxic or hazardous wastes
XI	Power plants, any primary energy source
XII	Industrial and agro-industrial facilities (petro-chemicals, metallurgical, chlorine chemicals, alcohol distilleries, coal, extraction and cultivation of water sources)
XIII	Industrial districts and strictly industrial zones - ZEI
XIV	Forest stewardship activities, economic exploration of wood or firewood, in areas larger or smaller than 100 hectares, when it reaches significant areas in percentage terms or important from the environmental point of view.
XV	Urban projects, above 100 hectares or in smaller areas holding relevant environmental interest, at the discretion of SEMA and competent municipal and state organizations;
XVI	Any activity which uses or produces vegetable coal, in amount superior to two tons a day

e. EIA Approval Procedures

e.1 Federal Level

Once the required environmental licenses are determined, the required studies are decided, such as EIA/RIMA, EAS/RAS 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 process to acquire an environmental license is stipulated in CONAMA Resolution 237/97, Article 10. This process is shown in the flowchart below.

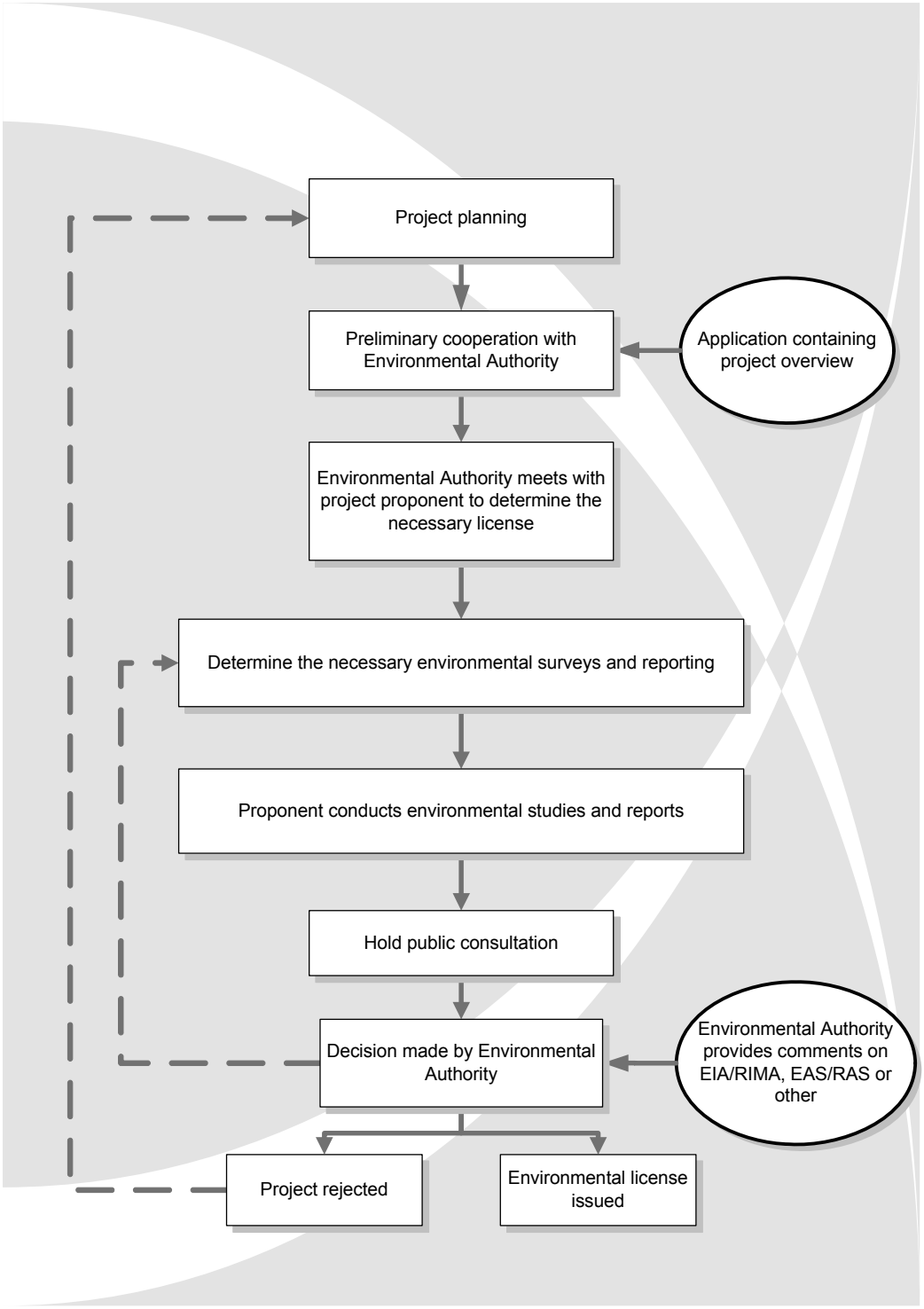
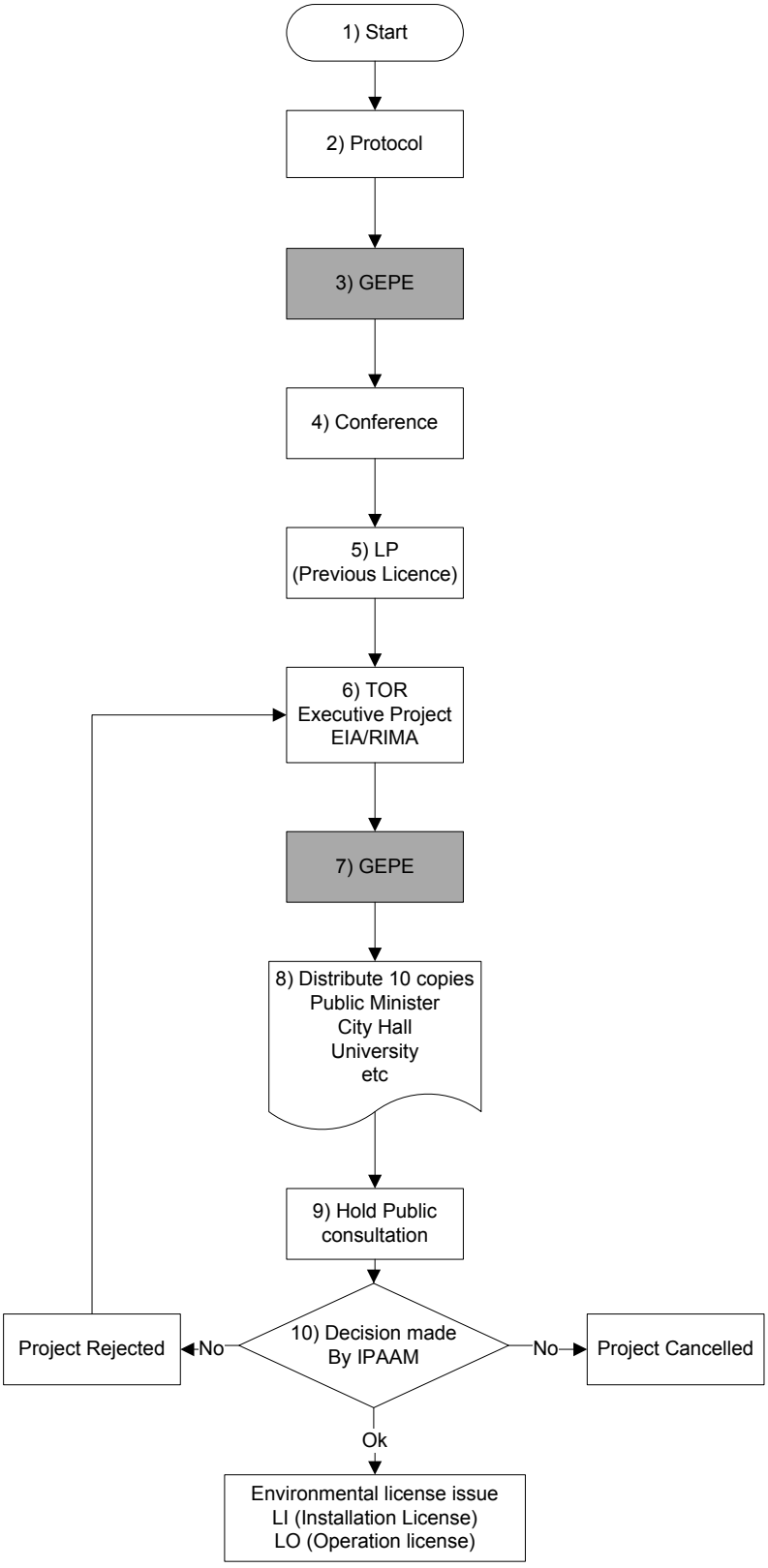


Figure 2-7: Flowchart showing Acquisition of Environmental License in Federal Level

e.2 Amazonas State

The environmental licensing system of Amazonas State significantly differs from it of 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.

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



Abbreviations:
GEPE - SPECIAL PROJECTS MANAGEMENT

RIMA – Summary report of Project for Public consultation

Figure 2-8: Flowchart showing EIA and Acquisition of Environmental License in Amazonas State

f. 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.

g. EIA Public Consultation

Public consultation for a project is stipulated in CONAMA Resolution 09/87 as follows:

The proponent will hold public consultation concerning the impact of the project before the EIA is concluded

To hold a public consultation, it will be implemented upon application by a public organization, agency or body of 50 members or greater.

In the event public comment is offered, IBAMA will hold a public consultation after the disclosure period is over, after the 15th day, and append the PL with advisory based on the results of the discussion.

The procedures for the public consultation conducted by IBAMA (federal) or IPAAM (Amazonas State) are the same as contained in the CONAMA Resolutions.

In Amazonas State, there is no additional legislation to address this issue.

The public participation is set in the environmental licensing process with the objective of:

- Guaranteeing the divulgation of information about the projects to be licensed, specially about the possible risks towards the environmental quality of the influence areas of the project or activity and the mitigating measures meant to reduce such effects;
- Collect the expectations and concerns of the affected populations and allow the managing organization to collect the manifestations and interests of different social groups.

IPAAM, when determining the accomplishment of the Environmental Impact Study and presentation of the RIMA, will set the period to receive the comments to be made by the public organizations and other interested stakeholders and, whenever it is judged as necessary, it will promote the celebration of public information meetings on the project, the impact and discussion of the RIMA.

h. Relevant Agencies and Organizations (Application Structure)

The body that will inspect and approve the environmental license, based on the scale, sector and potential environmental impact of the project, will be the federal (IBAMA), state or municipal agency.

The body responsible for EIA is stipulated in the corresponding sections of Federal Law 7,804/90 and CONAMA Resolution 237/97 as shown in the following table.

Table 2-20: Stipulation of Organizations responsible for EIA

Related Orgs	Projects targeted for Review and Approval
IBAMA	• A project located in any of the following: (1) both Brazil and neighboring countries, (2) within Brazil's territorial waters, (3) within the continental shelf or special economic zone, (4) within a Indio reservation or federal conservation area. • A project is located in two or more states. • Environmental impact of a project affects outside of Brazil or out of State. • A project is related to research, development, production, processing, transportation, storage of radioactive material, or is intended for the application/utilization of nuclear energy (in such cases, it is necessary to seek advice from the Brazilian National Commission for Nuclear Energy (CNEN)) • A project that has been considered for application to military base construction or military use (in such cases, it must in principal comply with special military regulation)
State Organizations	• A project that takes place in one state • A project that takes place in two or more municipalities (including villages and towns), or in an area under federal protection • A project that takes place in a forest designated under Law 4,771/ 65 or other related ordinance, or in a Permanent Preservation Natural Vegetation zone • Environmental impact of a project affects two or more municipalities (including villages or towns) • The Federal government (i.e. Union) has delegated authority to a State or Federal Territory
Municipal Environmental Office	• The Federal or State government has granted authority for approval by law or contract, or by the Federal Territory environmental authority

2.2.5 Management of Hazardous Materials

The Ministry of Environment (MMA) is implementing a project in preparation to introduce PRTR (Pollutant Release and Transfer Register)[1] with technical assistance by the World Bank.[2] The World Bank project for hazardous chemical material risk management as part of their "Environmental Sustainability Agenda" is a component of this project, which includes the following activities.

- Definition of the types of information and data of the emissions of correlate elements.
- Identification of criteria for the selection of priority pollutants
- Proposal of guidelines for the companies and factories obligated to report using PRTR
- Proposal of guidelines for the declaration of emissions and transfers using PRTR.

This project to implement a PRTR system was initiated in 2008, and the proposal for the system was set for March 2009. In the project, the PRTR system will be used mainly by the chemical industries to manage harmful chemical substances. The chemical industry in Brazil is composed mainly of inorganic chemical manufacturing (soda manufacturing, nitric acid

[1] In Brazil, this is referred to as, Registro de Emissão e Transferência de Poluentes (RETP).
[2] According to the Brazil Ministry of Environment homepage and "Kick –off Workshop to launch a PRTR Projects for Latin America and the Caribbean NCPCs, June 2008".

production, phosphorus, fertilizer manufacturing, and industrial gas manufacturing), and organic chemical goods manufacturing (petrochemical and plastic resin manufacturing), agrochemical manufacturing, paints, solvents, ink manufacturing, catalyst agents, additive manufacturing, and so on, with 7,263 offices throughout the country in 2005 (about 13% of the total number of offices in Brazil).

2.2.6 Current Effects on the Environment

Based on available data the following effects of industrial waste on the environment are identified.

a. Water Pollution

Social and Environmental Program for the Igarapes in Manaus (PROSAMIM) financed by Inter-American Development Bank (IDB) is being carried out in the Study Area. "Industrial Pollution Prevention and Control Plan (PCCI)" is conducted as one of the components of PROSAMIM project. PCCI described the water quality of Igarape 40 of which catchment area covers Industrial District (DI) 1 and 2, as follows:

- The water quality of Igarape 40 is very bad due to domestic wastewater from population in the catchment area as well as industrial waste water from DI 1 and 2.
- Coliform index ranges from 250,000/100ml to 1,400,000/100ml. (Concremat, 2004)
- Dissolved Oxygen (DO) ranges from 0.4 to 3.0 mg/l. (Concremat, 2004)
- The water quality of Igarape 40 is contaminated by heavy metals of industrial wastewater such as copper, manganese, iron, zinc, nickel, cadmium, chromium and Lead. Its concentration is above the discharge standard established by the CONAMA Resolution 20/86.

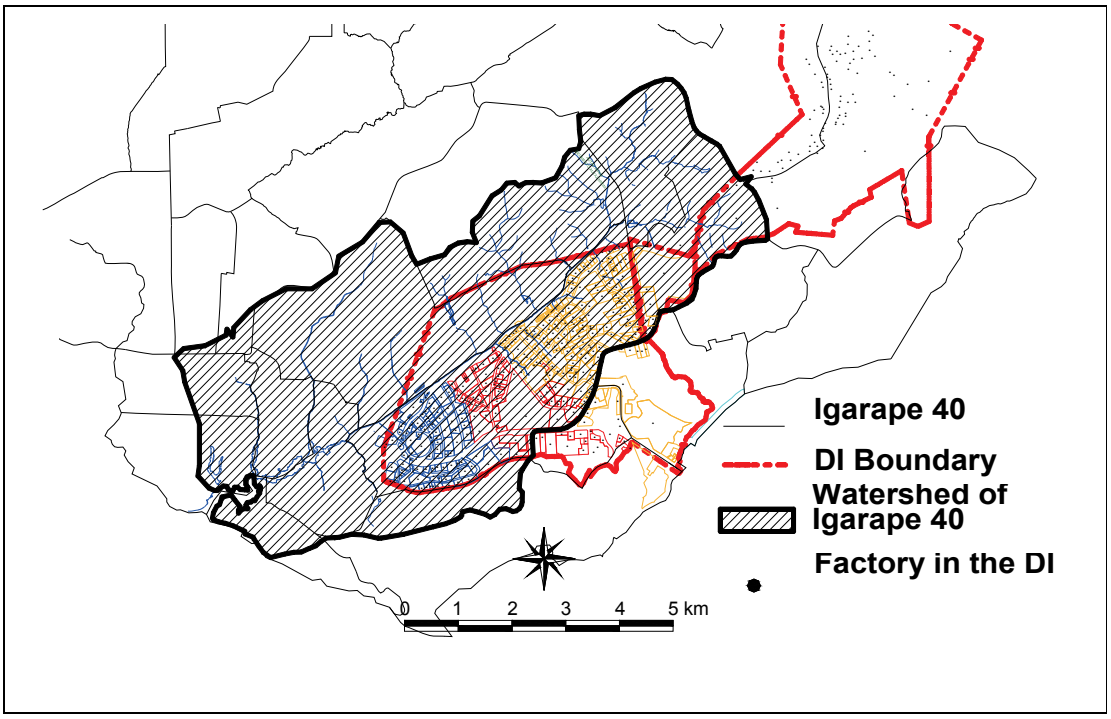


Figure 2-9: Industrial Districts (DI) 1 & 2 and Igarape 40

b. Illegal Dumping of Industrial Waste

In order to understand the situation concerning the illegal dumping of industrial waste, the Study Team investigated 16 illegal dumping sites in DI 1 & 2 in the beginning of April 2009. 15 sites, except one site located in DI 2, are cleaned and restored by SEMULSP. The waste illegally dumped at the site was health-care waste. It is doubtful that a collection company dumped the waste because of health-care waste and the dump site location, i.e. far inside of the DI 2.

Cleaned and Restored Dump Site in DI 1

Illegally Dumped Health-care Waste in DI 2

3. Supplement Studies on Current Conditions

3 Supplement Studies on Current Conditions

3.1 Contents of Supplement Studies

3.1.1 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).

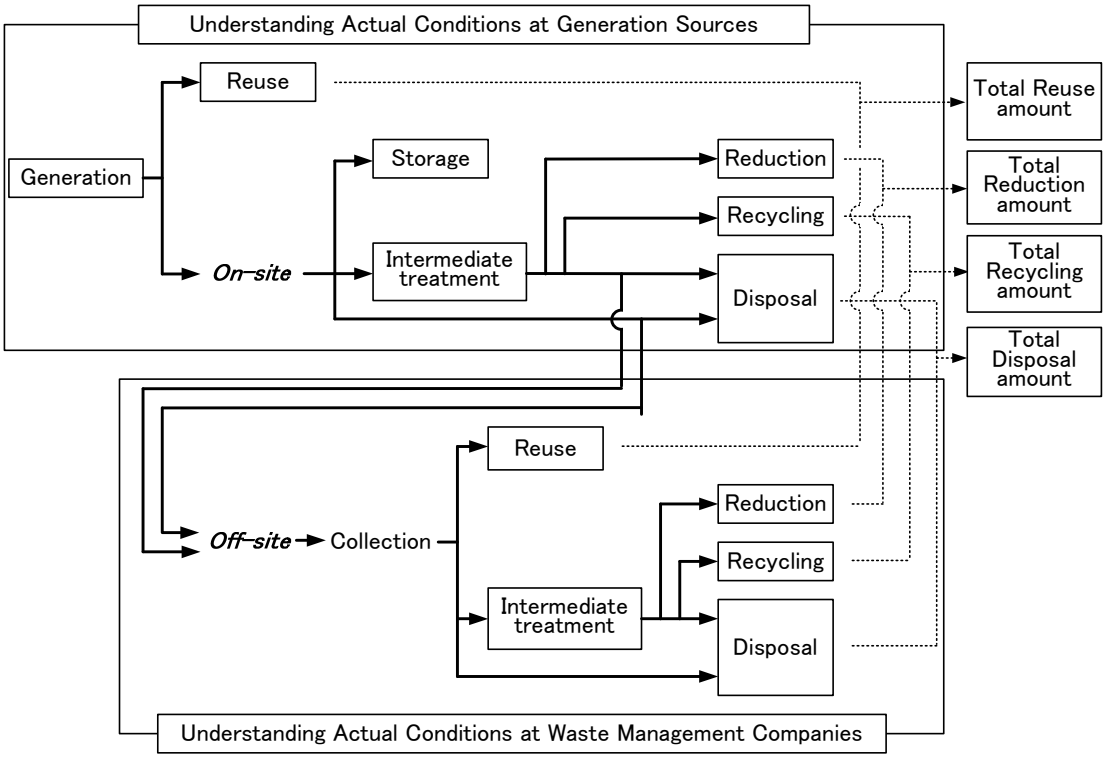


Figure 3-1: Waste Treatment Stream

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 was conducted to grasp the current conditions of off-site management.

3.1.2 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 has 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 described in each study report.

3.2 Study of Waste Service Companies

3.2.1 Outline of the Study

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, mentioned below, in order to clarify the waste stream after it is discharged from the PIM.

b. Study Method

A local consultant (OPCA: Olavo Branga & Paulo Farias Consultores Ambientais Ltda) was consigned to conduct the study. The local consultant visited and conducted interviews with waste service companies 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. 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. The following items were included in the questionnaire:

- General company information, number of employees, annual sales amount
- Types and amount of industrial waste handled
- Condition of equipment and facilities for collection and transportation, treatment (reuse, recycle, making harmless, etc.) and final disposal
- Industrial waste clients
- Approach toward and actual conditions of system and equipment for appropriate waste management
- Operational and environmental problems waste service companies are facing
- Demands related to government administration

- Other

c. Study Schedule

A local consultant (OPCA) was consigned to conduct the study on 6 April 2009. Beginning in late April, after preparations for the survey were made, the local consultant began the survey and completed interviews with 90 companies by the end of July. This data was to be compiled by the end of August, however, there were delays due to a necessity to clarify and add a number of companies not contained on the list received from IPAAM. Consequently, the interview survey has been conducted by the end of September and compilation of the results has been completed in November 2009.

3.2.2 Selection of Target Waste Service Companies

a. Registration System for Waste service companies in the State of Amazonas

Registration of waste service companies is handled by the Institute of Amazonas Environmental Protection (IPAAM). However, IPAAM does not register the companies themselves, but instead registers the environmental license of the waste service companies. The primary activity of IPAAM for environmental administration is to issue and manage environmental licenses, monitoring, and inspection; in this way, waste service companies are managed through the approval and issuance of environmental licenses.

b. Environmental Licensing

In the State of Amazonas, an environmental license must be obtained for any activity (industry) that could potentially impact the environment (Derecto No 10028 de 04 de Febreiro de 1987). These licenses are required not only for the installation and operation of factories, but for most activities where environmental impact is likely, including construction projects, agricultural, medical and so on. There are three environmental licenses, as follows: previous license, installation license and operation license.

c. IPAAM List of Waste Service Companies (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 compile a list of waste related activities, as shown in the table below.

Table 3-1: Waste Service related Codes of IPAAM for Environmental Licensing

Code	Class	Code	Sub-Class	
				Impact
22＊＊	Commerce and Services	2217	Incineration	High
		2218	Co-processing of wastes	High
		2219	Agrochemical Collection Center	Moderate
24＊＊	Other Services (including provision of electricity and water)	2407	Solid Industrial Waste Collection and/or Treatment	High
		2408	Municipal Waste Final Destination	High
		2410	Collection and Transport of Inert Solid Waste	Minimal

		2411	Collection and/or Storage and/or Commercialization of Solid Waste (e.g. recycling)	Moderate
		2412	Collection and/or Treatment of Hazardous Liquid Industrial Waste	High
		2417	Industrial Waste Disposal in Landfill	High
26＊＊	Transportation	2615	Transport and Storage of Hazardous Solid Industrial Waste	High
30＊＊	Waste Treatment and Recycling	3001	Treatment and Recycling of Solid Industrial Waste without chemicals	Moderate
		3002	Treatment and Recycling of Industrial Liquid Waste	Moderate
		3003	Treatment and Recycling of Solid Industrial Waste without Chemicals	High
		3004	Treatment and Recycling of Palettes	Moderate
		3005	Paper and Cardboard Recycling	Moderate
		3006	Treatment and Recycling of Mineral Waste (Waste Re-processing)	Moderate

Source: Classificacao das Fontes Poliudoras IN 001;06 Publicada em (3/12/2007)

IPAAM and the study team agreed that the companies with the above sub-class codes would be the targets for the survey of waste service companies. As a result, 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.

d. Selection of Target Companies for the Survey

A local consultant (OPCA) was hired to conduct the study using the IPAAM list of waste service companies to contact the companies and ask them to participate in the survey. As shown in the table below, the survey was carried out with 35 companies.

Table 3-2: Results of Survey Participation using IPAAM WSC List

Survey Results		No. of Companies
1	Conducted survey	35
2	Companies with multiple environmental licenses	8
3	Target companies that could not be identified *1	17
4	Declined to participate	18
5	Target company does not exist, or ceased waste management operations	4
6	Target company not involved in waste management	2
Total		84

Note: *1: These companies could not be found when visiting the location as indicated on the environmental license, nor could it be identified via the phonebook, Internet, etc.

3.2.3 Execution of the Survey

a. Execution of the Survey

Of the companies on the IPAAM WSC List, only 35 could be surveyed. Then, the local consultant identified 55 waste service companies based on interviews with factories and waste service companies so that, as of September 30, 90 waste service companies were surveyed. The table below shows which of these companies currently has an environmental license for operation.

Table 3-3: Operating License Ownership (of 90 Waste Service Companies)

Operating License Ownership	No. of Companies
Has license	67*1
Does not have license	23*2
Total	90

Note *1: Of these 67 companies, 35 were identified on the IPAAM WSC List, and 25 were identified by the local consultant.

*2: These 23 companies were identified by the local consultant

b. Issues Identified from the Survey

Although the IPAAM environmental licenses have been digitized, the following issues were identified:

- The database server is old and does not function sufficiently. Furthermore, the database system is used for file management (to track where certain files are located), and thus is not set up for license management.
- Other information about IPAAM activities is mixed with the environmental license data and managed in the same database, making it extremely difficult to extract the license information needed.
- As shown in Table 3-1: Waste Service related Codes of IPAAM for Environmental Licensing, waste service companies are registered by codes for various related activities.

It became evident that not all of the waste service companies were shown in the IPAAM WSC List because it only lists those companies which have a code for waste management related activities. Also, once a list was compiled of the companies that are no longer in business or ceased their waste management related activities, it was not possible to identify them in the IPAAM WSC List, suggesting that licenses are not properly renewed and pointing to the need for a series of improvements to be made.

IPAAM indicated that improvements will be made to their registration system for waste service companies so it will be more effective. Furthermore, those companies without environmental licenses will be encouraged to register, and the system reinforced by updating the database of IPAAM waste service companies—which will be constructed during this study.

3.2.4 Results of the Survey

a. Waste Service Company Survey and Environmental Licensing

a.1 Environmental License Owners

There were 90 waste service companies (WSCs) surveyed from which the following results were found.

- Companies that have obtained environmental licenses: 67
- Companies that have not yet obtained environmental licenses: 23

a.2 Responses from WSCs by business sector and business conducted

The following table is based on the responses from 90 WSCs surveyed showing the business sectors divided into 4 categories of 1) collection and transportation, 2) intermediate treatment, 3) final disposal, and 4) reuse and recycling. Some companies were engaged in multiple practices, so the total number amounts to 127.

Table 3-4: Responses from WSCs according to business sector

Environmental License Ownership	1) Collection and transportation	2) Intermediate treatment	3) Final disposal	4) Reuse and recycling	Total
Yes	41	9	10	42	102
No	7	0	0	18	25
Total	48	9	10	60	127

The above results were summarized according to amount of business conducted (management amount) into four categories, based on the answers of 90 companies, as follows.

Table 3-5: Responses from WSCs by business sector and business conducted (management amount)

Unit: ton/Day

Business Sector	Waste Division	Env. License Owner	No Env. License	Total
Collection and Transportation	Hazardous	97	0	97
	Non-Hazardous	3,240	6	3,246
	Sub-total	**3,337**	**6**	**3,343**
Intermediate Treatment	Hazardous	42	0	42
	Non-hazardous	266	0	266
	Sub-total	**308**	**0**	**308**
Final Disposal	Hazardous	8	0	8
	Non-Hazardous	2,250	0	2,250
	Sub-total	**2,258**	**0**	**2,258**
Reuse and Recycling	Hazardous	11	0	11
	Non-Hazardous	166	1	168
	Sub-total	**177**	**2**	**179**

a.3 Business Sector and Business Conducted (Management Amount) as analyzed by the Study Team

The following table shows the business sector of 67 waste service companies that have environmental licenses based on an examination by the study team with support from the local consultant.

Table 3-6: 67 WSC Environmental License Owners by business sector

Env. License Ownership	Collection and Transportation	Intermediate Treatment	Final Disposal	Reuse and Recycling	Not Classified*1	Total
Yes	26	24	0	21	4	75

Note *1: The business sector could not be identified on the license. The licenses indicated the following: 1. Distribution and supply of water (2 companies), 2. Spray and cleaning with insecticide (1 comp.), 3. Retailer of wood products (1 comp.)

As shown in the table above, waste service companies that responded they own the final disposal operation license, but the result of checking the 67 companies revealed that none of them owns the license. In the State of Amazonas, and including Manaus City, there is no final disposal site which owns an environmental license, so it is reasonable that the findings of the study team pertaining to final disposal are valid. In addition, problems with the licensing of other waste service companies have been confirmed as follows. A description of the above table is given as follows:

- Not classified: Case where a WSC is conducting incineration treatment with an environmental license for water supply, not waste disposal. In this case, a license should clearly be obtained for waste disposal activities.
- Reuse and Recycling: Of the 17 companies classified for reuse and recycling, 11 companies have an environmental license code for that other than waste-related activity. Paper or aluminum processing plants are using their primary business licenses to conduct reuse or recycling of waste as part of their operations. In this case, in addition to their primary business license, it is necessary to investigate the framework for a new license, such as obtaining a license for the reuse and recycling of waste.
- Intermediate treatment: There are many businesses that should be categorized not under intermediate treatment, but under reuse and recycling.

Solutions to the above challenges are closely related to how the database to manage WSCs at IPAAM is constructed and the policy used to manage it.

Table 3-5: Responses from WSCs by business sector and business conducted (management amount), was reorganized according to Table 3-6: 67 WSC Environmental License Owners by business sector. The findings show the waste service amount by 90 WSCs according to their ownership of environmental licenses at present.

Table 3-7: WSCs by business sector and business conducted as Examined by the Study Team

Unit: ton/Day

Business Sector	Waste Type	Env License Owner	No Env License	Total
Collection and Transportation	HIW	52	45	97
	Non-HIW	2,895	350	3,246
	Sub-total	**2,948**	**395**	**3,343**
Intermediate Treatment	HIW	42	0	42
	Non-HIW	265	1	266
	Sub-total	**307**	**1**	**308**
Final Disposal	HIW	0	8	8
	Non-HIW	0	2,250	2,250
	Sub-total	**0**	**2,258**	**2,258**
Reuse and Recycle	HIW	10	1	11
	Non-HIW	13	155	168
	Sub-total	**23**	**156**	**179**

a.4 Location of WSCs

The location of the 90 companies is shown in the table below. Of these, 87 are located in the industrial district or in the city of Manaus.

Table 3-8: Location of WSCs

Location	License Owner	No License	85 Companies	Ratio
1. Industrial District 1	9	6	15	17%
2. Industrial District 2	12	1	13	14%
3. Outside of Industrial District, but inside of Manaus City Zone	43	16	59	66%
4. Outside of Manaus City Zone	3	0	3	3%
Total	67	23	90	100%

a.5 Size of WSCs (Number of Employees)

The number of employees at waste service companies was sought according to their possession of an environmental license.

This survey revealed that number of (managerial and operational) employees at small or very small enterprises with less than 10 employees was 36% (i.e. 32 of 90 companies), but for the 21 enterprises without an environmental license, it was found that 21 were small or very small enterprises. On the other hand, of the 9 large enterprises with over 100 employees, the number of businesses that specialize in industrial waste management—thus excluding cement production, sale of construction materials and collection or disposal of municipal waste—was three. Presently, these large waste service companies are made up of three central groups.

Table 3-9: Size of WSCs and License Ownership

No. of Employees	90 Companies	Ratio	Env License Owner	No Env License
1. Less than 10	32	36%	11	21
2. 10 – 50	39	43%	38	1
3. 50 – 100	7	8%	7	0
4. More than 100	9	10%	8	1*1
5. No answer	3	3%	3	0
Total	**90**	**100%**	**67**	**23**

Note *1: There was one company with over 100 employees and no environmental license which sells construction materials as its primary business.

b. Collection and Transportation

b.1 Amount Collected/Transported

Of the 90 WSCs surveyed, the total amount collected and transported, as shown in the following table, is 3,343 ton/day. This amount is some five times the total amount of 628.9 ton/day of industrial waste discharged from PIM according to the factory survey.

Thus, a detailed analysis of the collection companies from the results of the survey of 90 WSCs is as follows.

Table 3-10: Detailed Breakdown by Scale of Business Conducted (Collection and Transportation) of Collection and Transportation Companies

Scale (collection amount)	WSCs for Collection and Transportation	Hazardous Waste	Non-Hazardous Waste	Total
Without License	20*1	44.7	350.3	395.0
1. less than 100 ton/day	19	4.1	148.5	152.6
2. 100 to 300 ton/day	1	40.6	201.8	242.4
With License	19*2	52.4	2,895.4	2,947.9
1. less than 100 ton/day	14	27.4	160.9	188.3
2. 100 to 300 ton/day	3	17.1	471.2	488.3
3. more than 300 ton/day	2	8.0	2,263.3	2,271.3
Grand Total	39	97.1	3,245.7	3,342.8

Note *1: 20 of the 22 companies responded with their collection amounts

*2: 19 of the 26 companies responded with their collection amounts

According to the table above, the two companies which are collecting over 300 ton/day are the two companies contracted to collect the municipal solid waste (MSW) of Manaus City. Thus, if this collection amount is taken to be MSW, the remaining collection and transportation amount is 1,071.5 ton/day. The following table summarizes the collection and transportation amount information obtained in the Off-site Survey (Survey of WSCs) and On-site Survey (survey of PIM generation sources: factories, medical institutions, construction). With the exception of the two companies that are clearly collecting MSW, the collection and transportation amount from the Off-Site Survey resembles that which was

found for the On-Site Survey (Survey of generation sources) of PIM manufacturing, construction, and health-care waste.

Table 3-11: Comparison of Off-Site Survey and On-Site Survey Results for Collection and Transportation Amount

Unit: ton/day

Waste	Off-site Survey Results	On-site Survey Results
1. Total Amount Collected/Transported	3,342.8	NA
2. Municipal Waste (2 companies)	2,271.3	NA
3. Industrial Waste	NA	591.5
4. Construction Waste	NA	37
5. Health-care Waste	NA	0.4
3 + 4 + 5	1,071.5	628.9

b.2 Conditions of Collection and Transportation

A large amount of recyclable material, such as plastic, paper and cardboard, and metals collected from MFZ is handled by large companies. In other words, the three major waste collection and transportation companies send their employees to waste centers located in the factories of large waste generating companies and have exclusive access to conduct separate collection of their recyclable materials. Based on this study, most used paper and 80% of scrap metal is collected by the three large collection and transportation companies. One of these large companies collects most of the waste plastic, and after separation and removal of foreign material, melts it will an extruder, cools it and makes pellets which are then used as raw material to make recycled plastic resin, and finally plastic products which are sold to manufacturing companies.

There is a factory that reuses waste paper in the study area, but no factory that reuses scrap metal, so with the exception of aluminum, most of the scrap metal is sent to companies in Sao Paulo, Rio de Janeiro and other places.

c. Intermediate Treatment

c.1 Intermediate Treatment, Reuse and Recycling

Since intermediate treatment has the function of producing valuable by-products such as compost, electricity, etc. the difference between intermediate treatment and reuse/recycling is generally a difficult issue. It is necessary to clearly regulate these in order to separate them.

The difference between the environmental licenses (EL) needed for intermediate treatment and reuse/recycling is unclear, and company declaration is also ambiguous. The following table shows the differences of the business practices based on the license of the 67 WSCs as well as the business practices as declared in their responses.

Table 3-12: Business Practices based on the Licenses of 67 WSCs with Env Licenses and the Business Practices of 90 WSC Respondents

Env License Ownership	1) Collection and Transportation	2) Intermediate Treatment	3) Final Disposal	4) Reuse/Recycling	Total
1. Total WSC Respondents	**48**	**9**	**10**	**60**	**127**
Those without an EL	7	0	0	18	25
Those with an EL	41	9	10	42	102
2. Business practices based on the licenses of 62 WSCs	**26**	**24**	**0**	**21**	**71**

c.2 Intermediate Treatment Amount

As can be seen in the table above, there is a large difference concerning intermediate waste treatment between the WSC respondents (9 companies) and the business practices based on environmental licenses (24 companies). Thus, the amount of intermediate treatment was summarized based on the answers from companies as shown below. This table indicates only one WSC treats 90% of wastes for intermediate treatment.

Table 3-13: Breakdown according to Scale of Intermediate Treatment Companies based on the Responses of Waste service companies (7 companies [*1])[*2]

Unit: ton/day

Scale (Intermediate Treatment Amount)	Intermediate Treatment Companies	Hazardous Waste	Non-Hazardous Waste	Total
Without License	2	0.2	0.7	0.9
1. less than 100ton/day	2	0.2	0.7	0.9
With License	5	41.9	265.6	307.5
1. less than 100ton/day	4	1.3	29.0	30.3
2. 100 to 300 ton/day	1	40.6	236.6	277.2
Grand Total	7	42.1	266.3	308.4

Note *1: 7 out of 9 companies responded with their intermediate treatment amount

*2: In this study, the largest treatment company of health-care wastes was not included.

The results for intermediate treatment were summarized for the off-site (survey of WSCs) and the on-site (PIM generation sources: factories, medical institutions, construction projects) survey results. The result shows similar values.

Table 3-14: Comparison of intermediate treatment amount for the Off-site Survey and the On-site Survey

Unit: ton/day

Waste	Off-site Survey Results	On-site Survey Results
1. Total Amount of Intermediate Treatment	308.4	246.5
2. Non-HIW of the 1. (above)	266.3	175.4
3. HIW of 1. (above)	42.1	71.1

c.3 Conditions of Intermediate Treatment

There are 25 companies that have environmental licenses for intermediate treatment, but of those, many are actually conducting recycling operations. One waste treatment company is conducting incineration service, and is treating a large amount of waste. The only cement factory in Amazonas State is conducting co-processing in its cement kiln. Based on the study data, the waste primarily being treated/used is waste tires (300 ton/month), waste molding sand (95 ton/month), and sludge from plating (30 ton/month). Mixing in the materials yard, they also input waste to the kiln (into a suspension pre-heater hatch), but the waste is brought up by a conveyor not an elevator and also requires manpower. Also, there is a little substitution of fuel with waste oil, the authentic treatment/reuse is happen from now.

d. Reuse/Recycle

d.1 Reuse/Recycle Amount

Similar to intermediate treatment, there is a large difference for reuse and recycling claimed by the WSC respondents (60 companies) and the business practices based on environmental licenses (21 companies). Thus, the reuse/recycle amount was based on the response from companies and summarized in the table below. This table indicates 82% (14 of 17 WSCs) are small companies which manage less than several ton of waste per day.

Table 3-15: Breakdown of Reuse/Recycle Amount by Scale of Company according to WSC Respondents (49 companies *1)

Unit: ton/day

Scale (Reuse/Recycle Amount)	Reuse/Recycle Companies	Hazardous Waste	Non-Hazardous Waste	Total
Without License	32	10.3	22.2	32.5
1. less than 100ton/day	32	10.3	22.2	32.5
With License	17	0.8	145.7	146.5
1. less than 10ton/day	14	0.8	17.3	18.1
2. 10 to 50ton/day	2		61.7	61.7
3. more than 50ton/day	1		66.7	66.7
Grand Total	49	11.1	167.8	178.9

Note *1: 49 of 60 companies responded with their reuse/recycle amount

The results for reuse and recycle amount were summarized for the off-site (survey of WSCs) and the on-site (PIM generation sources: factories, medical institutions, construction projects) survey results. The off-site survey and the on-site survey results show similar values.

Table 3-16: Comparison of Survey Results (Reuse/Recycle Amount) for WSCs and PIM Generation Sources (factories, medical institutions, construction projects)

Unit: ton/day

Waste	Survey Results of WSCs	Survey Results of PIM Generation Sources
1. Total Amount of Reuse Recycle	178.9 (487.3)	220.2 (466.7)
2. Non-HIW of 1. (above)	167.8 (434.1)	200.2 (375.6)
3. HIW of 1. (above)	11.1 (53.2)	20.0 (91.1)

Note *1: The number in parentheses are the total of intermediate treatment amount and reuse/recycle amount

d.2 Conditions of Reuse/Recycle

There are 60 companies that are conducting the reuse and recycling of waste, including those which do not possess an environmental license. However, upon examination of the environmental licenses themselves, there were 17 companies. Of these 17, there were 11 that had an environmental license code other than for waste management. All of them were conducting the reuse and recycling of industrial waste. As above, time is being given to check the activities of reuse and recycling activities. Even for those companies that do have licenses, there are many uncertainties concerning their activities. The reason for this is that the environmental license is only specified under "(industrial) activities that have potential environmental impact" for waste treatment and recycle (30＊＊) subcategory 3004 for treatment and recycling of palettes, and 3005 for recycling waste paper products and cardboard, whereas the other activities are ambiguous concerning this point.

Table 3-17: Waste Treatment and Recycling Activities for (Industrial) Activities with Potential Environmental Impact

Category Code	Category Description	Subcategory Code	Subcategory Description	Potential Impact
30＊＊	Waste Treatment and Recycling	3001	Solid Industrial Waste Treatment and Recycling without the use of chemicals	Mid
		3002	Treatment and Recycling of Liquid Industrial Waste	Mid
		3003	Solid Industrial Waste Treatment and Recycling with the use of chemicals	High
		3004	Treatment and Recycling of Palettes	Mid
		3005	Recycling of Waste Paper Products and Cardboard	Mid
		3006	Treatment and Recycling of Metal Waste (Waste Reprocessing)	Mid

Source: Classificacao das Fontes Poliudoras IN 001;06 Publicada em (3/12/2007)

The types of waste that are reused/recycled in the study area are limited to: used lubricating oil, used molding sand, aluminum scrap, waste paper, used paint, and used ink cartridges from printers, etc.

e. Final Disposal

e.1 Final Disposal Amount

Out of the WSCs surveyed, nine responded that they conduct final disposal activities. However, the results of examining the environmental licenses of the companies that responded revealed that none of them have environmental licenses for final disposal. Also, IPAAM reported that there is no landfill in MFZ, including the Manaus city landfill, which is not licensed for final disposal. Therefore, the following table summarizes the amount of final disposal based on the respondents.

Table 3-18: Breakdown of the Scale of Final Disposal Amount based on the WSC respondents (6 companies *1)

Unit: ton/day

Scale (Final Disposal Amount)	Final Disposal Company	Hazardous Waste	Non-Hazardous Waste	Total
Without License	6	8.0	2250.1	2258.1
1. less than 100 ton/day	4	0.0	3.0	3.0
2. more than 300 ton/day	2	8.0	2247.0	2255.0
Grand Total	6	8.0	2250.1	2258.1

Note *1: 6 of 9 companies responded their collection amount

In the above table, the 2 companies that conduct final disposal of more than 300 tons/day are the two disposal companies contracted to collect municipal waste in Manaus City and dispose of it using the city landfill. The amount collected and transported by these two companies is 2,271.3 ton/day, which is largely consistent with the final disposal amount. Therefore, the table above does not include the final disposal amount revealed in the On-site Survey of manufacturing (industrial), construction and health-care waste from PIM, which is 135.8 ton/day (98.5 + 37.0 + 0.3, respectively).

It is assumed that this amount of waste is being disposed of in landfill sites other than the Manaus city landfill.

e.2 Conditions of Final Disposal

Final disposal operation of the WSC respondents (9 WSCs) is categorized into the following categories.

Table 3-19: Type of Final Disposal Operation by WSC Respondents (9 WSCs)

Industrial + Health-care + Construction Waste	Construction Waste	Municipal Solid Waste	Wastewater Disposal	Total
1	3	2	3	9

There are two companies which are contracted by Manaus City that collect and dispose common waste. These two companies also collect and dispose medical and construction waste from factories in the industrial districts, etc. However, without their own final disposal sites, they must use the Manaus City final disposal site. There are three companies that dispose of construction waste which also use the Manaus final disposal site. Only one company has its own final disposal site for industrial waste, but the problem is that it began part of its operations before receiving approval for an (operation) environmental license from IPAAM. The EIA for this facility was not approved in a public hearing and has been ordered to suspend operations by the Amazonas State Attorney's Office.

f. Off-Site Industrial Waste Management Issues

Interviews during the survey of WSCs and related companies raised the following issues.

f.1 Issues Revealed in the Survey of WSCs

f.1.1 Enforcement of Laws and Regulations

- The government policy on industrial waste management is unclear and ambiguous (52 of 85 respondents)
- Insufficient industrial waste management system, monitoring (55 of 85 respondents)
- In the study area, not all of the companies are using a manifest (29 of 89 respondents are using a manifest)
- Illegal dumping is a problem (77 of 88 respondents)
- Overall social awareness of waste management is low (79 of 88 respondents)
- The capacity of organizations regulating and controlling waste management need to be strengthened (64 of 85 respondents)

f.1.2 Business Environment of WSCs

- There is no system of financial support (tax exemption, etc) from public organizations for waste management equipment or pollution control equipment. Companies would like to see such support. (60 of 66 respondents)
- A database for waste discharge is needed (72 of 79 respondents)
- Instruction and training on waste management is needed (73 of 79 respondents)
- High cost of electricity contribute to high costs (63 of 79 respondents)
- There is no wastewater treatment system that covers all of the industrial districts or Manaus city area (54 of 83 respondents)

f.2 Issues Revealed through Interviews with Stakeholder Organizations and Site Visits to WSCs

f.2.1 Environmental Licensing

These issues are from analysis of the environmental licenses offered by the Institute of Amazonas Environmental Protection (IPAAM) and related documents, as well as interviews with IPAAM.

- IPAAM has entered information on environmental licenses into a database, but the server is old and does not function sufficiently. Furthermore, the database system serves to support document management, not a system to manage the licenses.

Companies also feel that the approval and renewal process for licenses from IPAAM is slow.

- Of the activities that require environmental licenses because of potential environmental impact, the activities related to waste management are distributed to more than one classification, so it is necessary to integrate and restructure them.
- The activities listed on the environmental licenses are too common. Also, the activities that companies have been approved for often differ from the actual activities they are engaged in, and it is necessary for them to obtain licenses for those activities.
- There seem to be many cases where recycling activities have been granted environmental licenses with the code for treatment. Also, some companies are using waste has raw material (companies that are recycling waste) and have environmental licenses for the production of those products, so it is necessary to investigate the recycling activity code.
- IPAAM needs to strengthen its monitoring of approval conditions and regulatory requirements written on the environmental licenses.

f.2.2 Manifest

- Dischargers are not obligated to the manifest (industrial waste management sheets) by law or regulation. Also, the forms used for the manifest are from companies, not uniform.

f.2.3 Enforcement of Laws and Regulations

- The rights and responsibilities of the Municipal Secretariat of the Environment (SEMMA) and IPAAM for the enforcement of environmental laws and regulations are unclear. WSCs are dissatisfied with this.
- The Brazilian Association for Technical Specifications of waste categories, regulation ABNT 10004 is too detailed and difficult to utilize because it is impractical. Also, it is not generally understood.
- There are very few staff members or engineers with knowledge and experience with waste management at IPAAM, and SUFRAMA.

f.2.4 Lack of Companies with Appropriate Equipment and Skills, and Lack of Infrastructure (Facility)

- Only one company has its own final disposal site for industrial waste, but the problem is that it began part of its operations before receiving approval for an (operation) environmental license from IPAAM. The EIA for this facility was not approved in a public hearing and has been ordered to suspend operations by the Amazonas State Attorney's Office.
- In the study area, there are almost no companies dealing in the reuse of iron and non-ferrous metal scrap (except aluminum). Such waste is collected and sent to companies in places like Sao Paulo and Rio de Janeiro.

f.2.5 Unclear Treatment and Disposal Stream of Hazardous Waste

- One company that refused to cooperate with the survey of WSCs has been indicated to deal with a large amount of waste, and is manufacturing and selling asphalt filler made of a mixture of 5% waste. It is unclear whether this company is dealing with hazardous wastes.

- Non-hazardous waste and health-care waste from factories in the Industrial Districts are being disposed of in the Manaus City municipal landfill. However, in the cases where factory hazardous waste and health-care waste is not well separated from non-hazardous waste, it ends up being disposed of in the municipal landfill.

f.2.6 Business Environment of WSCs

- Co-processing of wastes in a cement kiln has begun, but the amount of waste in the study area is unclear so this has not been fully developed. The cost of co-processing is competitive with the cost of incinerating waste and final disposal.

3.3 Study of Waste Management in Factories

3.3.1 Outline of the Study

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 (SEA LTD.) was consigned to conduct the study. The local consultant visited and conducted interviews with 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. The following items were included in the questionnaire:

- General factory information, factory name, type of industry, number of employees, scale of production, value of annual shipment
- Kinds of industrial wastes, amount generated and amount discharged
- Storage, treatment and reuse/recycle methods for industrial wastes, and related costs (on- and off-site information)
- Needs for government administrative support
- Problems faced with management of industrial wastes
- Needs for a waste exchange database
- Future production plans, process improvements, environmental measures, etc. to be taken
- Existence of a clinic on premises
- Discharge of radioactive and construction waste
- Other

c. Study Schedule

A local consultant (SEA LTD.) was consigned to conduct the study on 27 March 2009. Immediately after the contract was signed, the trial survey was implemented, and upon appropriate revisions and additions to the draft questionnaire sheet, a full-scale survey was begun in late April, and the direct interviews were to be completed by late July. The results were to be compiled into a report in August, but delays in the interview process led to an extension into September. Therefore, the first analysis report was made based on the data from 134 factories obtained by August 17th. When the direct interviews were completed at the end of September, the additional data from the 53 factories were included and the first analysis report was modified to reflect those additions.

The primary causes for the delay in the factory survey were as follows:

- Although a draft of the questionnaire sheet was sent in mid-May to 339 factories, by the end of July, only 106 factories, at most, had returned the completed questionnaires.
- Furthermore, direct interviews were to be conducted based on the returned questionnaires, but the time required to obtain permission to visit the factories were greater than expected.

3.3.2 Target Wastes

a. Categories of Industrial Waste in CONAMA Resolution 313

The National Environment Council (CONAMA) issued their Resolution 313 on 29 October 2002. CONAMA Resolution 313 requires specified industries to report (using a waste inventory) on management conditions for industrial waste generated through industrial activity. CONAMA Resolution 313 designates that the inventory is produced in accordance with the Brazilian Association of Technical Standards (ABNT) NBR 10004, which stipulates the categorization of wastes.

b. Target Wastes

The target wastes are those generated by PIM which are designated in CONAMA Resolution 313 for inventory formulation.

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[1], 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.

[1] 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.

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

- Non-HIW (Non Hazardous Industrial Waste) generated from Non-production process
- HIW (Hazardous Industrial Waste) generated from Non-production process
- Non-HIW generated from Production process
- HIW 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, 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 table below.

Table 3-20: Non-Hazardous Industrial Waste Categories used in the Study

Type of Non-HIW	Non-HIW 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
Rubbers 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

Table 3-21: Hazardous Industrial Waste Categories used in the Study

Type of HIW	HIW Code	Example of HIW
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

3.3.3 Selection of Target Factories

a. Basic Considerations

At the beginning of the study, the Study Team planned to select 200 factories[1] located in PIM and it was planned to select 180 PIM factories and 20 PIM subcontractors and 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.

b. Factory Industrial Sectors for Conducting Survey of Generation Sources

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.

[1] 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.

c. Factory List

SUFRAMA formulates a list of PIM factories[1], hereafter referred to simply as the SUFRAMA factory list. In this list, the PIM factories are divided into four categories, or parts.

1. Part 1: Complete Projects Approved and Installed in PIM
2. Part 2: Simplified Projects Approved and Installed in PIM
3. Part 3: Complete Projects Approved and Under Installation in PIM
4. Part 4: Simplified Projects Approved and Under Installation in PIM

Here, the division between complete and simplified depends on criterion such as production output—complete projects are 2 million USD and above.

d. Selection of Target Factories

The target factories for the study were chosen by selecting 200 from the total 457 listed in Part 1 and 2 of 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 were 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 (SEA LTD.) was consigned to carry out the survey.

Although the Study Team intended to 200 factories, due to the following difficulties, the local consultant has completed 187 factories. 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.

Table 3-22: 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

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

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

3.3.4 Execution of the Survey

a. Survey Procedures

The procedures which were carried out for the survey are shown in the following figure.

First, a trial survey was conducted in order to complete the draft questionnaire. Next, the modified questionnaire was to be sent to all 457 target factories accompanied by a letter from SUFRAMA requesting their cooperation for the study. Then, when the questionnaires were returned, upon looking over the responses, direct interviews were conducted at the factories to complete the questionnaires.

The questionnaire sent to target factories is shown in the Supporting Report, sub-section 2.2.

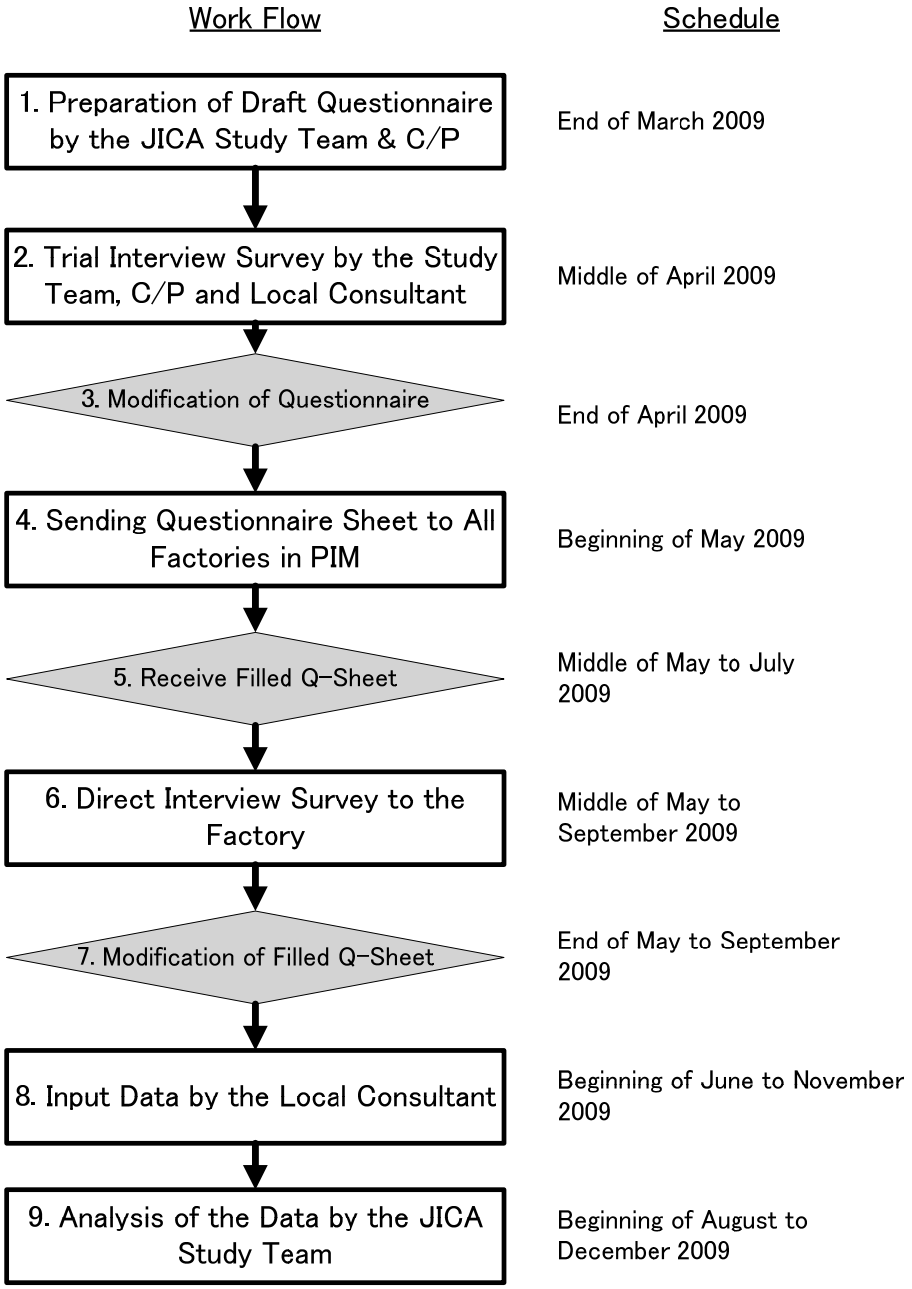


Figure 3-2: Work Flow of the Factory Survey

b. Survey Implementation Issues

Initially it was planned to send the questionnaire along with a letter of request from SUFRAMA to all 457 factories in Part 1 and 2 of the SUFRAMA factory list. However, because some of these factories were no longer located as indicated on the factory list, and others were no longer operating, the actual number of factories to which the questionnaire was distributed was 339. Furthermore, by the end of July, the number of factories that had returned the questionnaire with their answers was at most 106. As a result, the procedures for the factory survey were greatly delayed.

Given the above results, it is necessary to resolve the following issues so that when SUFRAMA conducts factory surveys at regular intervals in the future it will be possible to grasp any change in the condition of waste and environmental management in the PIM.

- Increase the reliability and accuracy of the SUFRAMA factory list
- Explore and execute measures to promote PIM factories to comply with the factory survey.

3.3.5 Results of the Survey

In this section industrial waste (IW) means general industrial waste (GIW). It should not include health-care, construction and radioactive wastes.

a. Generation Amount

a.1 Factories Surveyed

The following table shows the 187 factories that were surveyed in order to create this report. At present, this is 42.5% of the total number of factories (440) operating in PIM/MFZ.

Table 3-23: Detail on Factories Surveyed

Factory code	Industrial District (DI)			Outside DI			Total number of factory (A)	Surveyed number of factories	
	Number of Factory			Number of Factory					
	Part 1	Part 2	Sub-total	Part 1	Part 2	Sub-total		Number (B)	% (B/A)
F01	3		3	12		12	15	5	33.3
F02									
F03	6		6	3	7	10	16	6	37.5
F04	64	1	65	51	5	56	121	66	54.5
F05	2		2				2		0.0
F06	19		19	9		9	28	17	60.7
F07	23	2	25	19	3	22	47	19	40.4
F08		1	1	2	3	5	6	1	16.7
F09	1		1	3	1	4	5	2	40.0
F10	7		7	6		6	13	7	53.8
F11	2		2	1		1	3		0.0
F12				4	9	13	13	3	23.1
F13	13	2	15	15	4	19	34	12	35.3
F14	31	2	33	35	7	42	75	23	30.7
F15				1		1	1		0.0
F16				2		2	2		0.0
F17	15		15	16	2	18	33	19	57.6
F18		1	1	2	3	5	6		0.0
F19	7		7	5	8	13	20	7	35.0
Total	193	9	202	186	52	238	440	187	42.5

a.2 Responses on the Generation Amount of Industrial Waste

Of the 187 factories surveyed, 170 supplied valid answers to their amount of industrial waste generated (17 factories only answered the general items). The following table shows the answers of 170 factories indicating a total of 1,876 wastes. However, of this number, estimations for the amount of Item B: Health-care Waste and Construction Waste were done in separate surveys, and are therefore excluded. Since the effluent is not included in waste categories in this study, it is also excluded. The amount of effluent generated is as follow:

- Generation amount for target factories: 13,256 m^3 per year/36.3 m^3 per day
- Generation amount for all PIM factories: 22,960.7 m^3 per year/62.9 m^3 per day

Here, items indicated "m^3 per year" were converted to 1 ton/m^3.

Table 3-24: Responses for General Industrial Waste Generation Amount

Factory Code	A. Number of Wastes by Responding Factories	B. Eliminated Waste Items (Health-care, Construction, Effluent)	C. No. of Wastes used to estimate waste amount	D. Items showing ton/year from Items in C	E. Items showing m3/year
F01	40	1	39	38	1
F02					
F03	54	1	53	50	3
F04	771	34	737	677	60
F05					
F06	173	8	165	154	11
F07	136	2	134	118	16
F08	23	1	22	22	0
F09	2	0	2	2	0
F10	53	7	46	42	4
F11					
F12	13	0	13	12	1
F13	88	1	87	79	8
F14	203	10	193	173	20
F15					
F16					
F17	221	7	214	197	17
F18					
F19	99	3	96	92	4
Total	**1,876**	**75**	**1,801**	**1,656**	**145**

a.3 Number of Employees

The number of employees among the 170 factories that provided answers to the amount of industrial waste generated are given, along with the total number of employees at all factories in the study area.

Table 3-25: Number of Employees from Responding Factories and All Factories in Study Area

Factory Code	Factory survey		All factories in study area		Rate (C=A/B x 100)
	Number of Factories	Number of Workers (A)	Number of Factories	Number of Workers (B)	
F01	5	2,127	15	2,975	71.5
F02	-	-	0	0	
F03	6	342	16	843	40.6
F04	60	22,269	121	37,765	59.0
F05	-	-	2	348	
F06	17	4,250	28	5,464	77.8
F07	18	3,651	47	6,003	60.8
F08	1	519	6	698	74.4
F09	2	208	5	445	46.7
F10	6	612	13	1,789	34.2
F11	-	-	3	133	
F12	3	253	13	538	47.0
F13	12	335	34	1,355	24.7
F14	18	5,555	75	9,625	57.7
F15	-	-	1	20	
F16	-	-	2	589	
F17	16	32,383	33	43,937	73.7
F18	-	-	6	440	
F19	6	1,458	20	3,225	45.2
Total	**170**	**73,962**	**440**	**116,192**	**63.7**

a.4 Tabulating the Amount of General Industrial Wastes Generated

Responses from 170 factories were used to estimate the total generation amount of general industrial waste, and divided into 4 major categories of waste, were then tabulated according to the 19 factory codes and different waste codes.

- General industrial waste generated from a Non-Production Process which is Non-Hazardous: Non-PP / Non-HIW
- General industrial waste generated from a Non-Production Process which is Hazardous: Non-PP / HIW
- General industrial waste generated from a Production Process which is Non-Hazardous: PP / Non-HIW
- General industrial waste generated from a Non-Production Process which is Non-Hazardous: PP / HIW

The Table 3-26 shows the tabulated results of general industrial waste from a non-production process which is non-hazardous (Non-PP / Non-HIW).

a.5 Generation Rate

Using the employees as the base, the generation rate (kg/year/employee), as mentioned above in the tabulation of generation amount for general industrial waste of 170 factories, was

classified into 4 categories, 19 factory codes and general individual waste codes to calculate using Table 3-25: Number of Employees. Table 3-27 shows the generation rate for non-production process, non-hazardous wastes (Non-PP / Non-HIW).

As for the generation rate of the factory code, of which rate this survey could not get, the average generation rate for factory code obtained from all factories was applied.

a.6 Generation Amount

The generation amount of industrial wastes from PIM/MFZ was calculated by multiplying the number of employees from each factory code by the above mentioned generation rate from general industrial wastes generated. The resulting estimation of industrial waste generated from PIM/MFZ is as follows. The details are given in Table 3-28.

1.	Non-PP / Non-HIW:	61,479.0 ton/year, or	168.4 ton/day
2.	Non-PP / HIW:	13,970.0 ton/year, or	38.3 ton/day
3.	PP / Non-HIW:	110,751.6 ton/year, or	303.4 ton/day
4.	PP / HIW:	29,724.9 ton/year, or	81.4 ton/day
	Total	**215,925.5 ton/year,**	**591.5 ton/day**

This generation amount does not greatly conflict with the tabulated results from the SUFRAMA waste inventory.

Table 3-26: Tabulation of Responses for General Industrial Waste Generation Amount (Non-PP / Non-HIW) of 170 Factories Surveyed

Non-Production Process – Non HIW (Unit : ton/year)														
Factory code	NH01	NH02	NH03	NH04	NH05	NH06	NH07	NH08	NH09	NH10	NH11	NH12	NH!3	Total
F01	82.6	1,039.0	226.0	81.0	7.0				-	921.0	59.0	233.0	222.0	2,870.6
F02														
F03	3.7		4.3	0.9	0.1	0.1			2.2				17.5	28.8
F04	1,570.7	1,192.3	3,648.6	581.2	3.6	17.5			337.1	83.4	28.7	67.7	3,390.9	10,921.7
F05														
F06	187.1	556.5	832.6	131.8	166.0				23.0	0.8	12.0		458.4	2,368.2
F07	224.1	44.0	769.0	201.2		0.7			243.6	820.6			417.3	2,720.5
F08		57.9	2.6	9.9	4.5					0.4			20.2	95.5
F09														
F10	1,128.1	227.7	60.1	44.2		0.3			5,412.3				153.9	7,026.6
F11														
F12			0.1										-	0.1
F13	18.0		5.7	5.3					0.1	-		0.6	14.9	44.6
F14	101.4	254.4	593.8	24.4		3.3			96.7	3.0		39.0	501.1	1,617.1
F15														
F16														
F17	1,605.4	23.5	428.8	406.1	2.0	0.3	0.1			0.1	29.4		1,952.3	4,448.0
F18														
F19	27.0		55.9	140.2	38.0	2.0							102.4	365.5
Total	4,948.1	3,395.3	6,627.5	1,626.2	221.2	24.2	0.1	-	6,115.0	1,829.3	129.1	340.3	7,250.9	32,507.2

Table 3-27: General Industrial Waste Generation Rate (Non-PP / Non-HIW)

Generation rate (Non-Production Process – Non HIW) (Unit: kg/year/person)														
Factory code	NH01	NH02	NH03	NH04	NH05	NH06	NH07	NH08	NH09	NH10	NH11	NH12	NH13	Total
F01	38.8	488.5	106.3	38.1	3.3				0.0	433.0	27.7	109.5	104.4	1,349.6
F02	---	---	---	---	---	---	---	---	---	---	---	---	---	---
F03	10.8		12.6	2.6	0.3	0.3			6.4				51.2	84.2
F04	70.5	53.5	163.8	26.1	0.2	0.8			15.1	3.7	1.3	3.0	152.3	490.3
F05*1	66.9	45.9	89.6	22.0	3.0	0.3	0.0		82.7	24.7	1.7	4.6	98.0	439.4
F06	44.0	130.9	195.9	31.0	39.1				5.4	0.2	2.8		107.9	557.2
F07	61.4	12.1	210.6	55.1					66.7	224.8			114.3	745.0
F08	0.0	111.6	5.0	19.1	8.7					0.8			38.9	184.1
F09*1	66.9	45.9	89.6	22.0	3.0	0.3	0.0		82.7	24.7	1.7	4.6	98.0	439.4
F10	1,843.3	372.1	98.2	72.2		0.5			8,843.6				251.5	11,481.4
F11*1	66.9	45.9	89.6	22.0	3.0	0.3	0.0		82.7	24.7	1.7	4.6	98.0	439.4
F12*1			0.4										0.0	0.4
F13	53.7		17.0	15.8					0.3	0.0		1.8	44.5	133.1
F14	18.3	45.8	106.9	4.4		0.6			17.4	0.5		7.0	90.2	291.1
F15*1	66.9	45.9	89.6	22.0	3.0	0.3	0.0		82.7	24.7	1.7	4.6	98.0	439.4
F16*1	66.9	45.9	89.6	22.0	3.0	0.3	0.0		82.7	24.7	1.7	4.6	98.0	439.4
F17	49.6	0.7	13.2	12.5	0.1	0.0	0.0			0.0	0.9		60.3	137.3
F18*1	66.9	45.9	89.6	22.0	3.0	0.3	0.0		82.7	24.7	1.7	4.6	98.0	439.4
F19	18.5		38.3	96.2	26.1	1.4							70.2	250.7
Avg. rate: 170 factories	66.9	45.9	89.6	22.0	3.0	0.3	0.0		82.7	24.7	1.7	4.6	98.0	439.4

Note: *1: There are few factories with this factory code, so it was not possible in this study to obtain the generation rate for the amount generated from the Non-PP / Non-HIW category of waste in this table. Therefore, generation rate of these factory codes are calculated by dividing A (total generation amount of each 13 category of waste) by B (number of employees of 170 factories which gave the answers). Also, some items show 0.0 even though there were generation amounts reported, but the generation rate was so small that it is shown as 0.0.

Table 3-28: Amount of General Industrial Waste Generated from PIM/MFZ

Unit: ton/year

Factory Code	Non production process		Production process		Total
	Non-HIW	HIW	Non-HIW	HIW	
F01	4,015.0	56.5	332.6	62.8	4,466.9
F02	-	-	-	-	-
F03	71.1	5.4	1,421.4	757.9	2,255.8
F04	18,516.2	3,274.3	34,396.2	7,383.1	63,569.8
F05	153.0	38.9	308.2	91.2	591.3
F06	3,044.5	1,247.4	9,286.0	1,327.3	14,905.2
F07	4,472.2	848.4	17,887.8	1,245.6	24,454.0
F08	128.6	1.2	587.3	2.2	719.3
F09	195.5	49.9	32.1	109.1	386.6
F10	20,540.3	125.1	8,957.0	801.8	30,424.2
F11	58.3	14.9	118.0	34.8	226.0
F12	0.2	60.4	7,599.5	129.7	7,789.8
F13	180.3	1.2	1,475.9	135.4	1,792.8
F14	2,801.9	7,506.9	4,475.7	688.2	15,472.7
F15	8.8	2.2	17.6	5.2	33.8
F16	258.8	66.0	521.8	154.7	1,001.3
F17	6,032.6	606.3	20,712.0	15,975.3	43,326.2
F18	193.2	49.3	389.8	115.6	747.9
F19	808.5	2.6	2,232.7	705.0	3,748.8
Total	61,479.0	13,956.9	110,751.6	29,724.9	215,912.4
ton/day	168.4	38.3	303.4	81.4	591.5

b. Flowcharts of General Industrial Waste Management

The waste streams for seven types of general industrial waste are given below for:

1. All industrial wastes generated from PIM — Figure 3-3
2. Non-HIW generated from PIM — Figure 3-4
3. HIW generated from PIM — Figure 3-5
4. Non-Production Process, Non-Hazardous Industrial Waste: — Figure 3-6
5. Non-Production Process, Hazardous Industrial Waste: — Figure 3-7
6. Production Process, Non-Hazardous Industrial Waste: — Figure 3-8
7. Production Process, Hazardous Industrial Waste: — Figure 3-9

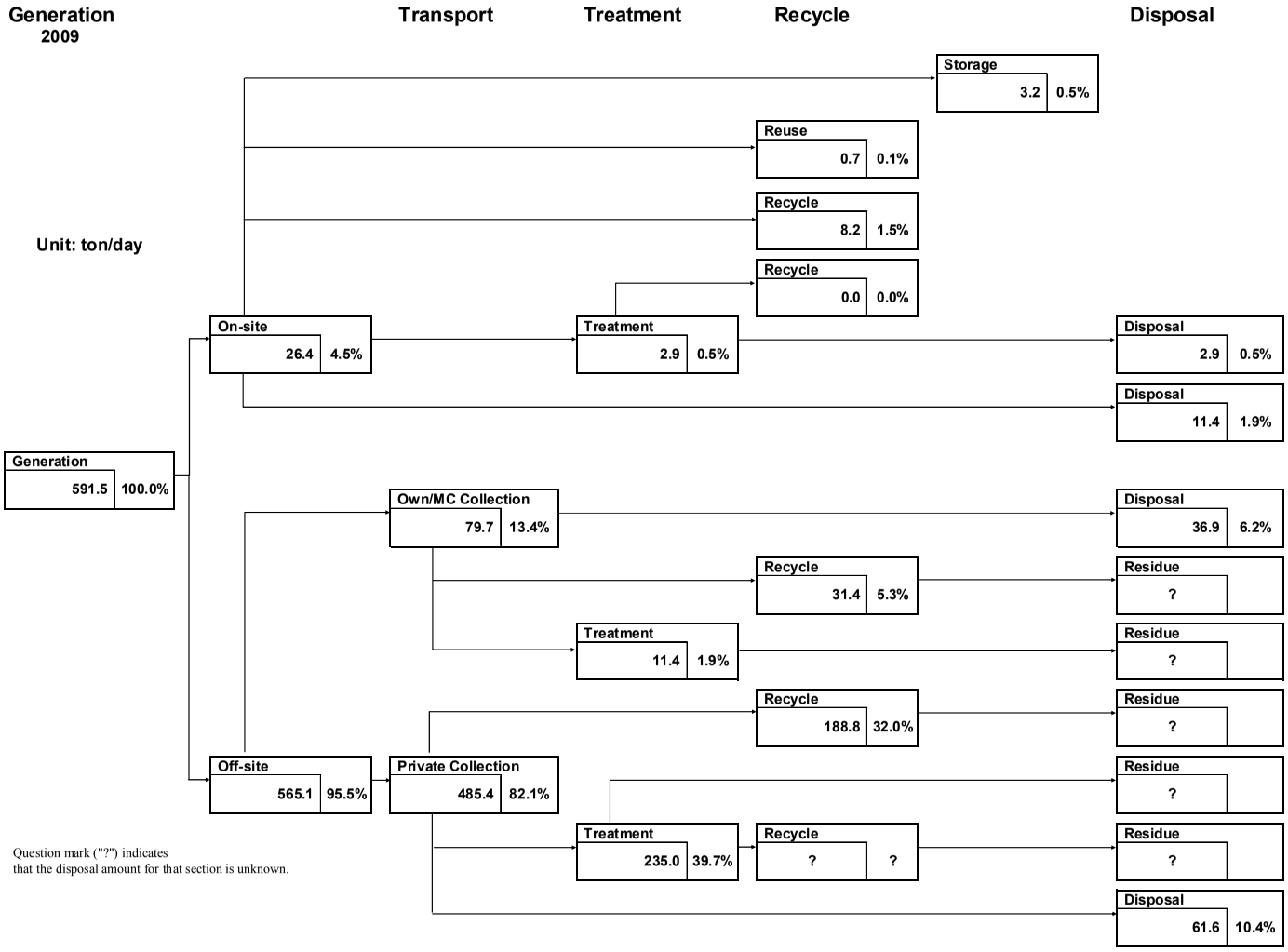


Figure 3-3: Waste Stream for all General industrial wastes generated from PIM

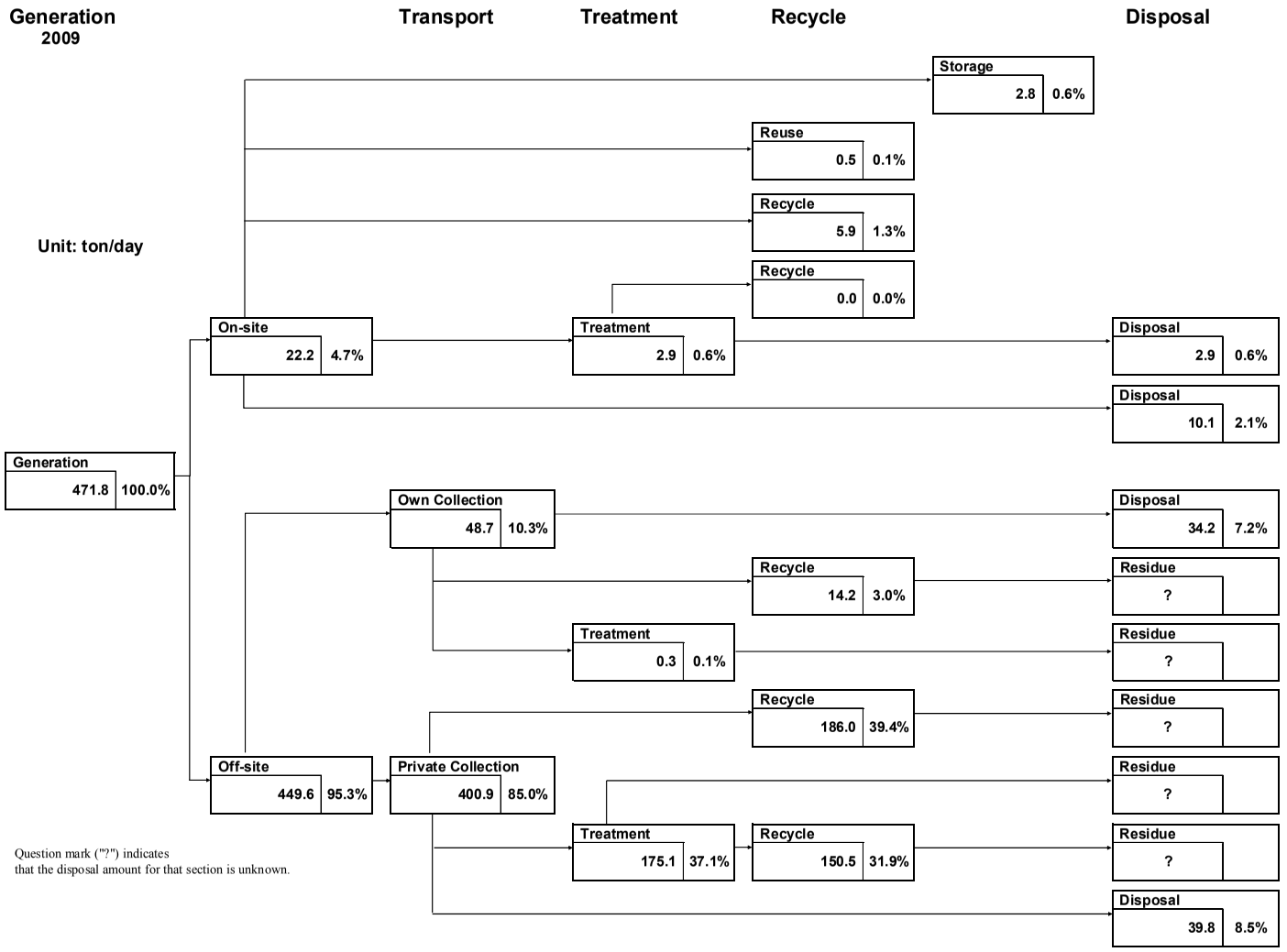


Figure 3-4: Waste Stream for General Non-HIW generated from PIM

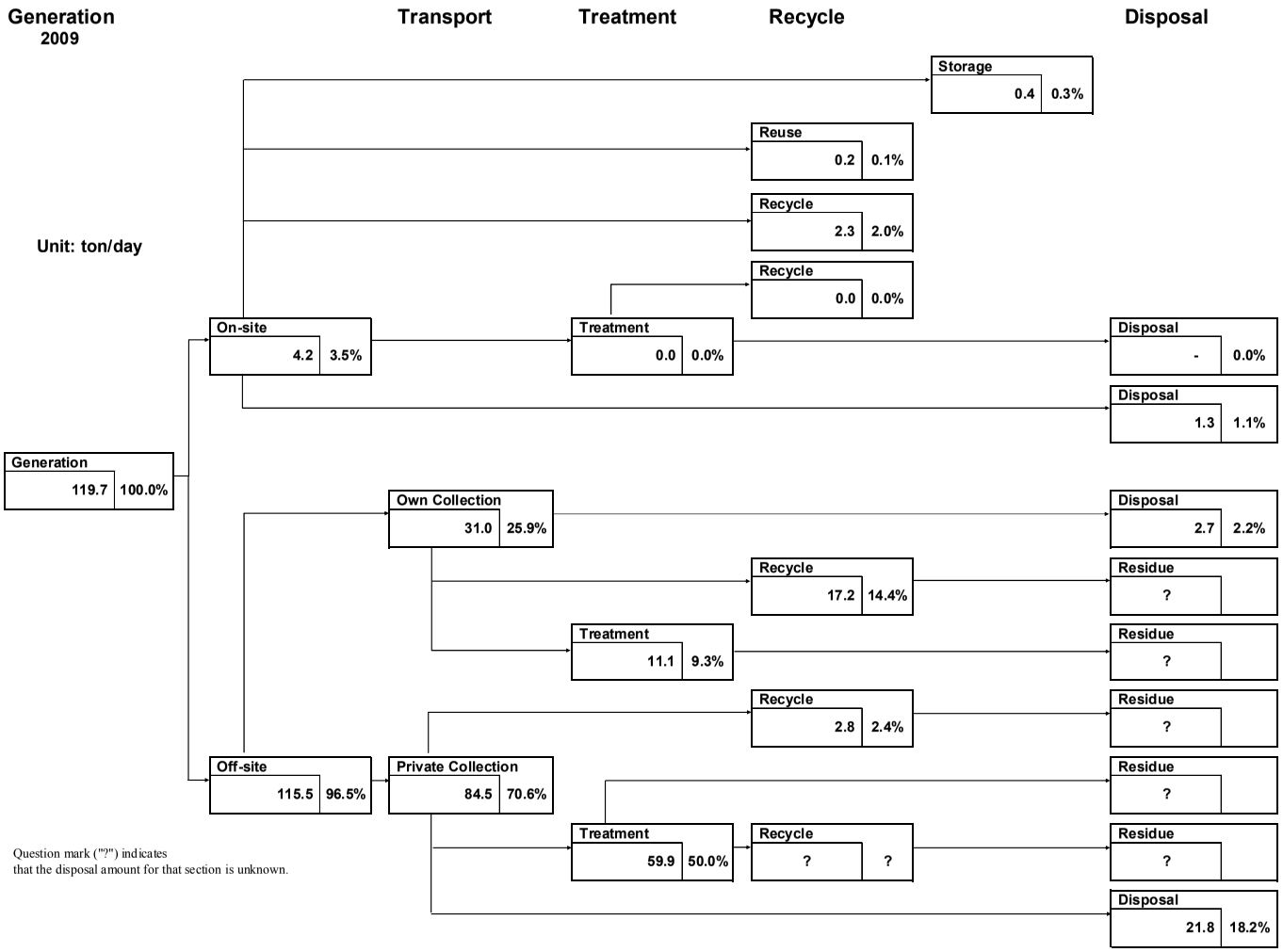


Figure 3-5: Waste Stream for General HIW generated from PIM

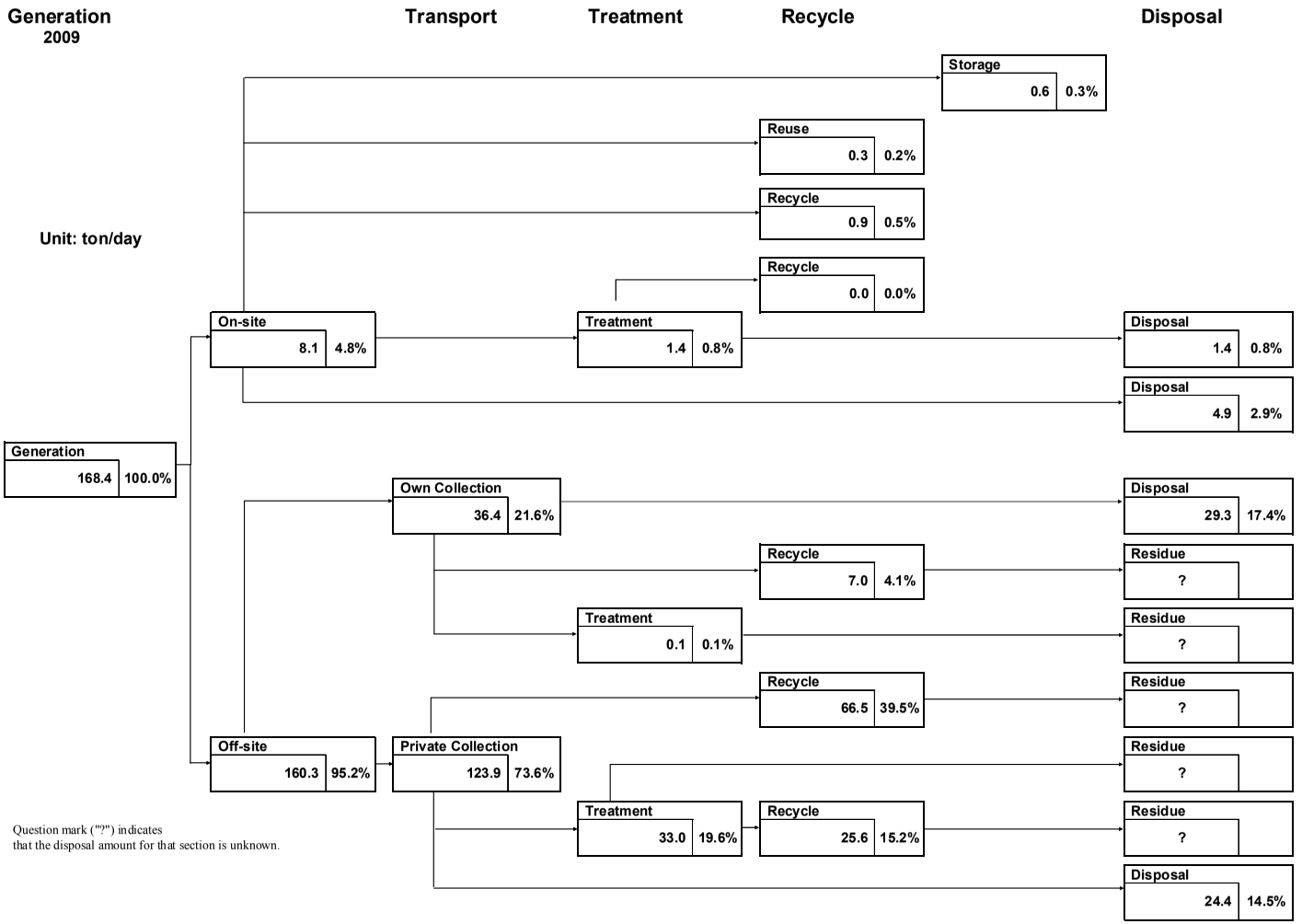


Figure 3-6: General Industrial Waste Stream (Non production process – Non HIW)

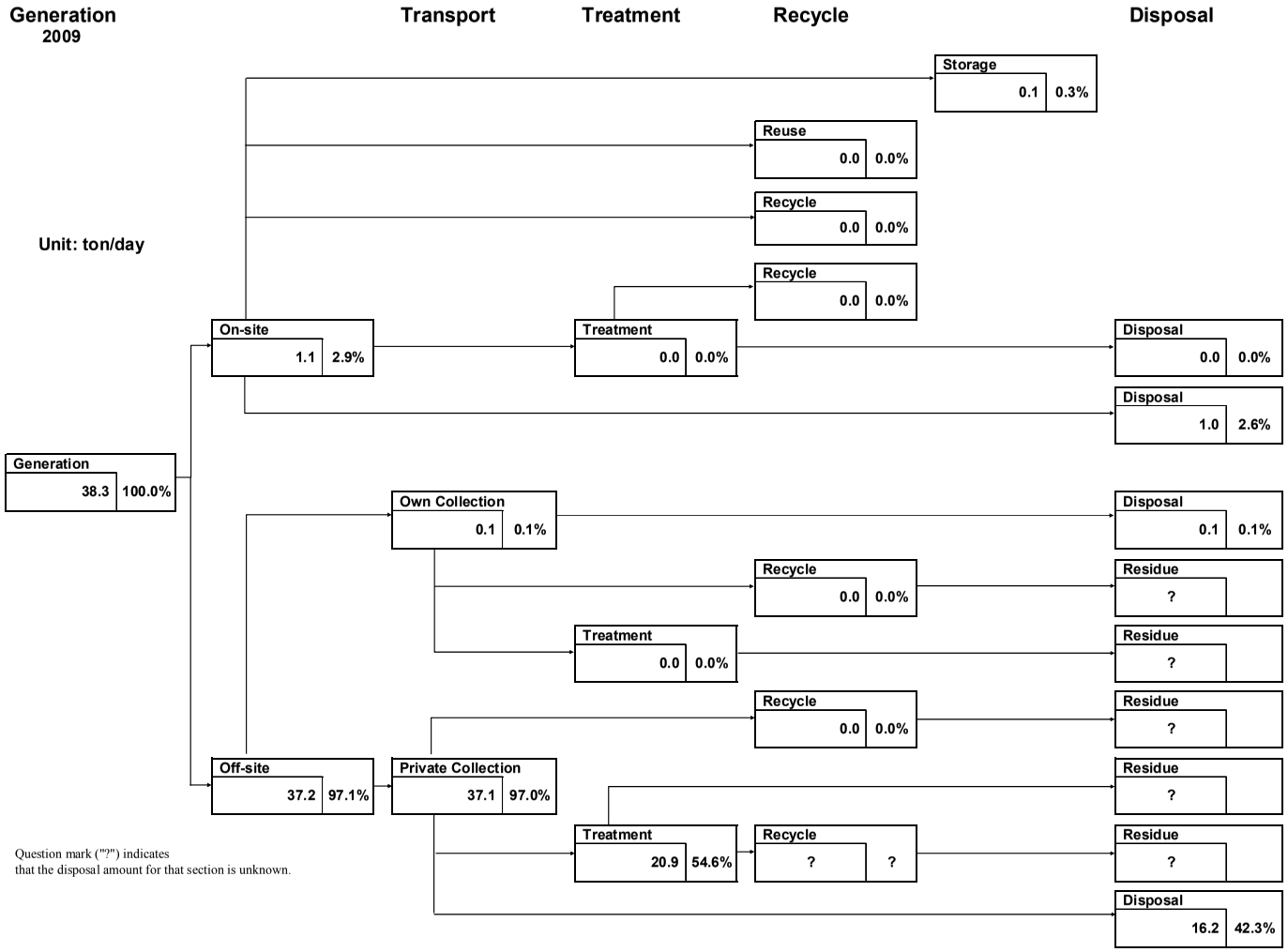


Figure 3-7: General Industrial Waste Stream (Non production process – HIW)

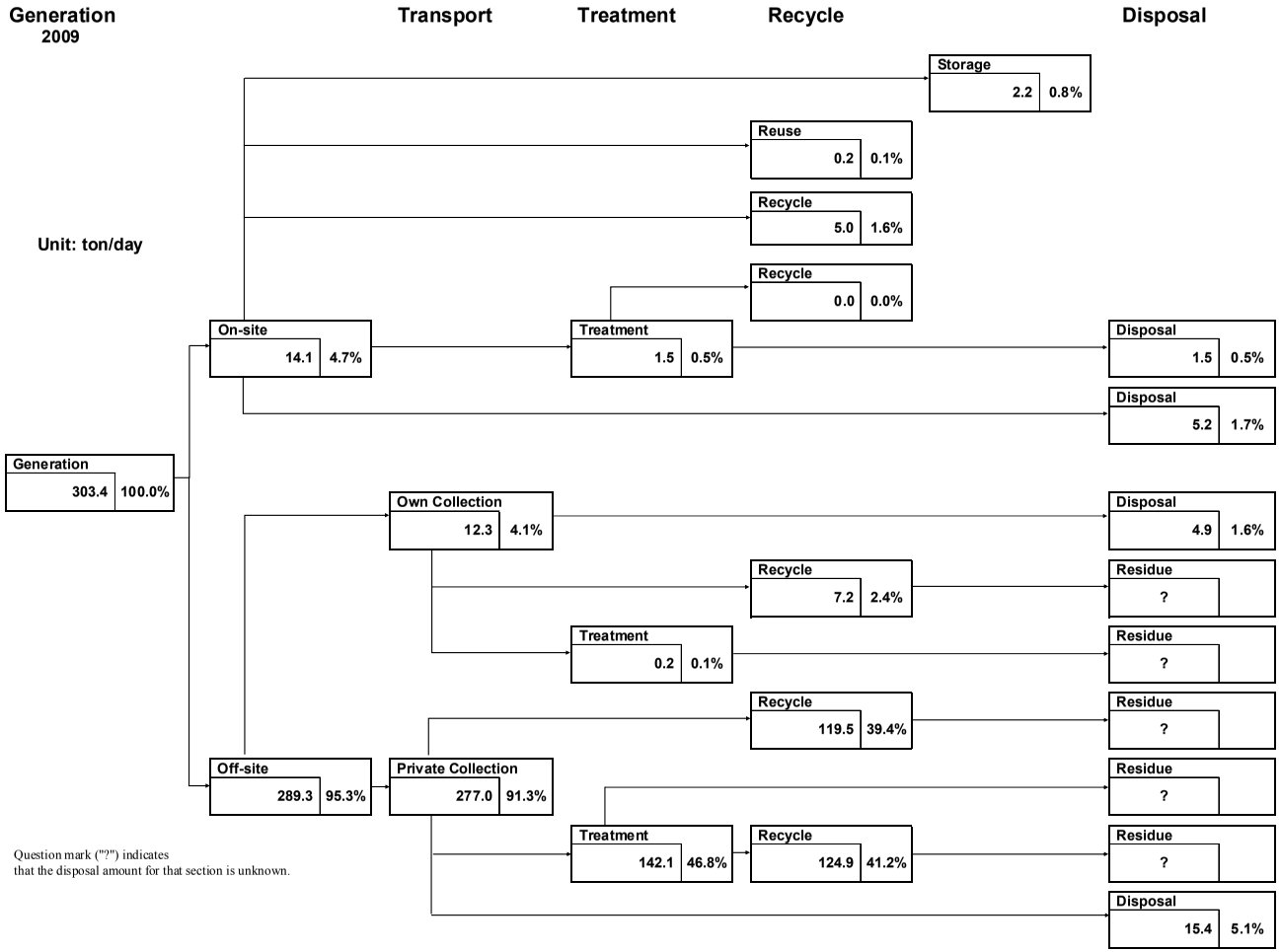


Figure 3-8: General Industrial Waste Stream (Production process – Non HIW)

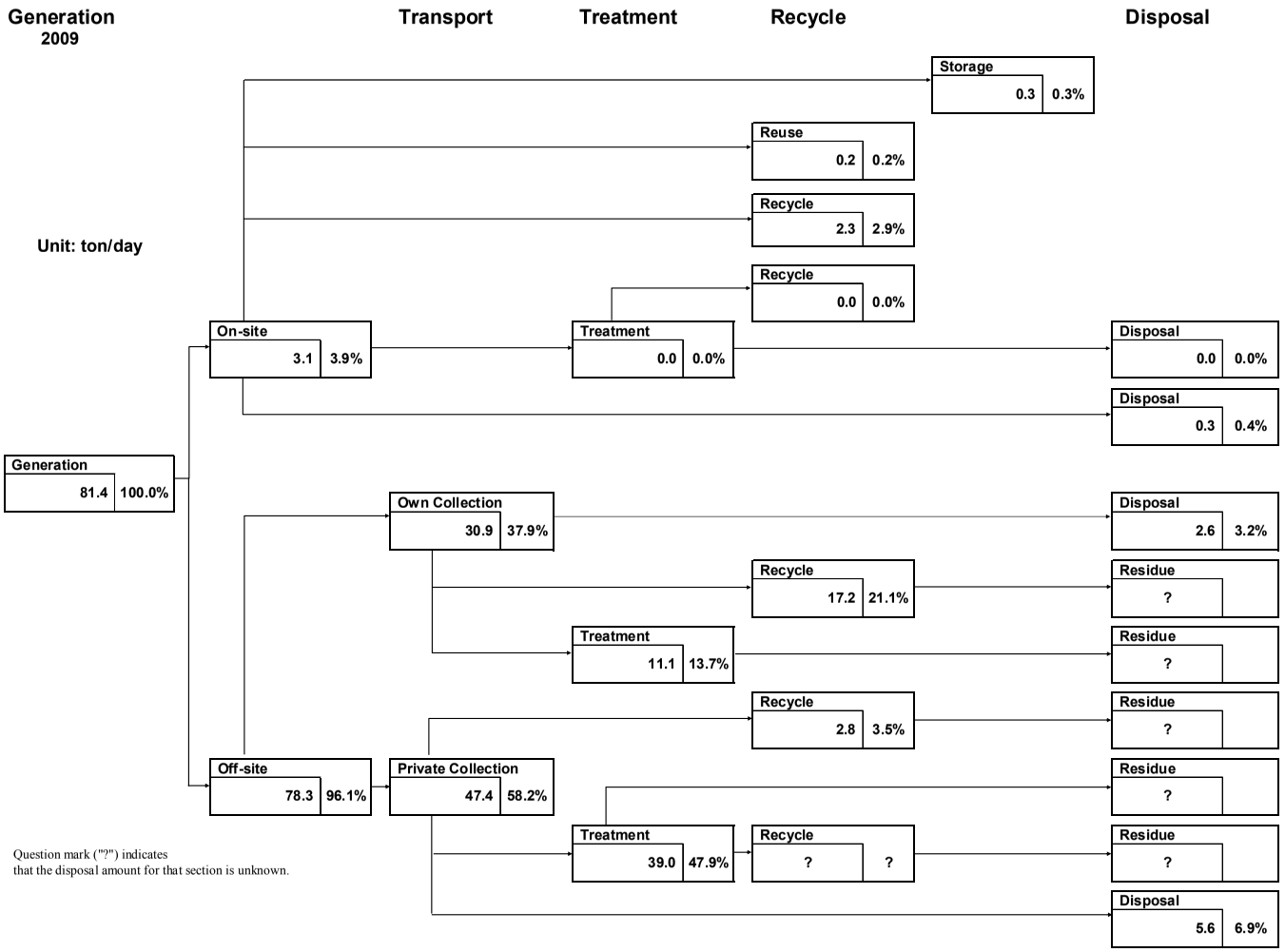


Figure 3-9: General Industrial Waste Stream (Production process – HIW)

c. Overview of PIM/MFZ Factories

c.1 General Conditions

The following general observations can be made given the survey results of 187 factories.

- 62.0 % of the factories (i.e. 116 of 187) are relatively new, having begun operations sometime since 1991.
- The average lot size (159 factories) and construction area (154 factories) was 55,800 sq meters and 15,300 sq meters, respectively.
- The total number of employees from all responding factories (187 factories) is 58,470, giving an average of 350.

c.2 Attached Medical Facilities (Clinics)

44.3 % of the factories (i.e. 78 of 176) have clinics attached. This is the result of the medical institution survey of 334 factories where 37.1% factories (i.e. 124 of 334) replied that they have medical facilities within the factory.

c.3 Radioactive Waste

Of all respondents, none of the factories indicated generation of radioactive waste. This fits in the result of responses from 7 factories surveyed in the radioactive waste survey.

c.4 Use of Pollution Control Facilities

The following table gives the responses of the use of pollution control facilities.

Table 3-29: Use of Pollution Control Facilities

Pollution control facilities	Valid answer (A)	1. Yes (B)	% (B/Ax100)
a. Boiler	172	22	12.8
b. Incinerator	171	3	1.8
c. Industrial wastewater treatment facilities	171	47	27.5
d. Domestic wastewater treatment facilities	175	95	54.3
e. Dust collector	172	20	11.6
f. Air control facilities	169	21	12.4
g. Plating process	168	5	3.0
h. Powder Painting process	170	15	8.8
i. Water Painting process	170	22	12.9
j. Metal coating process	173	13	7.5
k. Storage space of Dangerous substance (Underground: Oils, Volatile substance, etc.)	145	29	20.0
l. Storage space of Dangerous substance (Above surface: Oils, Volatile substance, etc.)	167	96	57.5

The table above gives the following results.

- The rate of industrial wastewater (effluent) treatment facilities installed is somewhat low at 27.5 %. However, this rate should be qualified for those cases where industrial wastewater treatment is necessary and evaluated after a study of the production processes at the plant, etc.
- On the other hand, the rate of treatment facilities installed for domestic wastewater

from non-production processes is 54.3 %, which is relatively high in comparison to that for industrial wastewater 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 over half of factories to install facilities from 2009.

d. On-Site Waste Management

d.1 Waste Inventory

In response to the question of whether it was required to submit a waste inventory, 27.5 % (i.e. 49 of 178 factories) responded that it was not. Of those factories that responded that it is required (i.e. 129 of 178), 11.6 % (i.e. 15 of the 129) responded that they had not submitted a waste inventory. Therefore, despite the requirement for all factories to submit a waste inventory, 36.0 % of factories surveyed (i.e. 64 of 178) said that they do not. This data indicates that there is a lack of awareness at factories concerning waste management.

d.2 Separation

86.0 % of factories (i.e. 154 of 179) separate their non-production process waste from their production process waste before discharge.

In relation, 18.8 % of factories (i.e. 33 of 176) reported that they mix their non-HIW and HIW for discharge. The reasons for this were given in the following order:

1. The amount is extremely small – 41.9 % (13 of 31 respondents)
2. Difficulties to separate PP / HIW and PP / Non-HIW – 12.9 % (4 of 31 respondents)
3. Collection service does not require the separation of HIW and Non-HIW – 9.7 % (3 of 31 respondents)

d.3 Ratio of On-Site and Off-Site Management

The following table clearly shows that the ratio of on-site management in PIM is extremely low at 4.5 %. Furthermore, the difference between non-hazardous industrial waste and hazardous industrial waste is practically negligent.

Table 3-30: Ratio of On-Site and Off-Site Management

Study Area	Waste	Ratio of On-Site Disposal	Ratio of Off-Site Disposal
PIM	Industrial Waste	4.5 %	95.5 %
	Non-HIW	4.7 %	95.3 %
	HIW	3.5 %	96.5 %
Bangkok Metropolitan Area*1	Non-HIW	29.9%	70.1%
	HIW	56.3%	43.7%

Source *1: The Study on Master Plan on Industrial Waste Management in the Bangkok Metropolitan Area and its Vicinity in the Kingdom of Thailand, November 2002 (Hereafter, Bangkok Industrial Waste Study)

d.4 Type of On-Site Management

The following table shows a comparison of types of on-site management at PIM factories.

Table 3-31: Type of On-Site Management

Study Area	Waste	Intermediate Treatment Ratio	Reuse and Recycle Ratio	Storage Ratio	Final Disposal Ratio
PIM	Industrial Waste	0.5 %	1.6 %	0.5 %	1.9 (2.4*2)%
	Non-HIW	0.6 %	1.4 %	0.6 %	2.1 (2.7*2)%
	HIW	0.0 %	2.1 %	0.3 %	1.1 %
Bangkok Metropolitan Area*1	Non-HIW	0.9%	13.1%	1.8%	14.1%
	HIW	32.8%	1.6%	0.4%	21.5%

Source *1: Bangkok Industrial Waste Study

Note *2: This ratio includes residue disposed after intermediate treatment

There is almost no difference between on-site management in PIM (ratio of quantitative generation rate) of non-hazardous industrial waste and hazardous industrial waste.

In comparison, the Bangkok study results show high prominence between non-HIW and HIW due to the high cost of off-site management, they reduce HIW by treating HIW as much as possible on-site (32.8% of the quantitative generation rate). In addition, Non-HIW was reused or recycled as much as possible (13.1% of the quantitative generation rate).

d.5 On-Site Final Disposal

The detailed descriptions of this in descending order are: hazardous wastes are sludge, contaminated plastics and ink residue. In addition, fluorescent lights and batteries were also reported, but done so individually so the weight is unknown. Reports for non-hazardous, in descending order, are cardboard, non-recyclable wastes, and plastic lids. The results suggest these items are for storage waiting for off-site management.

e. Off-Site Waste Management

Below are the responses from dischargers of waste concerning the conditions of off-site waste management. These must be analyzed in comparison with responses from waste service companies.

e.1 Collection

The following table shows the breakdown of the ratio of the amount of waste discharged from factories which is collected and transported by collection service providers.

Table 3-32: Breakdown of Collection Service Providers

Study Area	Waste	Factory (City) Ratio and Amount*2		Ratio of Private Enterprise and Amount	
		Ratio	Ton/Day	Ratio	Ton/Day
PIM	Industrial Waste	13.4 %	79.7	82.1 %	485.4
	Non-HIW	10.3 %	48.7	85.0 %	400.9
	HIW	9.3 %	31.0	70.6 %	84.5
Bangkok Metropolitan Area *1	Non-HIW	1.5%	95.8	68.6%	4,444.5
	HIW	0.1%	1.9	43.6%	665.4

Source *1: Bangkok Industrial Waste Study

Note *2: In PIM, only a very small amount is collected by the city (0.4%). In contrast, 100% was collected by the city in the Bangkok Industrial Waste Study.

From this table it is possible to see the distinct difference between Non-HIW and HIW where most of Non-HIW is collected by private enterprise (WSCs). In contrast, a large amount of HIW is transported by the factory itself. In the Bangkok study, the factory itself transported almost none.

e.2 Breakdown of Off-Site Management

The following table shows the breakdown (generation ratio) of off-site management based on answers from PIM factories.

Table 3-33: Breakdown of Off-Site Management

Target Area	Waste	Intermediate Treatment Ratio and Amount		Reuse and Recycling Ratio and Amount		Direct Final Disposal Ratio and Amount	
		Ratio	Ton/Day	Ratio	Ton/Day	Ratio	Ton/Day
PIM	Industrial Waste	41.6 %	246.4	37.3 %	220.2	16.6 %	98.5
	Non-HIW	37.2 %	175.4	42.4 %	200.2	15.7 %	74.0
	HIW	59.3 %	71.0	16.8 %	20.0	28.4 %	24.5
Bangkok Metropolitan Area *1	Non-HIW	2.5%	159.5	64.8%	4,198.8	2.8%	95.8
	HIW	28.9%	444.1	14.2%	216.1	0.6%	1.9

Source *1: Bangkok Industrial Waste Study

There is some difference between the off-site management (proportion of generation ratio) in PIM of Non-HIW and HIW. It is reasonable that rate of treatment of HIW is higher than Non-HIW and it of reuse/recycle of HIW is much lower than Non-HIW. It is, however, the rate of direct final disposal of HIW is two times more than it of Non-HIW. It is a serious issue that rate of direct final disposal of HIW is quite high, 28.4%.

In comparison, the findings from Bangkok show a very noticeable difference between the HIW and Non-HIW, where most of the Non-HIW discharged off-site (generation ratio of 64.8%) is reused or recycled. In contrast, much of the hazardous waste is put through intermediate treatment (28.9% of the generation ratio) in an attempt to render it harmless or reduce the amount. In addition, the rate of direct final disposal of industrial waste is much

lower than it in PIM, 0.6% for HIW and 2.8% for Non-HIW, especially HIW. In addition, the amount of residue after intermediate treatment and recycling could not be identified.

f. Plans and Intentions

f.1 Future Generation Amount of Industrial Waste

Respondents stated that future generation amounts would: remain at the current amount (31.8 %, or 54 of 170 factories); increase (37.6 %, or 64 of 170 factories); or reduce (21.2 %, 36 of 170 factories). Given these responses, it is likely that the generation amount will increase slightly in the future.

f.2 Plans to Promote 3R and IWM Improvement Plans

Most factories have no plans to promote 3R (70.2 %, or 120 of 171 factories). Also, the majority of factories have no intention to formulate an industrial waste management improvement plan (78.8 %, or 134 or 170 factories).

f.3 Waste Exchange

The majority of factories had some knowledge of waste exchange (73.4 %, or 127 of 173 factories). Presently, 36.2 % (i.e. 63 of 174) of factories are engaged in waste exchange, but there was a high rate of 67.8 % (i.e. 116 of 171) of those factories with an interest in this.

f.4 Disposal Fee

Payment to transporters of discharged industrial waste was indicated by 60 respondents at R$ 563,000 annually on average. On the other hand, the on-site waste management fee indicated by 20 respondents was R$ 769,000 annually on average.

f.5 Problems with Industrial Waste Management

62.6 % (i.e. 109 of 174 factories) said there were currently problems with industrial waste management. The reasons given are as follows, in descending order.

1. High cost of industrial waste disposal: 57.8 % (63 of 109 respondents)
2. No facilities, or insufficient facilities, for the reuse or recycling of industrial waste: 48.6 % (53 of 109 respondents)
3. No service, or insufficient service, for industrial waste treatment: 37.6 % (41 of 109 respondents)
4. No trustworthy treatment and disposal contractors in Manaus: 34.9 % (38 of 109 respondents)

3.4 Study of Health-care Waste Management in Medical Institutions

3.4.1 Outline of the Study

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 (OPCA) 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. The following items were included in the questionnaire:

Table 3-34: Content of the Medical Institution Survey

1. Basic Items	2. Current Waste Management	3. Comment/Notes
・ Location of Medical Institution ・ Medical Services Provided ・ No. of Employees ・ No. of Beds ・ Number of Inpatients/Outpatients ・ Others	The following items are surveyed, making a division between infectious/hazardous waste and common waste. ・ Generation amount ・ Separation at Source ・ Storage Methods and Containers Used ・ Discharge Methods and Containers Used ・ Treatment Methods (e.g. Incineration, Sterilization), if any, and other Methods ・ Contracted Collection Company and Collection Method ・ Location and Methods of Disposal ・ Others	・ Management system of infectious/hazardous waste ・ Knowledge of an implementation of regulations for health-care waste management ・ Reporting on infectious/hazardous waste management conditions, if any, and who is reported to. ・ Education, if any, and methods for employees to handle infectious/hazardous waste ・ Fees for Collection, Treatment, Disposal of infectious/hazardous waste ・ Awareness of environmental consideration ・ Others

3.4.2 Health-care Waste Categories

a. ABNT NBR 12808 (1993) and RDC 306/2004-ANVISA

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 the ABNT NBR 12809 and the RDC 306/2004-ANVISA.

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 12809 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 12809.

Table 3-35: Conversion of Health-care Waste Categories between

RDC 306/2004-ANVISA			ABNT NBR 12809	
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

b. Health-care Waste Categories used in the Study

In this study, health-care waste was divided into five large groups according to RDC 306/2004-ANVISA. The details of each group are explained in the Supporting Report Chapter 2.

3.4.3 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 to confirm whether they had an attached clinic. The following results were found according to their responses.

- Factories that responded by telephone: 334
- Factories that have closed: 17
- Factories that refused to reply: 25
- Factories that could not be reached by telephone: 81

In this survey, it was revealed that 440 factories are PIM factories operating in the MFZ, including those which could not be reached by telephone (which was likely due to a changed phone number, etc.) and excluding the 17 which have closed.

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 3-36: 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

3.4.4 Execution of the Survey

A local consultant (OPCA) was consigned to conduct the study on 19 June 2009. Immediately after the contract was signed, the local consultant contacted all PIM factories approved by SUFRAMA by telephone, etc., and inquired about the existence of a clinic on premises, then selected the target medical facilities before beginning the direct interview process. Finally, working with the study team, the survey results were compiled by the end of August. The interview survey and summary of results was completed by the end of July, as planned, and the results were analyzed together with the study team in August before being summarized into a report.

Although questionnaire survey and analysis of the survey results were done base on the waste categories of ABNT NBR 12809, those have been revised based on the waste categories the designated by the RDC 306/2004-ANVISA.

3.4.5 Results of the Survey

a. Results of Waste Amount, Generation Rate and Waste Streams

a.1 Generation Amount of Health-care Waste in ABNT NBR 12809 Category

The generation amount of health-care waste in ABNT NBR 12809 Category for the 10 medical institutions is given below.

Table 3-37: Amount of Health-care Waste (in ABNT NBR 12809 Category) Generated by Target Medical Institutions

Unit: kg/day

Category of Health-care Waste	General Hospital	Clinics ([*1])
Class A: Infectious Waste	**26.16**	**0.96**
A.1. Infectious waste	4.19	0.16
A.2. Blood and derivates	1.83	0.01
A.3 Surgical, anatomo-pathologic and exudates	8.11	0.10
A.4 Piercing or cutting	3.40	0.43
A.5 Contaminated animal	---	---
A.6 Patient care	8.63	0.26
Class B: Special Waste	**1.67**	**0.27**

B.1 Radioactive waste	---	---
B.2 Pharmaceutical waste	1.00	0.11
B.3 Hazardous chemical waste	0.67	0.16
Total of Class A and B (Hazardous Waste)	**27.83**	**1.22**
Class C: Common Waste	**94.0**	**1.17 (*2)**
Total	**121.83**	**2.40**

Note *1: Average number for 9 clinics

*2: This number is less than the amount of hazardous health-care waste generated. The reason being that it is discharged as non-process, non-hazardous waste from another place within the factory, and the clinic does not that this discharge into consideration. One clinic did not respond.

a.2 Generation Amount of Health-care Waste in RDC 306/2004-ANVISA Category

The generation amount of health-care waste in RDC 306/2004-ANVISA Category for the 10 medical institutions is given below.

Table 3-38: Amount of Health-care Waste (in RDC 306/2004-ANVISA Category) Generated by Target Medical Institutions

Unit: kg/day

Category of Health-care Waste	General Hospital	Clinics
Group A	**22.76**	**0.52**
A.1. Biologic	6.01	0.16
A.2. Animals	---	---
A.3 Body part	8.11	0.10
A.4 Patient care etc.	8.64	0.26
A.5 Prions	---	---
Group B: Chemical etc.	**1.67**	**0.27**
Group C: Radioactive	**---**	**---**
Group E: Piercing or Cutting	**3.40**	**0.44**
Total of Group A, B, C and E (Hazardous Waste)	**27.83**	**1.22**
Group D: Common waste	**94.00**	**1.17**
Total	**121.83**	**2.40**

a.3 Number of Factories with a Clinic

124 factories of 334 surveyed have a clinic within their compound. It is estimated 163 (= 124 x 440/334) factories have a clinic in PIM in total.

a.4 Generation Rate and Amount of Health-care Waste Generated from Factories in PIM

As 163 factories have a clinic in PIM in total, the generation amount of health-care waste generated from factories in PIM and generation rate per an employee is calculated as follows:

Generation Amount of Factories in PIM = Generation Rate per a Clinic x 163

Generation Rate per an Employee = Generation Amount of Factories in PIM / Number of Employees in PIM (116,192)

Table 3-39: Generation Rate and Amount of Health-care Waste Generated from Factories in PIM

Group		Description	Generation Rate per a Clinic (kg/clinic/day)	Generation Amount of Factories in PIM (kg/day)	Generation Rate per an Employee (g/employee/day)
1.Group A	A.1	Biologic	0.16	26.1	0.22
	A.2	Animals	0.00	0.00	0.00
	A.3	Body part	0.10	16.3	0.14
	A.4	Patient care etc.	0.26	42.4	0.36
	A.5	Prions	---	---	---
2. Group B		Chemical etc.	0.27	44.1	0.38
3. Group C		Radioactive waste	0.00	0.00	0.00
4. Group E		Piercing or Cutting	0.44	71.9	0.62
Hazardous Health-care Waste Sub-total			1.23	200.8	1.73
5. Group D		Common waste	1.17	191.1	1.64
Total			2.40	391.9	3.36

The amount of health-care waste generated in PIM including a general hospital is shown in the table below.

Table 3-40: Amount of Health-care Waste Generated in PIM

Unit: kg/day

Category	Whole Factories in PIM (B x 440 /334) (kg/day)	General Hospital (kg/day)	Whole PIM (E = C + D) (kg/day)
Group A	84.8	22.7	107.5
Group B	44.0	1.7	45.7
Group C	0.0	0.0	0.00
Group E	71.7	3.4	75.1
Hazardous Health-care Waste Total	200.5	27.8	228.3
Class D	190.7	94.0	284.7
Health-care Waste Total	391.2	121.8	513.0

a.5 Health-care Waste Generation

Health-care waste generation from factories in PIM excluding a general hospital is as follows:

- Hazardous Health-care Waste: 200.5 kg/day
- Non-hazardous Health-care Waste: 190.7 kg/day
- Total Health-care Waste: 391.2 kg/day

Given the above information, the daily generation amount from the target area (PIM), including the one general hospital, of hazardous and non-hazardous health-care waste is estimated as follows:

- Hazardous Health-care Waste: 228.3 kg/day
- Non-hazardous Health-care Waste: 284.7 kg/day
- Total Health-care Waste: 513.0 kg/day

a.6 Present Health-care Waste Management Stream

The present health-care waste management stream in PIM, according to the survey of medical institutions, is shown in the following figures.

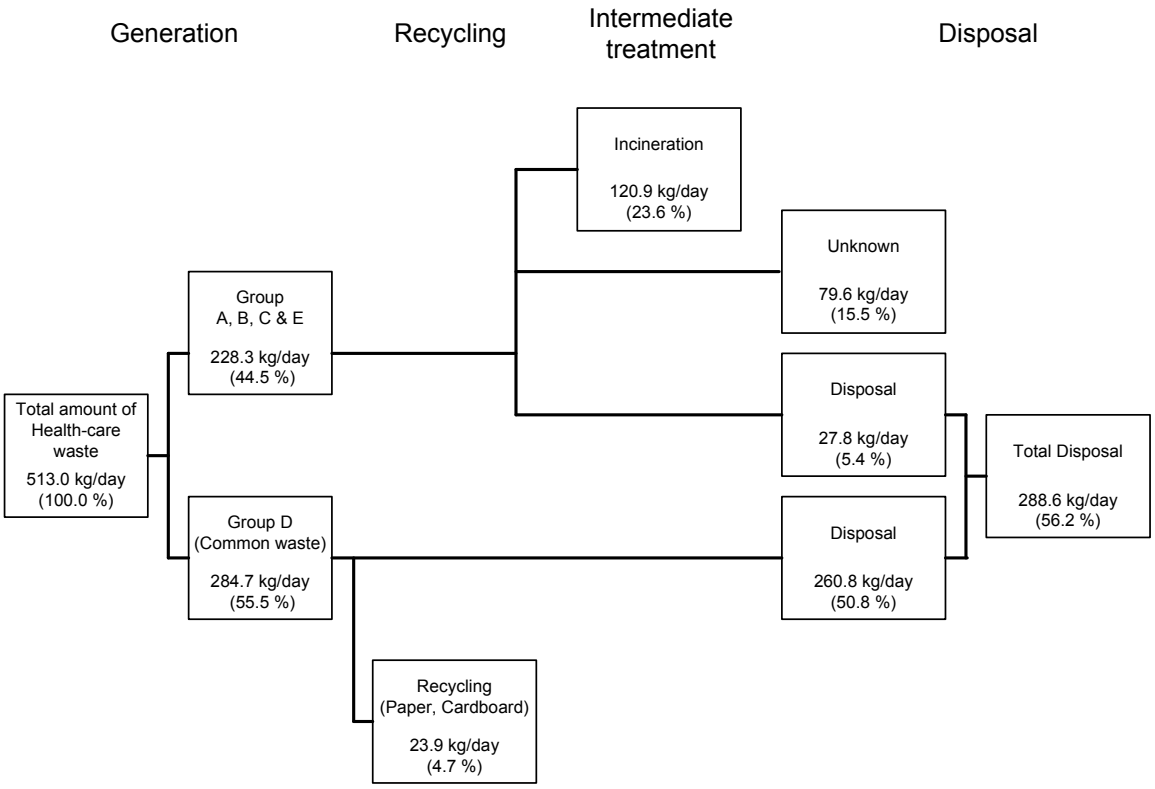


Figure 3-10: Health-care Waste Management Stream in PIM including General Hospital

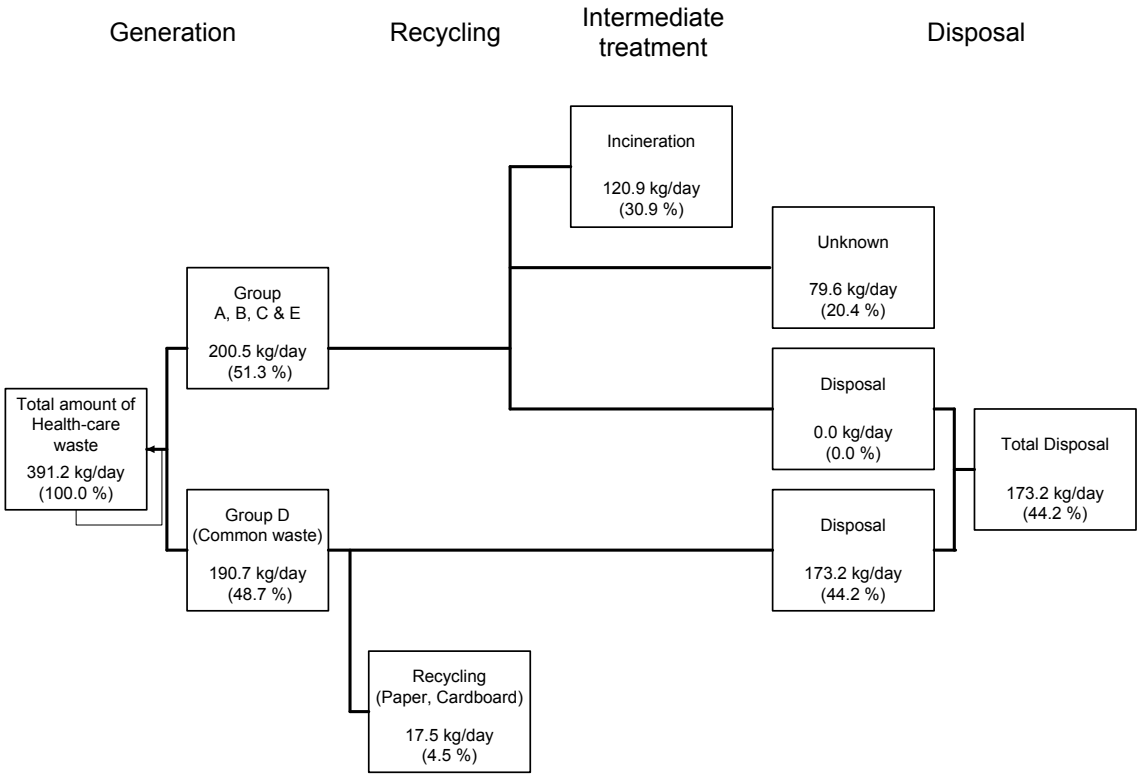


Figure 3-11: Health-care Waste Management Stream in PIM excluding General Hospital

b. On-Site Health-care Waste Management

b.1 Discharge Containers

RDC 306/2004-ANVISA regulates discharge containers according to different waste categories. The general hospital utilizes the categorization put forth in RDC 306/2004-ANVISA. For attached clinics at factories, the ratio which is observed is no more than half of this.

b.2 Storage

Of the facilities surveyed, one responded that the hazardous health-care waste and common waste they stored was mixed. Also, concerning storage containers, excluding Group E (e.g. needles, scalpels), the general hospital stores hazardous health-care waste in plastic bags inside a plastic container with lid. Waste is stored in covered containers at 61% of the clinics. Also, the hospital and one-third of the clinics used cardboard boxes to store Group E (needles, scalpels, etc.).

All of the facilities surveyed responded that that did not have cool storage facilities for certain Group A.3 (Body part) waste.

b.3 Intermediate Treatment and Disposal

Intermediate treatment and disposal is not carried out, with the exception of treatment of Group A.1 (Biologic) using an autoclave in the general hospital.

b.4 Recycling

Forty percent of the medical institutions, including the general hospital, recycle common waste valuables, such as paper and cardboard. Recyclers collect these valuables from each medical institution on a regular basis.

b.5 Discharge

Waste is discharged from attached clinics according to prescribed categories.

Hazardous health-care waste and non-hazardous health-care waste are not mixed when discharged. Nevertheless, even though Group A, B and E and each class type, are stored separately, 20% of the facilities reported mixed discharge; the medical institutions' employees are the likely reason for this.

b.6 Training and Instructions

All of the facilities reported having written instructions concerning the handling of hazardous health-care waste within the medical institution. Also, 100% said there is training/instruction for waste workers for handling hazardous health-care waste. Furthermore, 50% said that this training takes place once a year.

Employees at 80% of the medical institutions report receiving environmental educational training or information concerning hazardous health-care waste. At attached clinics, 242 people attend the classes on average.

b.7 Cooperation for Waste Management Improvements

All ten of the medical institutions surveyed replied that they are able to cooperate on waste management improvement. Concerning efforts they would be willing to make for improvements, all replied "raising the environmental awareness of the public", eight (8) replied they could "minimize waste generation" and seven (7) said through "discharging wastes neatly". Also, all replies confirmed that they would cooperate with national and municipal authorities toward waste management improvement.

b.8 Priority of Waste Management Improvements

A rise in waste management fees was indicated by 60% of medical institutions. 70% replied that waste management was a very high priority. Furthermore, 50% said they would welcome technical support from a government organization, whereas 30% were hopeful for financial support.

b.9 Intention to Improve Conditions for Collection and Disposal of Hazardous Health-care Waste

In order to improve the current conditions of collection and disposal of hazardous health-care waste, 3 (of 8 respondents) answered "education to change people's bad habits", and 2 (of 8) indicated "improvement of landfill operation".

Concerning who should bear the rise in cost for improvement of current collection and disposal conditions for hazardous health-care waste, respondents indicated the following: the State of Amazonas (30%), the City of Manaus (20%), and others (20%). Further, five facilities indicated that the greatest amount they would be willing to pay for collection and disposal was, on average, 145R$/month.

c. Off-Site Health-care Waste Management

c.1 Collection

All of the medical institutions (100%) receive collection service for both non-hazardous and hazardous health-care waste. With the exception of one institution which receives service from SEMMA/SEMULSP, all institutions receive collection service of hazardous waste from private companies. 40% of medical institutions, however, do not pay fee for hazardous health-care waste. 60% indicated that they set the collection fee, although it varied from place to place.

Despite the fact that 30% of medical institutions indicated dissatisfaction with current collection service, there were no complaints from medical institutions in the past year received by collection service providers.

c.2 Monitoring of Hazardous Health-care Waste Disposal

All of the medical institutions indicated that a person has been assigned to be in charge of appropriate collection and disposal of hazardous health-care waste.

c.3 Disposal of Hazardous Waste

The general hospital replied that its hazardous health-care waste was sent, according to waste category, to a prescribed location in a landfill, or other. In the case of attached clinics, two-thirds of respondents said that their waste went to an incinerator, whereas the remaining one-third provided no answer.

d. Issues on Health-care Waste Management

The following results were revealed in the survey of medical institutions.

d.1 Health-care Waste Management System Provisions

Over one-third (37.1%) of PIM factories have an attached medical clinic. These attached clinics are also equipped with beds where medical treatments can take place. For this reason, not only Group D: Common waste, but also Group A, B, C and E hazardous wastes are generated. The amount of hazardous health-care waste solely at attached clinics is estimated at 200.8 kilograms per day, and estimated at 228.6 kg/day when combined with the general hospital. The problem is that this amount of hazardous health-care waste is generated was not known. It is necessary, from here on, using these results as the basis, to prepare a management structure to grasp the actual conditions of health-care waste, and particularly hazardous health-care waste, to implement more appropriate methods.

d.2 On-Site Management

Appropriate waste management has been set to a certain level at medical institutions which produce health-care waste. Also, awareness of appropriate management is high. In particular, there are no identifiable problems at the general hospital, according to their response to the survey. However, the following problems were identified at the clinics.

- Less than half use the designated container for discharge set by RDC 306/2004-ANVISA
- Although hazardous health-care waste is stored according to Group A, B, C and E, mixed discharge takes place at two clinics (2 of 8 respondents).

d.3 Understanding Current Conditions of Off-Site Disposal

On the other hand, the replies from medical institutions concerning off-site waste management after discharge were insufficient to understand actual conditions. On this point, it may be inferred that the waste manifest system is insufficient, and responsibility of the discharger remains unclear for appropriate management after discharge.

Non-hazardous, Group D (common waste) is collected by Manaus City and disposed of in the city's landfill. Nevertheless, questions as to hazardous health-care waste were revealed, as follows.

1. Replies indicated that treatment and disposal of hazardous waste was outsourced; however, three medical institutions (of 9 respondents) were unable to elaborate on the actual conditions therein. The amount is 79.9 kg per day, which indicates 35% of the total generation amount of hazardous health-care waste.
2. Replies indicated that some hazardous health-care wastes (12.1% of the total amount of hazardous health-care waste generated) were disposed of in a dedicated landfill area, but there is no landfill in Manaus sanctioned to receive hazardous waste.
3. 40% of medical institutions, however, replied that they do not pay fee for hazardous health-care waste.
4. Many medical institutions indicated using incineration (52.9% of the total amount of hazardous health-care waste generated); however, it will be necessary to check that this is being done properly by referencing the results of the survey of waste service companies and so on.

d.4 Hazardous Health-care Waste Generation Amount

As shown in the following table, survey results show that the generation amount and unit generation of hazardous health-care waste are comparable to other JICA surveys. The results show that the amount of hazardous waste produced by PIM factories differs from surgical hospitals and the like; a comparison of the unit generation amount (1.95 g/person/day) revealed a much higher amount than expected.

Table 3-41: Hazardous Health-care (Medical) Waste Generation Rate in Other Cities

Country/City	Study Year	Population	Generation Amount (kg/day)	Unit Generation (g/person/day)
Chile / Santiago	1995	5,642,000	20,000	3.54
Turkey / Adana	1998	1,196,620	4,401	3.68
Turkey / Mersin	1998	643,850	1,539	2.39
Azerbaijan / Baku	2000	2,051,200	12,892	6.28
Cambodia / Phnom Penh	2003	1,199,414	961	0.80
Sri Lanka / Kandy	2002	110,049	530	4.81
Mongol / Ulaanbaatar	2005	866,591	1,600	1.85
PIM in Manaus	2009	116,192(*1)	229	1.97

Source: JICA solid waste management study reports

Note *1: The number of employees at 440 operating factories, as of August 2009

Table 3-42: Common Health-care Waste Generation Rate in Other Cities

Country/City	Study Year	Population	Generation Amount (kg/day)	Unit Generation (g/person/day)
Chile / Santiago	1995	5,642,000	44,658	7.92
Turkey / Adana	1998	1,196,620	11,805	9.87
Turkey / Mersin	1998	643,850	4,663	7.24
Azerbaijan / Baku	2000	2,051,200	20,588	10.04
Cambodia / Phnom Penh	2003	1,199,414	9,719	8.10
Sri Lanka / Kandy	2002	110,049	4,734	43.02
Mongol / Ulaanbaatar	2005	866,591	14,800	17.08
PIM in Manaus	2009	116,192(*1)	239	2.06

Source: JICA solid waste management study reports

Note *1: The number of employees at 440 operating factories, as of August 2009

3.5 Study of Construction Waste Management

3.5.1 Outline of the Study

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 (OPCA.) 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. The questionnaire contained the following items

- Overview of construction work, contract amount for work, type of work, number of workers
- Generation amount of construction waste
- Type of construction waste
- Final disposal aspects
- Recycling aspects
- Others

3.5.2 Construction Waste Categories

a. Construction Waste Categories in CONAMA Resolution 307

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 3-43: 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)*.

b. Target Wastes

The target wastes are construction wastes generated by works at PIM factories which are designated in CONAMA Resolution 307.

c. Construction Waste Categories used in the Study

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 (see below) 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.

- Excavated soil, concrete debris, asphalt debris, brick debris, glass tile and ceramic materials, foam polystyrene, vinyl materials, synthetic rubber, used tires, plastic sheet, vinyl sheet, iron-bar, steel materials, small metal waste, old temporary scaffoldings and fences, natural rubber waste, sludge, mud, plaster boards, packaging material which organic materials stick to, lead battery, wood debris of demolish waste, timber form for concreting, scaffolding material, interior timber materials, packing materials (such as cardboard), wall paper, cloth and old rags, rope, carpet, machine oil, heavy oil, asphalt, waterproof sheet, ash of materials used for construction (such as old rags, cardboard, timber), materials containing asbestos, materials which are sprayed with asbestos, transformer, condenser, stabilizer for fluorescent light, sulfuric acid, coolant for a freezer, volatile oil, kerosene, diesel oil, mixed waste.

The 44 construction waste categories and the questions asked are presented in the Section 2.4.6 of the Supporting Report.

3.5.3 Selection of Target Factories

The 457 factories located in the MFZ in the factory list provided by SUFRAMA, were contacted to confirm whether they had conducted any construction projects in the past year, from June 2008 to May 2009. The following results were found according to their responses.

- Factories that responded by telephone: 334
- Factories that have closed: 17
- Factories that refused to reply: 25
- Factories that could not be reached by telephone: 81

In this survey, it was revealed that 440 factories are PIM factories operating in the MFZ, including those which could not be reached by telephone (which was likely due to a changed phone number, etc.) and excluding the 17 which have closed.

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 3-44: 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.

3.5.4 Execution of the Survey

A local consultant (OPCA) was consigned to conduct the study on 19 June 2009. Immediately after the contract was signed, the local consultant contacted all PIM factories approved by SUFRAMA by telephone, etc., and inquired about any construction works that took place over the past year, before selecting the target factories and beginning the direct interview process. The direct interview survey and compiling the survey result were completed as planned by the end of July, and then, working with the study team, the survey results were analyzed in August before being summarized into a report.

3.5.5 Results of the Survey

a. Generation Amount of Construction Waste

In the year from June 2008 to May 2009, the amount of construction waste generated from construction projects at the 10 factories came to a total of 832.7 tons, as shown in column A in the following table. Moreover, the amount generated per day is shown in column B (B = A/365).

Table 3-45: Generation Amount of Construction Waste from Survey of 10 Factories

Waste No	Description of Waste	Total Number of Answer	A. Generation Amount (kg)	B. Generation Amount (kg/day)	Classification & Generation of Waste by CONAMA Resolution 307 (kg/day)			
					Class A	Class B	Class C	Class D
01	Excavated soil	5	32,985	90.4	90.4			
02	Concrete debris	7	53,830	147.5	147.5			
03	Asphalt debris	1	62,500	171.2	171.2			
04	Brick debris	5	3,015	8.3	8.3			
06	Tile and ceramic	1	10	0.0	0.0			
11	Plastic/vinyl sheet	1	430	1.2		1.2		
12	Iron-bar, steel materials	5	250	0.7	0.4	0.3		
13	Small metal waste	5	571	1.6	0.1	1.5		
17	Plaster boards	1	20	0.1	0.1			
20	Wood debris	3	1,335	3.7	2.8	0.8		
21	Timber form	1	200	0.6		0.6		
22	Scaffolding material	1	1,230	3.4		3.4		
23	Interior timber	3	1,150	3.2	2.9	0.3		
24	Packing (cardboard)	4	960	2.6	0.3	2.3		
29	Machine oil	1	74	0.2	0.2			
33	Ash	2	165	0.5	0.5			
44	Mixed construction waste*1	2	674,000	1,846.6	1,846.6			
	Total	48	832,725	2,281.4	2,271.2	10.3	0.0	0.0

Note *1: Large-scale construction projects were confirmed at two factories which took place over the course of 6 months and 1 year produced a large amount of construction waste.

b. Number of Factories in PIM

123 factories of 334 surveyed have a construction works within their compound. It is estimated 162 (= 123x 440/334) factories have a construction works in PIM in total.

c. Generation Rate and Amount of Factories in PIM

As 162 factories have a construction works in PIM in total, the generation amount of construction waste from factories in PIM and generation rate per employee is calculated as follows:

Generation Amount of Factories in PIM
= Generation Rate per a factory with construction works x 162
Generation Rate per an Employee
= Generation Amount of Factories in PIM / Number of Employee in PIM (116,192)

Table 3-46: Generation Rate and Amount of Factories in PIM

Waste No	Description of Waste	Generation Rate per a factory (kg/factory/day)	Portion (%)	Generation Amount of Factories in PIM (C=Bx440/334) (ton/day)	Generation Rate per an Employee (kg/employee/day)
1	Excavated soil	9.04	4.0	1.46	0.013

2	Concrete debris	14.75	6.5	2.39	0.020
3	Asphalt debris	17.12	7.5	2.77	0.024
4	Brick debris	0.83	0.4	0.13	0.001
6	Tile and ceramic	0.003	0.0	0.00	0.000
11	Plastic/vinyl sheet	0.12	0.1	0.02	0.000
12	Iron-bar, steel materials	0.07	0.0	0.01	0.000
13	Small metal waste	0.16	0.1	0.03	0.000
17	Plaster boards	0.01	0.0	0.00	0.000
20	Wood debris	0.37	0.2	0.06	0.001
21	Timber form	0.06	0.0	0.01	0.000
22	Scaffolding material	0.34	0.1	0.06	0.001
23	Interior timber	0.32	0.1	0.05	0.000
24	Packing (cardboard)	0.26	0.1	0.04	0.000
29	Machine oil	0.02	0.0	0.00	0.000
33	Ash	0.05	0.0	0.01	0.000
44	Mixed construction waste	184.66	80.9	29.92	0.258
	Total	228.18	100.0	36.96	0.318

From the above, it was estimated that the daily generation amount of construction waste in the target area (PIM/MFZ) is 37.0 ton/day. The categorization according to CONAMA Resolution 307 for construction waste which is generated is as follows. Note that there was no hazardous construction waste confirmed in this study.

- Class A (reusable or recyclable as aggregate): 36.8 ton/day
- Class B (recyclable as material other than aggregate): 0.2 ton/day
- Class C (not economically feasible for recycling): 0.0 ton/day
- Class D (hazardous): 0.0 ton/day

d. Present Construction Waste Management Stream

The present construction waste management stream in PIM, according to the survey of construction works, is shown in the following figure.

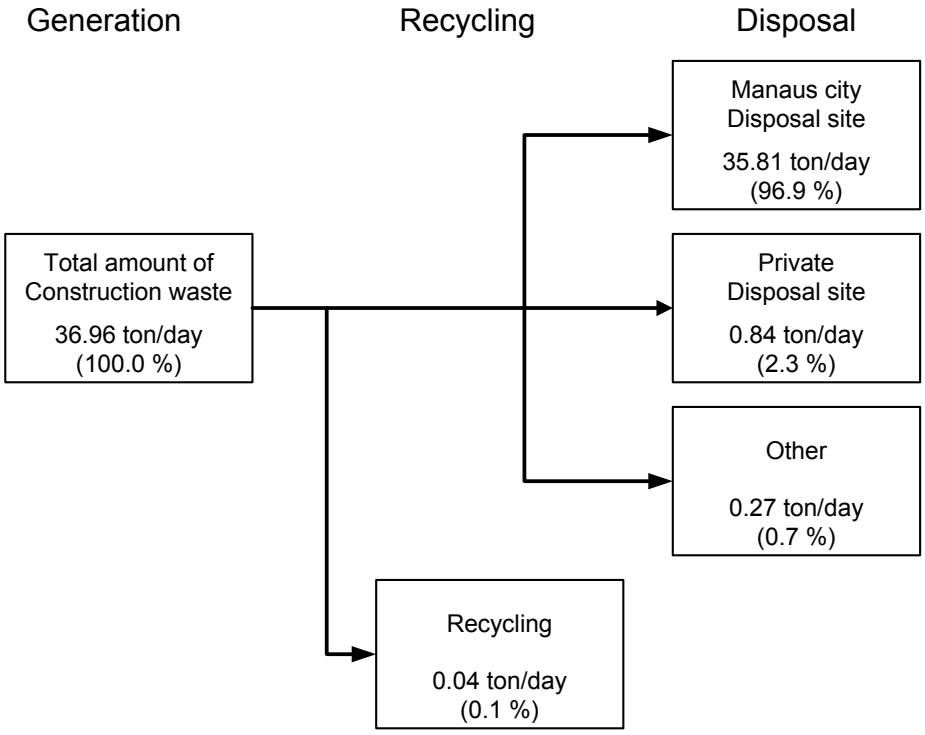


Figure 3-12: Construction Waste Management Stream in PIM

e. On-Site Construction Waste Management

e.1 Environmental License for Construction Projects

Of the total number of factories, about 60% had obtained environmental licensing to undertake a construction project.

e.2 Integrated Management Plan for Construction Waste

Of the total number of factories, about 60% had formulated a construction waste management plan as outlined in CONAMA Resolution 307.

e.3 Recycling

Of the 10 factories surveyed, only one factory replied that it resold the following five items.

- Iron-bar, steel materials
- Small metal waste
- Wood debris
- Interior timber
- Packing (cardboard)

This amounted to a total amount of 900kg, which, when calculated for the generation rate (GR) amounts to 0.247kg/day (GR = 900/365/10). Accordingly, the total recycling amount (TRA) for the entire PIM/MFZ was estimated to be 40 kg/day (TRA = 0.247 x 440 x 123 / 334), which is less than 0.1% of the generation amount.

e.4 Discharge

The responses concerning off-site discharge of construction waste that was generated revealed that 44 of the 48 items surveyed, or 91.7%, was collected by private collection companies that had been contracted for their services. Two items, or 4.2%, were offloaded to the Manaus City collection service.

f. Off-Site Construction Waste Management

f.1 Manifest (Monitoring the Disposal of Construction Waste)

In Brazil, there is no mandate for the use of a manifest for construction waste. It is left to the judgment of each state whether or not use of a manifest is required. In contrast with industrial (manufacturing) waste, Amazonas State does not require the use of a manifest in this instance. As such, respondents indicated that a manifest was used for only 11 of the 48 items which are discharged, or 22.9%.

Table 3-47: Use of Manifest for Discharged Wastes

Waste No	Description of Waste	Total Number of Answer	Answer		
			a. Yes	b. No	c. I don't know.
01	Excavated soil	5	1	4	
02	Concrete debris	7	2	4	1
03	Asphalt debris	1		1	
04	Brick debris	5	2	2	1
06	Tile and ceramic	1			1
11	Plastic/vinyl sheet	1		1	
12	Iron-bar, steel materials	5	2	2	1
13	Small metal waste	5		4	1
17	Plaster boards	1	1		
20	Wood debris	3		2	1
21	Timber form	1	1		
22	Scaffolding material	1		1	
23	Interior timber	3	1	2	
24	Packing (cardboard)	4	1	2	1
29	Machine oil	1		1	
33	Ash	2		2	
44	Mixed construction waste	2		2	
Total		48	11	30	7

f.2 Construction Waste Disposal

According to respondents, 26 of the 48 wastes discharged, 54.2%, are disposed of at the Manaus City landfill, as shown in the table below. This accounts for 54.2% of the items, yet in actuality, in terms of the amount disposed, 96.9 % of construction waste is disposed in the Manaus City landfill.

Table 3-48: Disposal of Construction Wastes

Waste No	Waste materials generated in your site		Total Number of Answer	Answer			
				Manaus City Landfill	Private Landfill	Other	Do not know
01	Excavated soil		5	3	1	1	
02	Concrete debris		7	5	1		1
03	Asphalt debris		1	1			
04	Brick debris		5	3	1		1
06	Tile and ceramic		1				1
11	Plastic/vinyl sheet		1	1			
12	Iron-bar, steel materials		5	2	1	1	1
13	Small metal waste		5	1	1	2	1
17	Plaster boards		1	1			
20	Wood debris		3		1	1	1
21	Timber form		1	1			
22	Scaffolding material		1	1			
23	Interior timber		3	1	1	1	
24	Packing (cardboard)		4	2		1	1
29	Machine oil		1		1		
33	Ash		2	2			
44	Mixed construction waste		2	2			
Total			48	26	8	7	7
Disposal amount by the Survey		(kg/day)	2,281.4	2,211.1	51.0	18.9	0.5
		(%)	100.0	96.9	2.3	0.8	0.0
PIM disposal amount (ton/day)			36.97	35.82	0.85	0.30	0.0

g. Issues on Construction Waste Management

The following issues were identified from the construction waste survey.

g.1 Construction Waste Management System Provisions

Over 1/3 of PIM factories (36.8%) carried out construction projects over the course of one year, from June 2008 to May 2009. The generation amount of the 10 factories surveyed estimated for all of the PIM factories is calculated as 37 tons per day, or an annual amount of 13,500 tons of construction waste generated. Although in this study there is no report of hazardous waste discharge, the hazardous waste asbestos is used in various construction materials. Therefore, based on the results of this survey, it is necessary to provide a management system to grasp a more accurate picture of construction waste, and particularly hazardous waste.

g.2 On-Site Management

Waste management at construction sites for on-site construction waste is judged to be established to a certain level according to the following facts.

- Construction waste is divided into 44 categories, according to respondents.
- Approximately 60% of factories have formulated a construction waste management plan as outlined in CONAMA Resolution 307.

Nevertheless, two factories that discharged a large amount of waste confirmed that it was mixed. Thus, from a quantitative standpoint, the mixed discharge rate is 80%.

g.3 Recycling

Contrary to the designs of CONAMA Resolution 307, the present recycling rate of construction waste is extremely low at 0.1%. Also, over 80% of the quantity is discharged as non-separated waste and disposed of at the Manaus City landfill. The cause for this is that motivation needed to encourage dischargers to separate and recycle to reduce their disposal expenses is lost, (i.e. the Manaus City landfill does not collect a disposal fee).

g.4 Hazardous Construction Waste

Class D hazardous waste, as defined in CONAMA Resolution 307, was not reported in this study. However, renovations account for 60% and asbestos, a hazardous waste material, is used in ceiling and roofing materials as well as water storage tanks and so forth. In addition, construction generally generates waste oil and organic solvents, so it is necessary to confirm whether there are truly no hazardous wastes generated. Furthermore, if they are generated, it will be necessary to confirm the treatment and disposal methods used in a future study.

g.5 Understanding Current Conditions of Off-Site Disposal

After discharge, the final disposal of most construction waste (96.9%) is done at the Manaus City landfill. If this waste does not contain hazardous substances, such final disposal is not a problem, however the actual situation remains unclear. It is necessary to work with the City of Manaus to confirm that appropriate disposal methods are being followed.

3.6 Study of Radioactive Waste Management

3.6.1 Outline of the Study

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, as shown in the table below.

Table 3-49: Institutions in PIM that use radioactive material

No	Purpose of Use	Reg No.	Institution
1	Large-sized irradiators	14522	Amazonas State Hematology and Hemotherapy Foundation
2	Nuclear medicine (with non-sealed sources)	11649	Amazonas State Nuclear Medicine and Ultrasonography Center
3		14234	Rio Solimões Institutional Support Foundation - UNISOL
4	Nuclear measurers - Process control	13686	Amapoly Industria e Comercio Ltda
5		14606	Brasil Norte Bebidas Ltda
6		14386	Cervejarias Kaiser Brasil S/A - Manaus/Am
7		14569	Cia de Bebidas das Americas - Ambev - Filial Manaus
8		14579	Microservice Tecnologia Digital da Amazônia Ltda
9	Research	12546	Amazon National Research Institute – INPA
10	Prospection of Oil	10571	Schlumberger Servicos de Petroleo Ltda - Urucu
11	Radiotherapy	11457	FCECON - Oncology Control Center Foundation
12		14886	IMAM - Instituto de Mama do Amazonas Ltda
13	Analytical techniques	13760	COIMPA Industrial Ltda
14		14932	Instituto Nokia de Tecnologia

Note *1: Listed in the "Profile of the Companies with Projects Approved by SUFRAMA - Dez/2008"

Eight of the 14 facilities listed above 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. The questionnaire contained the following items:

- Existence of usage permit and management standards
- Intended purpose for radioactive materials
- Types and management of radioactive materials
- Whether or not radioactive waste is generated
- Types of radioactive waste and generation amount
- Treatment and disposal methods of radioactive wastes
- Other

3.6.2 Legislation and Administration related to Radioactive Waste

a. Management of Radioactive Materials

Radioactive materials are managed by a single institution: the National Commission of Nuclear Energy, Ministry of Science and Technology (CNEN). CNEN has established the following regulations concerning the management of radioactive materials.

1. Licensing of Radioactive Facilities CNEN-NE-6.02 – September 1984
2. Management of Radioactive Wastes in Radioactive Facilities CNEN-NE-6.05 – December 1985

Licensing regulations divide radioactive facilities into 3 classes and 10 groups, with stipulations for each group to acquire the necessary license.

b. Management of Radioactive Waste

Regulation for the management at radioactive facilities of radioactive waste purports that the waste is categorized as shown below and managed accordingly for each category.

Table 3-50: 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

3.6.3 Selection of Target Facilities and Execution of the Survey

Of the following 14 institutions using radioactive materials in Manaus, eight were selected and then visited to conduct direct interviews. The study team directly hired an aid to assist in the survey. The interviews and compiling the results was completed as planned by late July, and the study team prepared the report in August 2009.

Table 3-51: Institutions using Radioactive Materials in Manaus

Type	Number of Factories/Institutions
Large-sized Irradiators	1
Nuclear Medicine (with non-sealed sources)	2

Nuclear Measurers - Process Control	5
Research	1
Oil Prospection	1
Radiotherapy	2
Analytical Techniques	2
Total	14

3.6.4 Results of the Survey and Findings

a. Administration on Radioactive Waste Management

The National Commission of Nuclear Energy (CNEN), under direct control of the Ministry of Science and Technology, is solely responsible for the management of radioactive substances through activities such as issuing guidelines for handling radioactive material and radioactive-contaminated material, granting licenses, monitoring, and construction of facilities to handle radioactive materials. CNEN issues regulation of radioactive materials (Management of Radioactive Wastes in Radioactive Facilities CNEN-NE-6.05—December 1985).

Based on CNEN-NE-6.05, standards for the handling of health-care radioactive waste are established by the National Environment Council (CONAMA) and the National Health Surveillance Agency (ANVISA), respectively, as shown below:

- Treatment and Final Disposal of Health-care Waste: CONAMA Resolution 358/2005
- Appropriate Management Criteria for Health-care Waste: RDC 306/2004-ANVISA

b. Generation Amount of Radioactive

b.1 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)

b.2 Generation Amount of Radioactive Waste

According to survey responses from the 8 factories and organizations on their use of radioactive materials, neither claimed to generate radioactive waste. It is therefore assumed, given that the facilities and equipment are relatively new, that radioactive waste is not generated.

c. Radioactive Materials Management in PIM

As mentioned above, according to the response of the 8 factories and organizations surveyed, there are no radioactive wastes presently generated in the target study area. Based on the response from 7 factories, the current conditions of radioactive materials management at PIM factories is give below.

c.1 Licensing

All seven of the factories have obtained licensing for the use of radioactive materials.

c.2 Intended Use of Radioactive Materials

The intended use of radioactive materials is given in the table below, including process control, quality control and the like.

Intended Use	No. of Respondents	Ratio (%)
Filling level inspection/measurement	4	57.1
Measurement of the PVC sailcloth in the process	1	14.3
Products dimension control	1	14.3
Verification of the solder	1	14.3
Total	7	100.0

c.3 Shield against Radiation Sources

Radiation sources are all shielded, with the exception of one location. At one location radioactive light is used as an irradiation lamp.

c.4 Containment of Radiation Sources

Containment of radiation sources is as follows.

Conditions of Radiation Source Containment	No. of Respondents	Ratio (%)
It is stored inside of the controlled area with special container	2	28.6
It is stored inside of the controlled area and installed inside of the X-ray equipment	3	42.8
It is installed in a level measurement device	1	14.3
It is installed in a device within a controlled area	1	14.3
Total	7	100.0

c.5 Location of radioactive light emitting equipment

All seven factories use radioactive light emitting equipment in controlled localities.

4. Current Industrial Waste Management and Issues

4 Current Industrial Waste Management and Issues

4.1 Administration of Industrial Waste Management

4.1.1 Industrial Waste-related Policies

a. National and Regional Plans

a.1 National Sustainable Development Strategy

Brazil is organized into a federative system of 26 states and 5,507 municipalities, plus the Federal District, where is located the three Powers of the Republic. Social, cultural and economic diversity is great and is reflected in the production and consumption of goods, with the resulting of industrial waste.

The Brazilian Agenda 21 was signed in July 2002 by the president Fernando Henrique Cardoso, in preparation for the World Summit on Sustainable Development. This comprehensive strategy is not classified as an official government document. Rather, it was created through years of extensive consultation across all sectors of society, and is consequently classified as a "social pact". The extent to which the government is bound by this pact is unclear.

The Brazilian Agenda 21 provides an overview of the development process of this strategy, acknowledging the challenges, lessons learned and actors involved. The Agenda expands upon the concept of sustainable development, and how Brazil's situation fits into the international context. The bulk of the Agenda outlines several objectives, including actions and recommendations. The objectives are organized under the following five priority areas:

- The economy of savings in the society of knowledge
- Social inclusion for a solidarity society
- Strategy for the urban and rural sustainability
- Strategic natural resources: water, biodiversity and forests
- Governability and ethics for the promotion of sustainability

The final components of the Agenda include a discussion on implementation mechanisms and instruments, accompanied by an overview of accomplishments already undertaken in this country.

Under the Brazilian Constitution, the government's Multi-Year Plan (Plano Plurianual - PPA) must be prepared every four years and approved by the National Congress. The PPA includes the programs that are to receive funding. In 1999, when the 2000-2003 PPA was prepared, it incorporated information on consultations undertaken and documents written to date which pertained to the basic themes of the Brazilian Agenda 21. It was hoped that by incorporating these themes at the national planning level they would, in turn, eventually be incorporated into public policies.

The 2004-2007 PPA, created under President Lula resulted in a major budget cut for the environmental sector. However, "the great innovation of the new PPA is the insertion of the environmental dimension on the National Development Strategy. The government wants to

integrate environmental questions with Brazil's development policy. The other four dimensions of the Plan are: social, economic, regional and democratic".

Although the Brazilian Agenda 21 is not named clearly as a national sustainable development strategy, the Agenda notes that "the common objective to be achieved is not restricted to the preservation of the environment alone, but to a progressive and expanded sustainable development, which brings into discussion the search for balance between economic growth, social equity and environmental preservation". Further the three target dimensions of sustainability are embedded in the objectives addressed in the Agenda, ranging from natural resource management and conservation issues, to social inclusion and income distribution, through to economic mechanisms, governance and international relations.

a.2 Priorities of 2008/2011 PPA (Federal Government)

The 2008-2011 Multi-Year Plan (Plurianual Plan - PPA) contains all the goals and guidelines of the federal government, in addition to the forecast of public expenses for that period. This PPA was sent on August 31 of 2007 by the government of President Lula da Silva, in order to be submitted to the consideration of the National Congress.

The PPA is always elaborated in the first year of the mandate of the elected president. Thus, those years are characterized by an intense mobilization in the social field, since organizations articulate and are mobilized with the intention of intervening in the budget, particularly to extend the resources destined to social policies.

The PPA defines, by regions, the directives, objectives and goals of the federal public administration for capital expenses, derived expenses of these objectives and goals and the expenses of programs of continued duration.

The 2008/2011 PPA is based on three axes: "economic growth", "quality education" and the "social agenda". The contents of these axis correspond, respectively: (i) to the Growth Acceleration Program (PAC), that orients the infrastructure policy of the second mandate of the federal government, with special emphasis in works related to the power and transportation sectors; (ii) to the Plan for the Development of Education (PDE), that has the objective to improve the quality of Brazilian education; and (iii) to the Social Agenda, whose main policy is the continuity of focused programs of "transference of income", such as the program "Family Stipend" (Bolsa Família), and the investments in the area of public security.

a.3 Strategic Plan of Amazonas State Government

The government's strategic plan defines the top-objectives of the State and establish government frameworks, the territorial dimension, challenges and orientation that guide the planning of actions to be developed, and the evaluation of its implementation[1].

It is intended, therefore, from the challenges, guiding every State Secretariat in the definition of the whole program.

The frameworks of the government express a vision of the future and say how the government wants to be known at the end of the Plan period. The frameworks proposed for the PPA are:

- The government will prioritize the socioeconomic development, on a sustainable basis, the use of regional potentials, building the human resources development of citizens.

[1] Source: Project of Law (Volume II), Pluriannual Plan 2008-2011, Government of Amazonas State

- The government will ensure the economic sustainability of the State, the Interior and the Capital.

The government will modernize the public services management for service quality of social demands.

The top-objectives are represented by actions to be developed in following segments:

- Sustainable socioeconomic development;
- Enhancement of human development, with emphasis on education;
- Improvement of public service and operational management of the government Administration.

As regards the territorial dimension, this expresses the need to observe local demands and have policies that guide the actions of the government taking into of differences, needs and opportunities between the various regions of State. The territorial dimension is thus marked by internalization of Development and Ensuring the Sustainability of the Capital (Manaus).

Regarding environmental issues, the Environmental Program of the Amazon 3111 of the PPA 2008-2011, mentions the objective: to reduce environmental impact of potentially polluting activities and/or harmful to the environment in the State of Amazonas, to promote and disseminate education.

The target audience is individuals and companies that develop activities with a potential impact or environmental degradation in the Amazon and the public and private institutions working in the field of environmental education.

However, as the federal PPA, the state PPA focuses on economic development, education and public services, and the insertion of environmental issues is very general, and considerations on industrial waste is almost null.

b. Policies on Environmental Protection and Waste Management

b.1 Agenda 21

Agenda 21 was one the main results of the Eco-92 or Rio-92. The principles of Agenda 21 are consolidated into specific agendas, such as green (forest, biodiversity and genetic resources), the blue (water resources) and brown (urban ecosystem).

Brasil, as a signatory of agreements signed at Rio-92, undertook to develop its own Agenda 21.

In 2007, the Brazilian Agenda 21 was transformed into Agenda 21 program that aims to implement the Brazilian Agenda 21, to develop and implement Local Agenda 21 and to provide continuing education in Agenda 21.

The Brown Agenda, drawn up in Johannesburg, South Africa in 2003, among the subjects is also the management of waste.

The address issues of environmental quality also present in the Brown Agenda in 2006, the Brazilian government issued Decree 5718/March 2006 (later repealed by Decree 6099/2007), in which IBAMA reform its structure and establishing a Department of Environmental Quality (DIQUA) to implement policies for preventing environmental emergency situation or minimizing their impacts.

b.2 CONAMA national proposal on SWM

A Draft Bill was built on a proposal approved by CONAMA in July 1999 and discussed in the National Seminar for National Policy on Solid Waste, sponsored by the Council in 2004. The suggestions made in the event were systematized and consolidated by the Working Group of the Department of Urban and Regional Environmental Management of the Secretariat of Environmental Quality of MMA[1].

The proposal of the National Policy on Solid Waste, and preventive measures regarding waste generation, seeking to encourage reuse, recycling and use of alternative materials to the environment. The proposal is based on the participation of society in planning, formulation and implementation of public policies on regulation, monitoring, evaluation and provision of services. The text will also serve to protect public health and environmental quality, and preserve and ensure the sustainable use of natural resources.

b.3 National Solid Waste Policy

b.3.1. Outline of NSWP

On March 2010, the federal government presented the Substitute of Draft Bill No. 203 (Substitutivo Projeto de Lei No. 203) and its Annexes, which establishes the national solid waste policy and other measures.

After 19 years of discussion, the National Solid Waste Policy (NSWP) was approved by the House of Commons (Camara de Deputados) Representatives on 10 March 2010 and covers all the principles, objectives, tools, guidelines, goals and actions adopted by the federal government, either alone or in cooperation with States, Federal District, Municipalities and private, with a view to integrated and environmentally sound management of solid waste.

It sets 15 goals; among them: the protection of public health and environmental quality, implementation of the 3Rs; adoption of sustainability standards and encouraging the recycling industry, adoption, development and improvement of clean technologies, and integrated waste management.

b.3.2. SWM Plans

Article 14 of NSWP presents the following solid waste plans:

1) The National Plan for Solid Waste,
2) Solid waste plan of the State,
3) Plans for integrated municipal solid waste,
4) Micro-regional plans for solid waste and solid waste plans for metropolitan areas or urban areas,
5) Inter-municipal integrated management of solid waste plans.

Next, main issues (1), (2) and (3) of the National Solid Waste Plan are described.

(1) The National Plan of Solid Waste:

The Article 14, Section 2 of NSWP describes items of the National Plan for Solid Waste, under the coordination of the MMA. The most important items are the following:

- Diagnosis of the current situation of solid waste;

[1] http://www.medioambienteonline.com/site/root/resources/industry_news/2936.html?changer-id=aDw68EEy_km-&&lang=es

- Goals for reducing, reusing and recycling, among others, in order to reduce the amount of waste and waste sent for environmentally appropriate disposal;
- Goals for the energy use of gas generated in units of final disposal of solid waste;
- Targets for recovery and disposal of garbage, the inclusion of social and economic emancipation of recyclable materials are reusable and recyclable;
- Measures to encourage and facilitate the regionalized management of solid waste;
- Guidelines for planning and other activities of solid waste management regional integrated development imposed by a complementary as well as areas of special interest tourism;
- Standards and guidelines for the disposal of waste and, where applicable, of waste;
- Means to be used for the control and monitoring at the national level, the implementation and operation, ensured social control.

(2) Solid Waste Plan of the State

According to Article 14, Section 3 of NSWP, some items are defined as minimum content, the most important of which are the following:

- Diagnosis, including identification of key waste streams in the state and their socioeconomic and environmental impacts;
- Goals for reduction, reuse, recycling, among others, in order to reduce amount of waste and waste sent for disposal environmentally appropriate;
- Goals for the energy use of gas generated in units of final disposal of solid waste;
- Targets for recovery and disposal of garbage, the inclusion of social and economic emancipation of recyclable materials are reusable and recyclable;
- Measures to encourage and enable the consortium or shared management of solid waste;
- Guidelines for planning and other activities of solid waste management in metropolitan areas, urban and micro;
- Standards and guidelines for the disposal of waste and, where applicable, waste, compliance with the provisions laid down nationally.

(3) Plan for Integrated Municipal Solid Waste

The plan for integrated municipal solid waste has items defined as minimum content according to Article 14, Section 4 of NSWP. The most important items are the following:

- Diagnosis of the situation of solid waste generated in their territory containing the origin, volume, waste characterization and disposal and ways of disposal adopted;
- Identify favorable areas for environmentally sound disposal of waste,
- Identification of solid waste generators subject to specific management plan or system of reverse logistics.
- Definition of responsibilities for implementation and operation, including the steps of the plan for solid waste management.
- Programs and environmental education activities that promote non-generation, reduction, reuse and recycling of solid waste;

- Targets for reduction, reuse, waste collection and recycling, among others, in order to reduce the amount of waste sent for environmentally sound disposal;
- Means to be used for the control and supervision, at the local level, implementation and deployment plans for solid waste management systems and logistics for specific (in Art. 33 of Substitute of Draft Bill No. 203).
- Preventive and corrective actions to be taken, including monitoring program;
- Identification of environmental liabilities related to solid waste, including contaminated areas and their remedial measures;

b.3.3. Other Important Issues

(1) Responsibilities

Establishing the shared responsibility for the lifecycle of the product, manufacturers, importers, distributors and marketers will have to invest to market recyclable items that generate the least amount of solid waste. Sets the packaging shall be manufactured from materials that are conducive to reuse or recycling. Measures should be implemented to receive packages and products after use by the consumer (Reverse Logistics) for: pesticides, waste and packaging, batteries, tires, lubricating oils, waste and packaging, fluorescent lamps, and electronic products and components.

In the municipalities that establish waste collection customers are required to be packaged properly and separately with the waste generated and to provide adequate solid waste to reusable and recyclable collection and return to the Government should establish a separate collection, composting system set up (waste processing solid organic fertilizer) and to final destination environmentally sound waste from street cleaning (street sweeping).

The urban sanitation companies should give priority to the work of collection cooperatives formed by low-income people, according to standards of a future regulation.

Municipalities that deploy the collection with the participation of associations and cooperatives of pickers will have priority access to resources in the credit lines under the National Plan for Solid Waste.

(2) Hazardous Waste

Sets the facility or enterprise that manages or operates with hazardous waste may be authorized or licensed to prove their charge capacity and conditions to provide the care needed to manage such waste. However, does not define what characterizes the person as capable and able to provide care. Further stipulates that legal entities that operate with hazardous waste are required to register the National Registry of Operators of Hazardous Waste. The environmental licensing of projects or activities that operate with hazardous wastes, the licensing body of SISNAMA may require placement of insurance against liability for damage caused to the environment or public health.

(3) Prohibitions

The following are prohibited forms of appropriation or disposal of solid waste:

- Released on beaches, at sea or any water bodies;
- Outdoor littering, except for mineral waste;
- Burning practices or open container, plant or equipment not licensed for this purpose;
- Other forms vetoed by the Government.

The provision of waste disposal, including the installation of sanitary landfills and industrial areas, in conservation areas and in areas of environmental conservation or permanent protection of water sources are prohibited in final disposal sites, scavenging activities, animal husbandry, settlements of temporary and permanent residents and others vetoed by the Government.

It prohibited the importation of waste and solid waste characteristics damaging to the environment and public health, animal and plant, even for treatment, renovation, reuse or recovery.

The rule on the final disposal of waste should be implemented within four years after the publication of the law, but state and local plans may set different deadlines, in order to tailor them to local conditions and needs.

c. IWM - related National and Regional Plans

With regard to IWM, CONAMA Resolution No.313/02 establishes the following:

Article 7. In three years from 2002, it shall prepare the State Programs for Industrial Management, and in four years, the National Plan for Industrial Waste Management.

Article 8. Industries, after sixty days from the date of publication of this resolution (21/11/02), must register monthly and keep in the industrial unit the generation and disposal data of waste generated in order to obtain data for the national inventory of industrial waste.

Article 9. Noncompliance with the provisions of this resolution shall be subject to penalties and sanctions for offenders under Law No. 9605 of 12 February 1998 and Decree No. 3179 of 21 September 1999.

CONAMA Resolution Nº 313, of October 29, 2002, discusses the National Inventory of Solid Industrial Wastes.

Considering the absence of precise information concerning the quantity, types and destinations of the solid wastes generated in the industrial park of the country;

Art. 1. The waste existent or generated by industrial activities will be the object of specific control, as an integrated part of the environmental licensing process.

Art. 3. The electric energy concessionaires and businesses that possess materials and equipment containing PCBs will have to present to the state agency of the environment the inventory of these stocks, in the form and place to be defined by the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA).

Art. 4. The industries of the types anticipated in the National Classification of Economic Activities of "IBGE", will have to, within the maximum period of one year after the publication of this Resolution, or in accordance with the period established by the state environmental agency, present to it, information concerning generation, characteristics, storage, transport and destination of its solid wastes.

4.1.2 Factory Classification and IW Classification

a. Factory Classification and Factory List

a.1 SUFRAMA's Classification of Factories

SUFRAMA classifies factories as shown below into 19 main categories, which, together with sub-categories, total 28 types by sector. In this study, SUFRAMA's 19 main categories were used to summarize the current conditions and issues dealing with industrial waste management in PIM/MFZ.

Table 4-1: SUFRAMA's Factory Classification

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 "

a.2 SUFRAMA's Factory List

SUFRAMA has created a list of PIM factories (hereafter, SUFRAMA factory list)[1]. The PIM factories on this list are divided into 4 categories.

1 Part 1: Complete Projects (Large Factories) Approved and Installed in PIM

2 Part 2: Simplified Projects (Small Factories) Approved and Installed in PIM

3 Part 3: Complete Projects (Large Factories) Approved and Under Installation in PIM

4 Part 4: Simplified Projects (Small Factories) Approved and Under Installation in PIM

There are a total of 475 factories on the SUFRAMA factory list under Part 1 and Part 2 for large and small factories currently in operation in PIM.

Table 4-2: Factories in Operation on the SUFRAMA Factory List

Factory Code	Inside the DI			Outside the DI			Outside the MFZ			Total number of factory (A)
	Part 1	Part 2	Sub-total	Part 1	Part 2	Sub-Total	Part 1	Part 2	Sub-Total	
F01	4		4	12		12	2	1	3	19
F02										
F03	6		6	3	7	10	1		1	17
F04	73	1	74	52	5	57				131
F05	2	1	3	1		1	2	8	10	14
F06	19		19	9		9				28
F07	23	2	25	20	3	23		1	1	49
F08		1	1	2	3	5				6
F09	1		1	3	1	4		2	2	7
F10	7		7	6		6				13
F11	2		2	1		1				3
F12				5	9	14	1		1	15
F13	13	2	15	15	4	19				34
F14	32	2	34	35	7	42				76
F15				1		1				1
F16				2		2				2
F17	15		15	16	2	18				33
F18		1	1	3	3	6				7
F19	7		7	5	8	13				20
Total	204	10	214	191	52	243	6	12	18	475

a.3 List of PIM/MFZ Factories in Operation

A list of PIM/MFZ factories in operation was compiled, based on the previously mentioned SUFRAMA factory list, according to the following:

- Excluding PIM outside the study target area, MFZ.
- Excluding factories that have been closed, of the 334 factories contacted by telephone

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

during the Medical Institution and construction waste survey.

The current conditions and issues of PIM/MFZ industrial waste management were summarized based on the above results of 440 factories, as shown in the following table.

Table 4-3: List of PIM/MFZ Factories in Operation

Factory Code	Inside the DIs			Outside the DIs			Total No. of Factories (A)
	No of Part 1 Factories	No of Part 2 Factories	Subtotal	No of Part 1 Factories	No of Part 2 Factories	Subtotal	
F01	3		3	12		12	15
F02							
F03	6		6	3	7	10	16
F04	64	1	65	51	5	56	121
F05	2		2				2
F06	19		19	9		9	28
F07	23	2	25	19	3	22	47
F08		1	1	2	3	5	6
F09	1		1	3	1	4	5
F10	7		7	6		6	13
F11	2		2	1		1	3
F12				4	9	13	13
F13	13	2	15	15	4	19	34
F14	31	2	33	35	7	42	75
F15				1		1	1
F16				2		2	2
F17	15		15	16	2	18	33
F18		1	1	2	3	5	6
F19	7		7	5	8	13	20
Total	193	9	202	186	52	238	440

a.4 Factory Registry Database

SUFRAMA releases a monthly report of industrial statistics termed “Performance Indicators of Manaus Industrial Pole”. Factories use an “online performance index system” introduced in 2004 to report these statistical results to SUFRAMA (COISE/CGPRO/SAP) based on actual performance. The results reported by these companies are entrusted to FUCAPI by SUFRAMA and managed in a database.

Meanwhile, SUFRAMA’s CGPRI department issues a “Profile of Companies with Projects Approved by SUFRAMA” (hereafter, the SUFRAMA factory list) on a quarterly basis, which encapsulates the registered factories receiving tax benefits. This factory profile is made in MS Word format, not in database format, but the basic data is taken from the database made by COISE/CGPRO/SAP.

The study team used the SUFRAMA factory list[1] of December 2008 as the basis for the study, but contacted all of the Part 1 & 2 factories on the list (which are supposed to be operating.) to conduct interviews for health-care waste and construction waste. However, it seemed that the SUFRAMA factory list had not been updated because it was found that 17 factories that were no longer operating.

The profile in the factory list is divided into 4 parts, as shown below, which are already categorized into 19 industrial sectors (28, including sub-classes).

Part 1: Complete Projects Approved and Installed in PIM

Part 2: Simplified Projects Approved and Installed in PIM

Part 3: Complete Projects Approved and Under Installation in PIM

Part 4: Simplified Projects Approved and Under Installation in PIM

The categories in the SUFRAMA factory list for registered factories has some variation, but the more detailed list of 18 items from Part 1 are given here. These correspond to a portion of the items contained in the database managed by FUCAPI.

Table 4-4: Items included on the SUFRAMA Factory List (from Part 1)

SUFRAMA Factory List Items			
1	Registration of the National Company Records	10	Long Distance Call / Fax
2	SUFRAMA Registration Number	11	E-mail
3	Situation of Factory	12	Director
4	Company	13	Production Start-up
5	City	14	Facilities area
6	Address	15	Land area
7	Zip code	16	Number of Employee
8	Telephone	17	Share capital
9	Telex	18	Description According to the Standard Code (Name of Products)

b. Industrial Waste Categories

b.1 Classification of Waste in ABNT NBR 10004

Brazilian federal law does not specify the definitions for “waste” or “hazardous waste”, but for the purpose of listing hazardous wastes in a manifest, uses waste categorization from the Brazilian Association for Technical Specifications ABNT NBR 10004 as a reference for those categorized in CONAMA Resolution 6/88 for the categorization of wastes. Although ABNT NBR 10004 and other ABNT specifications have no legal binding authority, ABNT NBR 10004 is used as a reference for a large number of federal and state laws giving it substantial requisite standing. The latest version of NBR 10.004 was established 30

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

November 2004 to replace the 1987 version. This new standard is based on the American hazardous waste standard CFR－Title 40－Environmental Conservation－Part 260-265－Transfer of Hazardous Wastes.

ABNT NBR 10004 classifies wastes in the following categories.

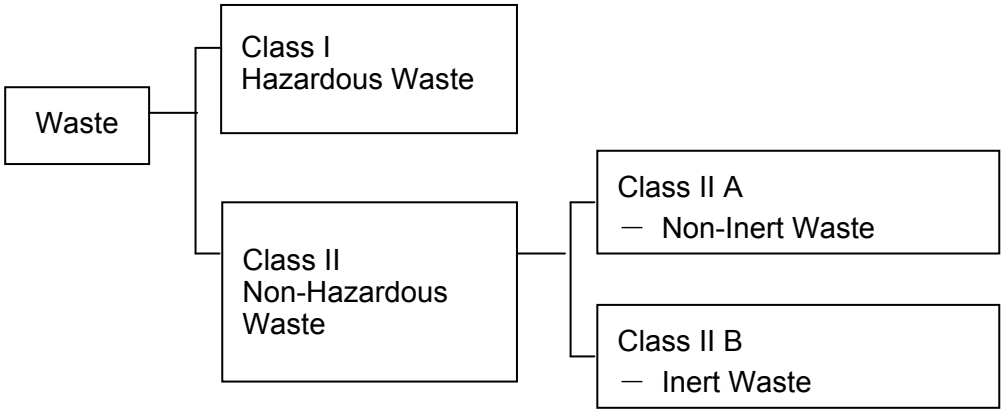


Figure 4-1: Classification of Waste in ABNT NBR 10004

Class I (Hazardous) wastes fall either under the accessory specifications A and B in ABNT NBR 10004 or that for standard hazardous characteristics (ignitable, corrosive, reactive, toxic, pathogenic, etc.). ABNT NBR 10004 Annex A indicates wastes from non-specified sources, whereas Annex B indicates those from specified sources. The material consistency used the standard set out in the 1987 version of ABNT NBR 10004, making it necessary to analyze all wastes, and since this became a great financial burden to dischargers of waste, a change was made in the 2004 version to indicate the generation source.

b.2 CONAMA Resolution 313

CONAMA (the National Council for Environment) issued CONAMA Resolution 313 on October 29, 2002, obligating specific manufacturing industries (factories) to report (i.e. via an industrial solid waste inventory) all waste generated from their activities. Furthermore, using this inventory, CONAMA Resolution 313 sought to have each state environmental agency submit data garnered from the inventory in a set format to IBAMA and formulate a state-level industrial waste management plan.

In the State of Amazonas, all factories are required to create and submit an inventory of the wastes they generated, in accordance with CONAMA Resolution 313.

b.3 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 3 major groups, as shown in Figure 4-1: Classification of Waste in ABNT NBR 10004.

- 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 waste generated is attributed. Thus, upon discussion with 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.

4.1.3 Administration of Industrial Waste Management

a. IWM-related Laws and Regulations

a.1 Federal Level

a.1.1. CONAMA Resolution

There is no basic waste disposal law in Brazil as there is in Japan. At present, the Brazilian Ministry of Environment (MMA) has submitted a comprehensive law dealing with solid waste management (National Solid Waste Policy Bill) PL203/91, which is now under deliberation in the legislature.

However, CONAMA formulates various resolutions dealing with the regulation of industrial waste management. Thus, industrial waste management is basically carried out according to the various resolutions put forth by CONAMA. The following resolutions are those which are primarily related to this study.

- **Resolution CONAMA no. 237/1997** that seeks for the need of revision of the procedures and criteria used in **environmental licensing**, in order to execute the use of the licensing system as an instrument of environmental management, instituted by the Environmental National Policies;
- **Resolution CONAMA no. 307/2002** that establishes guidelines, criteria and procedures for the **administration of construction wastes**;
- **Resolution CONAMA no. 313, of October 29, 2002**, on the **national inventory of industrial solid wastes**; and
- **Resolution CONAMA no. 358, of April 29, 2005**, on **treatment and final disposal of health-care waste and other measures**.

a.1.2. Others

The National Health Surveillance Agency (ANVISA), an independent agency under the Ministry of Health, has established an appropriate management standard, called **RDC 306/2004-ANVISA**, for the medical institutions which are the source of these wastes.

The National Commission of Nuclear Energy (CNEN), under direct control of the Ministry of Science and Technology, issues regulation of radioactive materials (**Management of Radioactive Wastes in Radioactive Facilities CNEN-NE-6.05—December 1985**).

a.2 State Level

In the extent of state legislation, Law n. 2.712, from December 28, 2001, establishes the Water Sources State Policy and the Water Sources System and the State System of Resources Management.

a.3 Municipal Level

The Municipality of Manaus presents legislation on solid wastes. In general, the legislation acts to forecast urban cleaning public services, postures and the precautions where appropriate in order not to jeopardize the water resources and the environment.

The main legal instrument is the Organizational Law, promulgated on April 05, 1990 which, in Article 80, paragraph f, establishes that the Municipality is in charge of public cleansing, collection, treatment and disposal of waste. Clause VI of Article 229, establishes the items which are mandatory to be taken into account: definition and maintenance of public cleansing systems, including the collection, treatment and final disposal aspects of the waste.

The Municipal Master Plan of November 04, 2002 Law no. 671, regulated the Urban and Environmental Master Plan, establishing guidelines for the development of the city of Manaus. The issue of solid waste is described in Article 7, Paragraphs f) and g); articles 52, 53 and 126.

b. IWM-related Organizations

b.1 General Industrial Waste

Industrial waste management in the State of Amazonas is the jurisdiction of the Institute of Environmental Protection of the State of Amazon (IPAAM); IPAAM does this based on an environmental licensing system.

Waste management in the city of Manaus is the jurisdiction of Municipal Secretariat of Urban Cleaning and Public Services (SEMULSP). This organization owns and operates its own final disposal site, which in addition to municipal solid waste (MSW), also accepts industrial (manufacturing) waste, health-care waste, and construction waste.

b.2 Health-care Waste

In Brazil, a National System of Sanitary Surveillance (SNVS) has been established. According to this SNVS, administration on health-care waste at the federal, state and municipal levels is as follows.

b.2.1. Federal Level

Health-care waste management at the federal level is controlled by the National Health Surveillance Agency (ANVISA), an independent agency under the Ministry of Health. ANVISA has established an appropriate management standard, called RDC 306/2004-ANVISA, for the medical institutions which are the source of these wastes. Appropriate management of health-care waste under the RDC 306/2004-ANVISA standard means that each medical institution which produces waste is required to formulate a health-care waste management plan.

Also, the National Environment Council (CONAMA) has issued regulation for handling health-care waste according to Resolution 358/2005.

b.2.2. State Level

DEVISA/AM (Sanitation Surveillance Department of Amazonas State) is a state-level department under SUSAM, the Health Secretariats of Amazonas State; the structure corresponds to ANVISA under the federal Health Ministry. DEVISA/AM works with the Amazonas State Environmental Protection Institute, IPAAM, to license medical institutions and waste management companies to carry out appropriate management and monitoring of health-care waste at the state level.

b.2.3. Municipal Level

At the municipal level, the Municipal Secretariat of Health (SEMSA) works in a similar capacity as the Ministry of Health at the federal level. Furthermore, Sanitation Surveillance Coordination, a unit in the Municipal Secretariat of the Environment (SEMMA), is the responsible municipal unit for the management and monitoring of health-care waste.

b.3 Construction Waste

In Brazil, administration on construction waste management is as follows:

- Those undertaking construction projects must obtain a construction permit from the city where the construction is to take place.
- Also, depending on the size and substance of a construction project, in the case of any environmental impact, an environmental license must be obtained accordingly.
- Municipalities must formulate a Construction Waste Management Municipal Program, according to CONAMA Resolution 307, and issue guidelines for construction waste management and management standards.
- Those undertaking construction projects must formulate a Construction Waste Management Project, according to the Construction Waste Management Municipal Program, and submit it to the municipality.

b.4 Radioactive Waste

The National Commission of Nuclear Energy (CNEN), under direct control of the Ministry of Science and Technology, is solely responsible for the management of radioactive substances through activities such as issuing guidelines for handling radioactive material and radioactive-contaminated material, granting licenses, monitoring, and construction of facilities to handle radioactive materials. CNEN issues regulation of radioactive materials (Management of Radioactive Wastes in Radioactive Facilities CNEN-NE-6.05—December 1985).

Based on CNEN-NE-6.05, standards for the handling of health-care radioactive waste are established by the National Environment Council (CONAMA) and the National Health Surveillance Agency (ANVISA), respectively, as shown below:

- Treatment and Final Disposal of Health-care Waste: CONAMA Resolution 358/2005
- Appropriate Management Criteria for Health-care Waste: RDC 306/2004-ANVISA

c. Waste Manifest System

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

In 2009, the Brazilian Institute for Environment and Renewable Natural Resources (IBAMA) proposed the Terms of Reference for the Elaboration of Wastes Manifest wherein the waste manifest system was regulated as follows, along with proposed provision requirements.

> "WASTES MANIFEST SYSTEM – wastes control system which, using its own form, the so called WASTES MANIFEST, allows one to know and control the destination given by the generator, transporter and receptor of the wastes."

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.

4.1.4 Administration of Waste Service Companies

a. Registration System

a.1 Registration System for Waste Service Companies in the State of Amazonas

Registration of waste service companies is handled by the Institute of Amazonas Environmental Protection (IPAAM). However, IPAAM does not register the companies themselves, but instead registers the environmental license of the waste service companies. The primary activity of IPAAM for environmental administration is to issue and manage environmental licenses, monitoring, and inspection; in this way, waste service companies are managed through the approval and issuance of environmental licenses.

a.2 Environmental Licensing

In the State of Amazonas, an environmental license must be obtained for any activity (industry) that could potentially impact the environment (Derecto No 10028 de 04 de Febreiro de 1987). These licenses are required not only for the installation and operation of factories, but for most activities where environmental impact is likely, including construction projects, agricultural, medical and so on.

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

- 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.
- 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.
- 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.

a.3 IPAAM List of Waste Service Companies (WSCs)

IPAAM environmental licensing covers all industries that impact 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 compile a list of waste related activities, as shown in the table below.

Table 4-5: Waste Service related Codes of IPAAM for Environmental Licensing

Code	Class	Code	Sub-Class	
				Impact
22＊＊	Commerce and Services	2217	Incineration	High
		2218	Co-processing of wastes	High
		2219	Agrochemical Collection Center	Moderate
24＊＊	Other Services (including provision of electricity and water)	2407	Solid Industrial Waste Collection and/or Treatment	High
		2408	Municipal Waste Final Destination	High
		2410	Collection and Transport of Inert Solid Waste	Minimal
		2411	Collection and/or Storage and/or Commercialization of Solid Waste (e.g. recycling)	Moderate
		2412	Collection and/or Treatment of Hazardous Liquid Industrial Waste	High
		2417	Industrial Waste Disposal in Landfill	High
26＊＊	Transportation	2615	Transport and Storage of Hazardous Solid Industrial Waste	High
30＊＊	Waste Treatment and Recycling	3001	Treatment and Recycling of Solid Industrial Waste without chemicals	Moderate
		3002	Treatment and Recycling of Industrial Liquid Waste	Moderate
		3003	Treatment and Recycling of Solid Industrial Waste without Chemicals	High
		3004	Treatment and Recycling of Palettes	Moderate
		3005	Paper and Cardboard Recycling	Moderate
		3006	Treatment and Recycling of Mineral Waste (Waste Re-processing)	Moderate

Source: Classificacao das Fontes Poliudoras IN 001;06 Publicada em (3/12/2007)

b. Current Administration Conditions

In the same way that other industrial activities that must obtain environmental licenses, IPAAM manages waste service companies through the renewal of maximum 2-year Operational Licenses. Although the IPAAM environmental licenses have been digitized, the following issues were identified:

The database server is old and does not function sufficiently. Furthermore, the database system is used for file management (to track where certain files are located), and thus is not set up for license management.

Other information about IPAAM activities is mixed with the environmental license data and managed in the same database, making it extremely difficult to extract the license information needed.

As shown in Table 4-5: Waste Service related Codes of IPAAM for Environmental Licensing, waste service companies are registered by codes for various related activities.

It became evident that not all of the waste service companies were shown in the IPAAM WSC List because it only lists those companies which have a code for waste service related activities. Also, once a list was compiled of the companies that are no longer in business or ceased their waste service related activities, it was not possible to identify them in the IPAAM WSC List, suggesting that licenses are not properly renewed and pointing to the need for a series of improvements to be made.

IPAAM indicated that improvements will be made to their registration system for waste service companies so it will be more effective. Furthermore, those companies without environmental licenses will be encouraged to register, and the system reinforced by updating the database of IPAAM waste service companies—which will be constructed during this study.

c. Current Condition of Waste Service Companies

Present conditions are similar to those mentioned above in that it is not possible to clarify the number of waste service companies in the study area or in what activities they are engaged. Moreover, it is reasonable to say that there are a number of parties engaged in waste services without having obtained the appropriate environmental license. In the very least, this study was able to recognize 23 companies after carrying out a survey of waste service companies.

The following table shows the business sector of companies that have environmental licenses based on an examination by the study team with support from the local consultant of the licenses of 67 waste service companies.

Table 4-6: 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

4.2 Present Generation of Industrial Waste

4.2.1 Previous Studies

A number of PIM factories have been submitting a waste inventory (WI) to SUFRAMA since 2002. SUFRAMA subsequently has compiled the WI from 2005 to 2008 as shown in the following table.

Table 4-7: Inquiries and Answers for Waste Inventory

Item	2005	2006	2007	2008
Questionnaires Sent	186	223	229	229
No. of Respondents	102	94	126	110
Ratio of Response (%)	54.8	42.2	55.0	48.0
Did not answer	84	129	103	129

Table 4-8: Generation Rate from Responding Factories

Unit: ton/year

Waste Type	2005	2006	2007	2008
Factories that responded	102	94	126	110
1. Non Industrial Waste	4,286.6	5,950.4	6,581.0	5,268.3
2. Various	37,565.6	35,226.4	38,250.9	41,058.4
3. Rubber and sludge	1,847.2	8,742.4	4,292.0	4,852.2
4. Contaminated waste	338.0	291.3	17,195.0	2,935.7
5. Dangerous residues	6,858.5	2,583.5	2,093.8	2,112.9
6. Metallic waste	9,432.7	43,769.1	33,913.3	30,351.8
7. Liquid waste	1,549.0	6,856.5	662.1	5,658.7
Total	61,877.7	103,419.5	102,988.0	92,238.0

The above attempt to analyze the WI received, shown above, did not clarify the overall generation of waste in PIM in terms of characteristics and quantity, nor the actual conditions of management of those wastes.

Based on the table above, the study team estimated the IW generation amount from all PIM as follows:

- The number of factories that submitted the WI in 2008 is 110 and total number of employees of the 110 factories 40,007.
- The IW generation rate per employee, per day is calculated as follows:

$$Generation\ unit\ (kg/employee/day) = \frac{92{,}238.0}{(40{,}007 \times 365)} \times 1{,}000 = 6.3$$

- Total IW generation amount is calculated at 732.0 ton/day by multiplying the generation rate with number of employees (116,192) of PIM.

Total IW generation amount of 732.0 ton/day seems to be quite similar to the study team's estimate 628.9 ton/day if we consider the inclusion of wastewater treatment amount, etc.

4.2.2 Current IW Generation Amount

a. Estimation Method

a.1 Generation Rate 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.

a.2 Estimation of General Industrial Waste

The generation amount for general industrial waste was estimated using Formula A, as shown below. This formula uses the amount of each waste generated per employee in each industrial sector (See Main Report, Chapter 3.3.5 a6). The generation rate was calculated using data from the factory survey with Formula B.

Formula A: $\mathbf{IWG_{ij} = G_{ij} \times M_i}$

i	Code i sector from the 19 factory sectors
j	Type j waste from 29 types of waste (13 non-hazardous + 16 hazardous = 29 types)
IWG_{ij}	Generation amount (ton/day) of wastes generated j from the industrial sector i in the target study area
M_i	Number of employees in sector i in the target study area
G_{ij}	Generation amount (ton/day) per employee of waste j per sector i

The industrial waste generation amount G is calculated as shown in Formula B by the total amount of different industrial wastes in the sectors from the factory survey, using the total number of employees in that sector.

Formula B: $\mathbf{G_{ij} = GAF_{ij} / M_i}$

GAF_{ij}	Total amount of waste j (ton/day) from the factories surveyed by industrial sector i
M_i	Total number of employees (per person) in the sector i

a.3 Health-care Waste and Construction Waste

Health-care waste and construction waste was calculated as follows.

- The number of factories with attached clinics and the number of construction projects in the past 1 year were confirmed by contacting all PIM factories, as listed in part 1 and II of the SUFRAMA factory list, by telephone.
- The response by telephone from all the factories (334), revealed the ratio (37.1%) of factories with attached clinics (124), and the ratio (36.8%) of factories that carried out construction projects in the past 1 year (123).
- Based on each of these ratios, for all 440 factories currently in operation, the number with attached clinics (163 factories) and construction in the past year (162 factories) was determined.
- Of these, 9 factories with attached clinics and 10 factories with construction in the past year were visited to conduct a face-to-face survey of the generation amount according to 9 types of health-care waste and 4 types of construction waste.
- From the generation amount of each of these, the generation rates per factory with attached clinic and construction in the past year were calculated for each of the 9 types of health-care waste and 4 types of construction waste.

- The total amount of health-care waste and construction waste generated in PIM was calculated by multiplying each generation rate with the number of factories with attached clinic (163) and construction in the past year (162).
- The generation rate per employee is found by dividing the total amount of health-care waste and construction waste by the total number of employees at all 440 PIM factories in operation (which is 116,192 persons), which was used to estimate the future generation amount.

b. Current IW Generation Amount

b.1 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 4-9: Summary of 440 PIM Factories

Factory Code	Description of Sector	Nos. of Factories	Nos. of Employees	Nos. 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**

b.2 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 4-10: 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

b.3 General Industrial Waste Generation Amount

In accordance with the above estimation method, the generation amount of general industrial waste per sector is estimated as shown in the table below.

Table 4-11: General industrial Waste Generation Amount per Sector (2009)

Unit: ton/day

Factory Code	Description of Sector	Nos. of Factories	Nos. of Employees	Non-HIW	HIW	All IW
F01	Beverage (soft drink, alcoholic) and vinegars	15	2,975	11.9	0.3	12.2
F02	Leathers, skins and similar	0	0	0.0	0.0	0.0
F03	Printing and graphical company	16	843	4.1	2.1	6.2
F04	Electric, electronic and communication materials	121	37,765	144.9	29.2	174.1
F05	Wood	2	348	1.3	0.4	1.7
F06	Mechanical	28	5,464	33.8	7.1	40.9
F07	Metallurgy	47	6,003	61.3	5.7	67.0
F08	Non metallic minerals	6	698	2.0	0.0	2.0
F09	Furniture	5	445	0.6	0.4	1.0
F10	Paper, cardboard, cellulose	13	1,789	80.8	2.5	83.3
F11	Rubber	3	133	0.5	0.1	0.6
F12	Food products	13	538	20.8	0.5	21.3
F13	Chemical	34	1,355	4.5	0.4	4.9
F14	Plastic material products	75	9,625	19.9	22.5	42.4
F15	Textile	1	20	0.1	0.0	0.1

F16	Clothing, fabric and travel goods	2	589	2.1	0.6	2.7
F17	Transport material	33	43,937	73.3	45.5	118.8
F18	Construction	6	440	1.6	0.5	2.1
F19	Others	20	3,225	8.3	1.9	10.2
	Total	440	116,192	471.8	119.7	591.5

Also, the general industrial waste generation amount for the separate non-production and production processes are shown in the following table.

Table 4-12: General Industrial Waste Generation Amount for the Separate Non-Production and Production Processes (2009)

Unit: ton/day

Factory Code	Description of Sector	Non production process		Production process		All IW
		Non-HIW	HIW	Non-HIW	HIW	
F01	Beverage (soft drink, alcoholic) and vinegars	11.0	0.1	0.9	0.2	12.2
F02	Leathers, skins and similar	-	-	-	-	-
F03	Printing and graphical company	0.2	-	3.9	2.1	6.2
F04	Electric, electronic and communication materials	50.7	9.0	94.2	20.2	174.1
F05	Wood	0.4	0.2	0.9	0.2	1.7
F06	Mechanical	8.3	3.4	25.5	3.7	40.9
F07	Metallurgy	12.3	2.3	49.0	3.4	67.0
F08	Non metallic minerals	0.4	-	1.6	-	2.0
F09	Furniture	0.5	0.1	0.1	0.3	1.0
F10	Paper, cardboard, cellulose	56.3	0.3	24.5	2.2	83.3
F11	Rubber	0.2	-	0.3	0.1	0.6
F12	Food products	-	0.2	20.8	0.3	21.3
F13	Chemical	0.5	-	4.0	0.4	4.9
F14	Plastic material products	7.7	20.6	12.2	1.9	42.4
F15	Textile	-	-	0.1	-	0.1
F16	Clothing, fabric and travel goods	0.7	0.2	1.4	0.4	2.7
F17	Transport material	16.5	1.7	56.8	43.8	118.8
F18	Construction	0.5	0.2	1.1	0.3	2.1
F19	Others	2.2	-	6.1	1.9	10.2
	Total	**168.4**	**38.3**	**303.4**	**81.4**	**591.5**

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 4-13: 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 4-14: 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_3PO4), 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	---	0.2

	incinerator		
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 Non-production process	Fluorescent tubes, Thermometer (use mercury), Batteries, Pesticides (Household use), etc.	5.7
Total			**119.7**

4.2.3 Flowcharts Depicting Industrial Waste Management

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

1. All Industrial Wastes (IW) generated from PIM (2009) Figure 4-2
2. All General Industrial Wastes (IW) generated from PIM (2009) Figure 4-3
3. General Non-HIW generated from PIM (2009) Figure 4-4
4. General HIW generated from PIM (2009) Figure 4-5
5. All Health-care Waste generated from PIM (2009) Figure 4-6
6. Non Hazardous Health-care Waste generated from PIM (2009) Figure 4-7
7. Hazardous Health-care Waste generated from PIM (2009) Figure 4-8
8. Construction Waste generated from PIM (2009) Figure 4-9

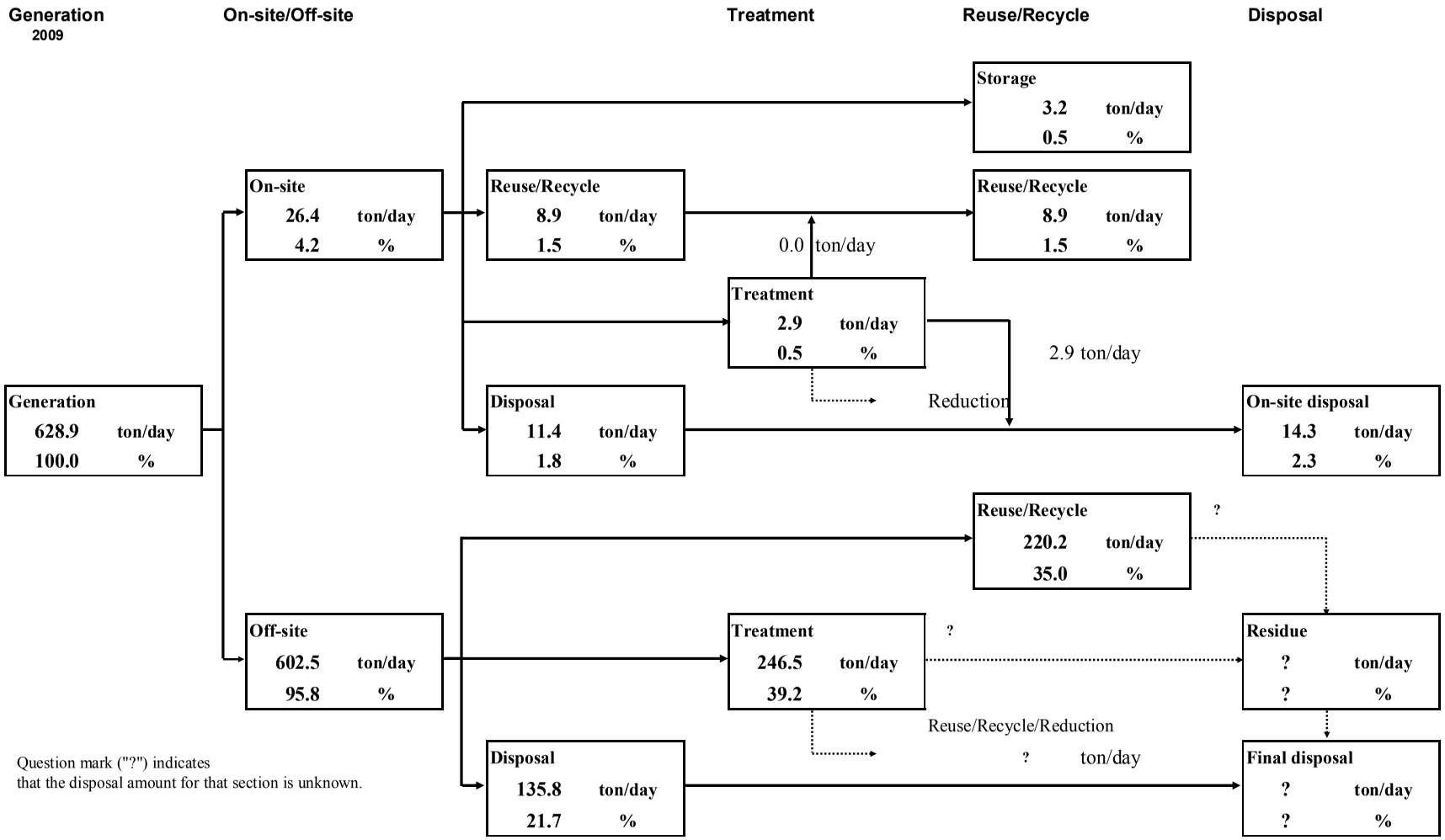


Figure 4-2: All Industrial Wastes (IW) generated from PIM (2009)

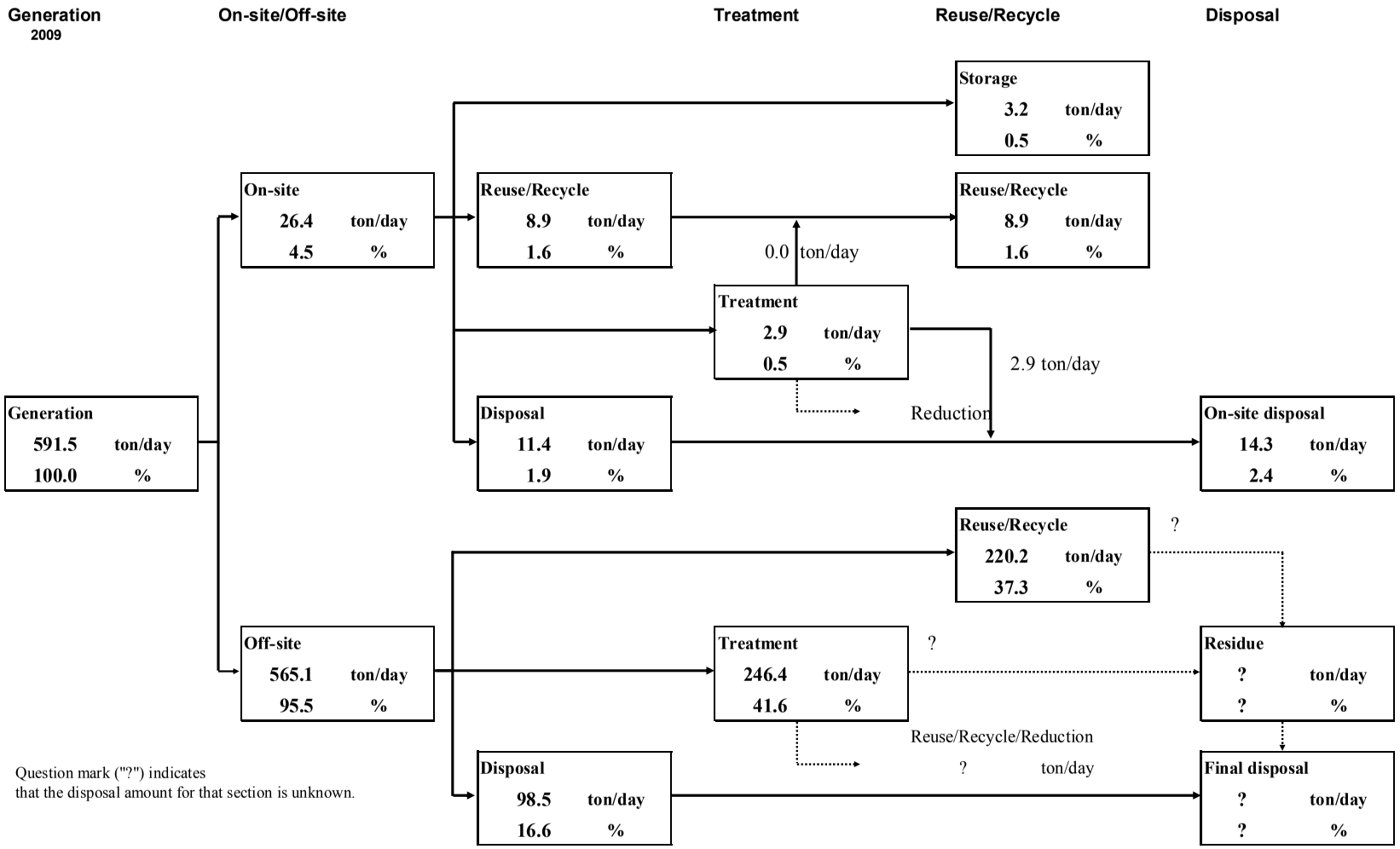


Figure 4-3: All General Industrial Wastes (IW) generated from PIM (2009)

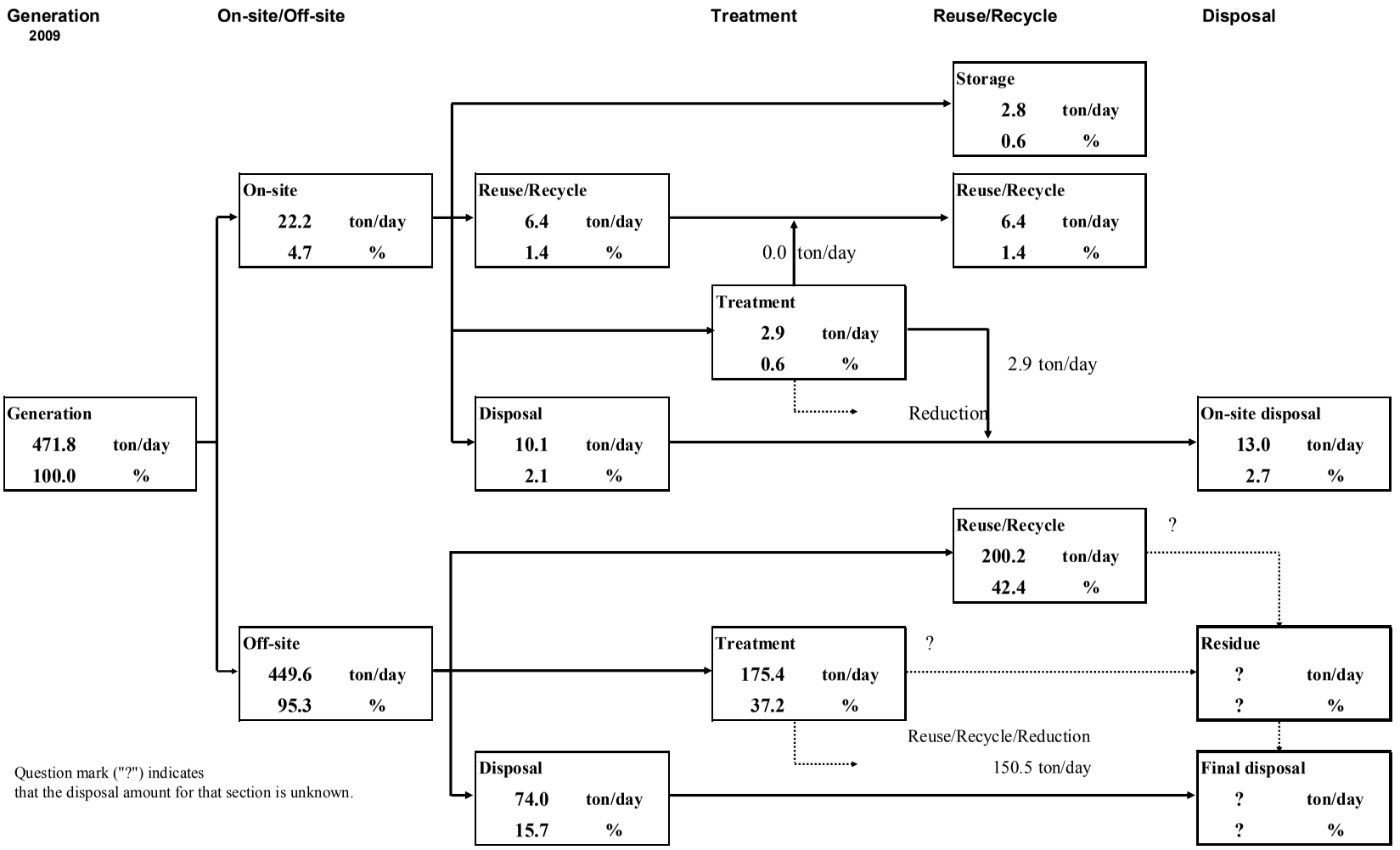


Figure 4-4: General Non-HIW generated from PIM (2009)

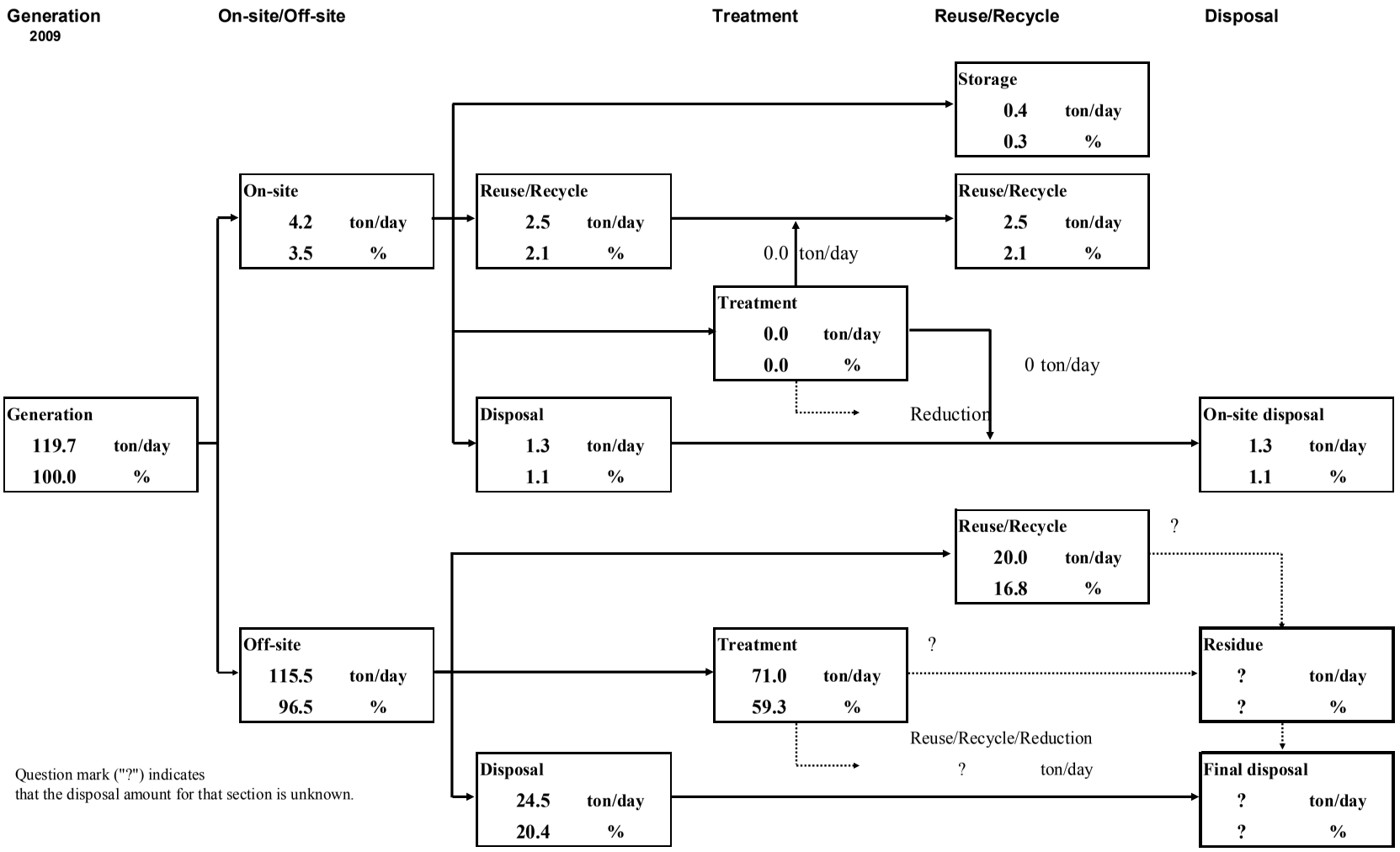


Figure 4-5: General HIW generated from PIM (2009)

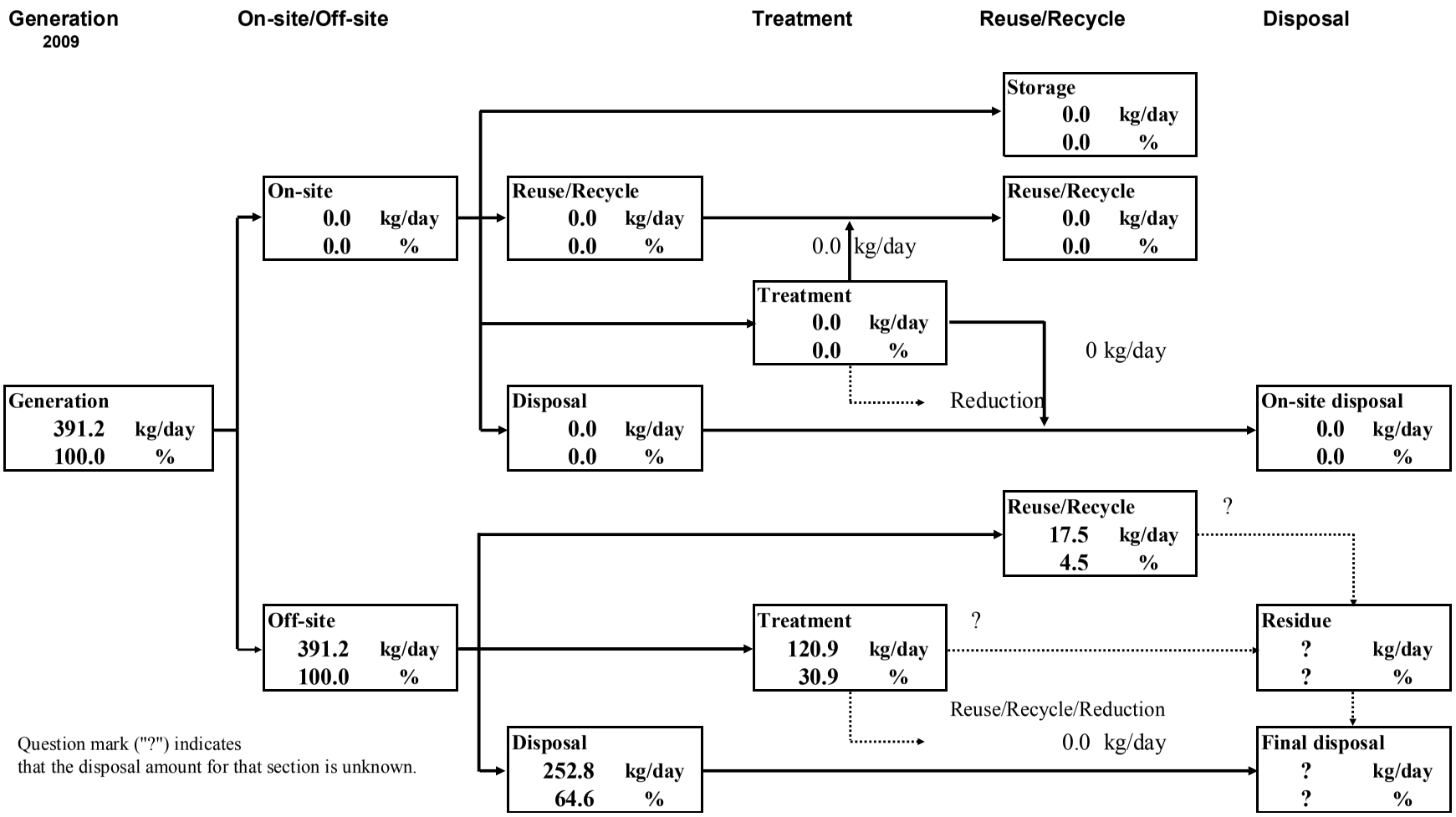


Figure 4-6: All Health-care Waste generated from PIM (2009)

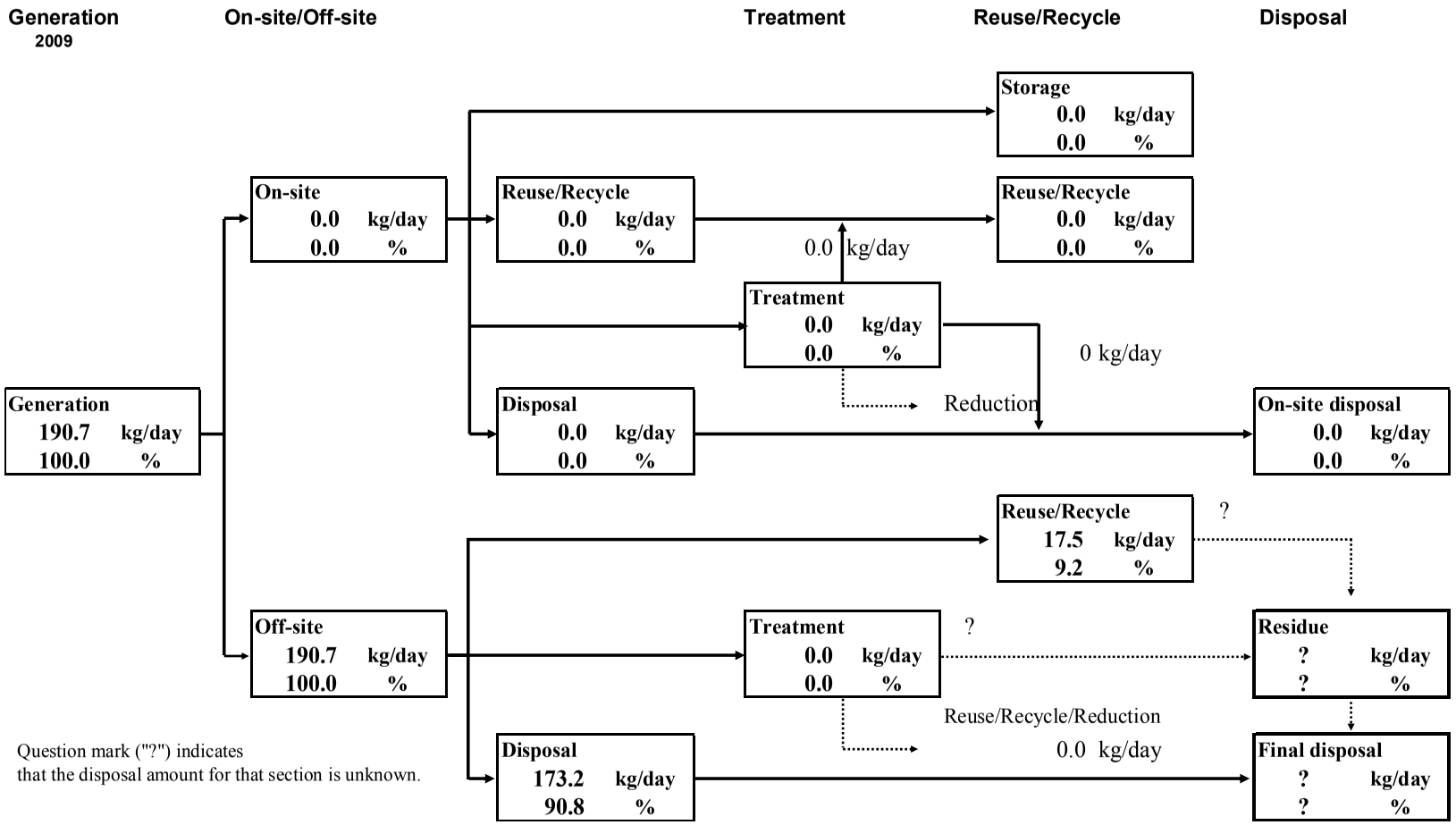


Figure 4-7: Non Hazardous Health-care Waste generated from PIM (2009)

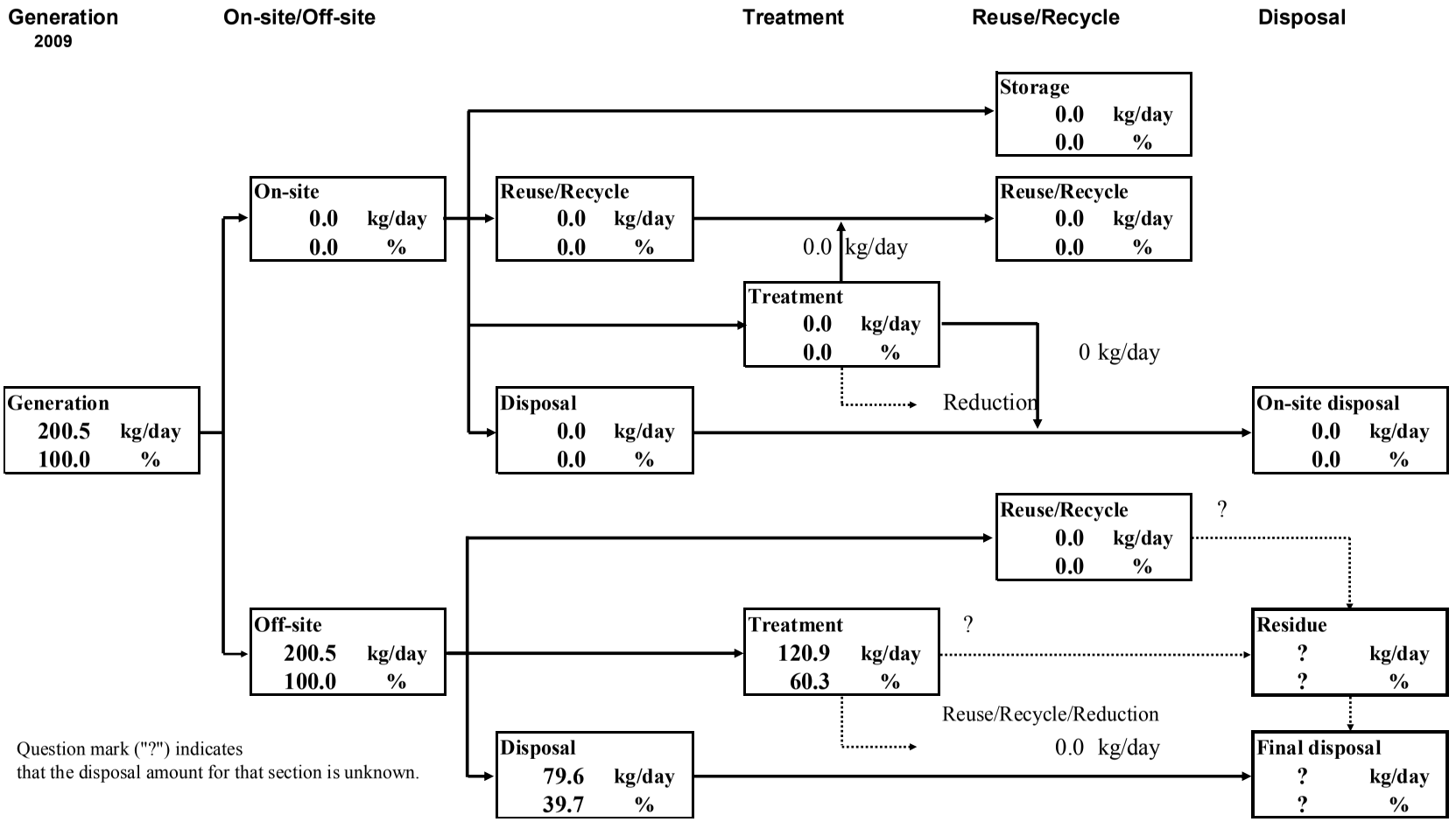


Figure 4-8: Hazardous Health-care Waste generated from PIM (2009)

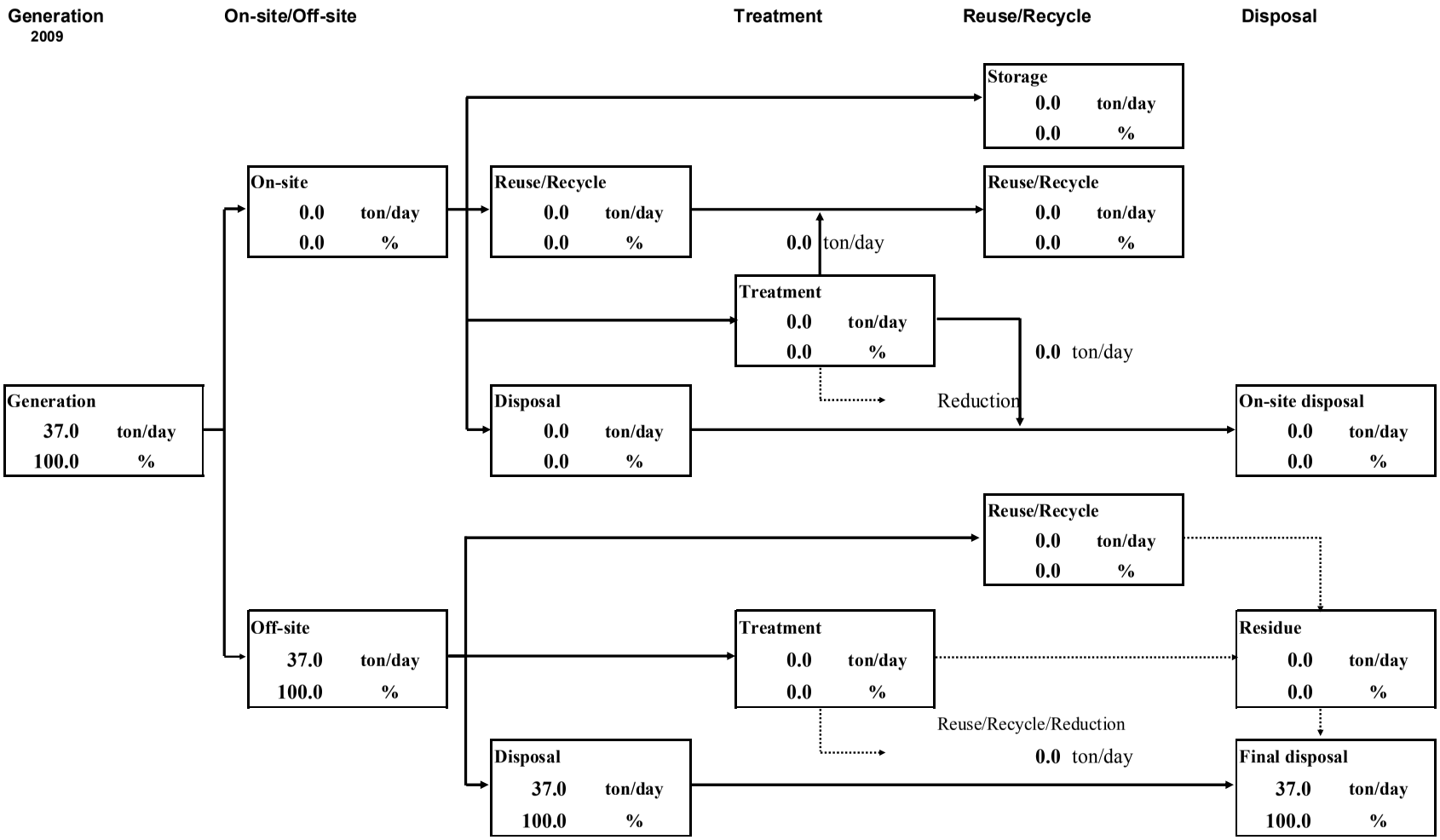


Figure 4-9: Construction generated from PIM (2009)

4.3 Current IWM in PIM

4.3.1 Current Conditions of Factories in PIM

a. Industry Scale

There are 475 factories in the factory list provided by SUFRAMA, and of those, 18 factories are located outside the target area, the MFZ. Since 17 of 457 PIM factories in the MFZ area were confirmed closed by the study, 440 factories are PIM factories operating in the MFZ.

There are a total of 116,192 people working in the 440 factories, which constitutes 6.8% of the population of Manaus in 2009. Also, the total production for the 440 factories in 2008 was 53.6 billion BRL (Brazilian Real). Accordingly, there is an average of 264 people working at each factory, so that yearly production per employee is 463,000 BRL.

The industry with the most number of factories is identified by Factory Code F04: Electric, electronic and communication materials, which makes up 27.5% of the total number. That is followed by F14: Plastic material products, which is 17% of the total. The industry with the highest number of employees is F17: Transport material, which is 37.8% of the total. Next is F04: Electric, electronic and communication materials, with 32.5% of the total. Accordingly, over 70% of all employees in PIM work in these two industries. Also, projecting from the production amount, these two industries account for 55.2% of the total amount in PIM.

According to the factory survey, the average lot size and building area at factories is 55,800 sq. meters and 15,300 sq. meters, respectively. Also, over one-third of the factories have medical clinics attached to them.

As shown above, the PIM factories are relatively large and mainly engaged in assembly production.

b. Pollution Control Facility

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

Table 4-15: 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

As this chart shows, the rate of installation is not very high. However, these rates should be qualified for those cases where pollution control facilities, except for domestic wastewater treatment facility, are necessary and evaluated after a study of the production processes at the plant, etc. 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.

4.3.2 Industrial Waste Generation

a. Generation Amount

The total generation amount of industrial waste is 628.9 ton/day, of which 94.05% is general IW, followed by 5.88% of construction waste. Health-care waste was minimal at 0.06%. Also, no radioactive waste was generated.

The industrial sector with the largest amount of general industrial waste generated is F04: Electric, electronic and communication materials with 29.4% of the overall total or 174.1 ton/day. That is followed by F17: Transport material with 20.1% of the overall total or 118.8 ton/day generated. These two sectors make up about half of the general IW generated in PIM. The sector with the most HIW generated is F17: Transport material with 38.0% of the total or 45.5 ton/day generated. This is followed by F04: Electric, electronic and communication materials with 24.4% of the total or 29.2 ton/day generated. These two sectors account for 62.4% of the HIW generated in PIM. Furthermore, 65.1% of general IW is generated by production processes.

b. Waste Composition

Approximately 80% of all general IW is composed of Non-HIW. Of this non-HIW, the largest amount of waste generated is under waste code NH09: Metals and metal alloys such as aluminum, copper, bronze at 163.5 ton/day, which is 34.7% of all non-HIW. This is followed by NH03: Paper, at 25.4% of all non-HIW at 119.9 ton/day generated. On the other hand, for hazardous industrial wastes, those under waste code HW14: Other hazardous substances (besides HW01-HW13) were generated the most at 34.5 ton/day, which is 28.8% of the total HIW generated. This is followed by HW11: Treatment sludge, HW09: Fuel, Oil and Grease, and HW07: Organic Compounds, which are generated at 17.0% 16.7% and 15.8% of all HIW, respectively.

4.3.3 Factory Awareness of Waste Management

a. Industrial Waste Management Improvement Plan

According to the factory survey, in the future there will likely be a slight increase in the amount of industrial waste generated. Also, 62.6% (i.e. 109 of 174 factories) said there were currently problems with industrial waste management. The reasons given are as follows, in descending order.

1. High cost of industrial waste disposal: 57.8 % (63 of 109 respondents)
2. No facilities, or insufficient facilities, for the reuse or recycling of industrial waste: 48.6 % (53 of 109 respondents)
3. No service, or insufficient service, for industrial waste treatment: 37.6 % (41 of 109 respondents)

However, the majority of factories (78.8%) have not formulated a plan to improve management of industrial waste generated. Furthermore, a number of factories (70.2%) responded that they have no plan to promote 3R. From this it can be assumed that factories do not place a high value on controlling the wastes generated or recycling and reducing what they do generate.

b. Waste Inventory

All factories in PIM are obligated to submit a waste inventory. 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. However, when SUFRAMA voluntarily requested the inventories from some factories, only about half complied—which is about 1/4 of the total number of factories. Again during the factory survey, 36.0% of factories replied that they do not submit the waste inventory. This infers that conditions for submitting the waste inventories need strengthening.

In addition, 27.5% of the factories replied that they were not required to submit a waste inventory, which points to a lack of recognition among the PIM factories regarding the waste inventories.

c. Separation

According to the factory survey, 14.0 % of factories do not separate their non-production process waste from their production process waste before discharge.

In relation, 18.8 % of factories reported that they mix their non-HIW and HIW for discharge. The reasons for this were given in the following order:

1. The amount is extremely small – 41.9 %
2. Difficulties to separate PP / HIW and PP / Non-HIW – 12.9 %

4.3.4 On-Site Waste Management

a. General Industrial Waste

a.1 Ratio of On-Site and Off-Site Management

The following table clearly shows that the ratio of on-site management in PIM is extremely low at 4.5% for all general IW, 4.7% for general Non-HIW and 3.5% for general HIW. Furthermore, the survey results of the 187 factories show that the difference between general Non-HIW and general HIW is practically negligent.

In comparison, the “Bangkok Industrial Waste Study” found that the proportion of on-site management was 29.9% for general Non-HIW and 56.3% for general HIW. Also, in Japan, the value for on-site management of IW (in Mie Prefecture, 2000) was 53.9%.

Accordingly, it can be said that the proportion of on-site management in PIM is extremely low. A large factor for this is quite likely the extremely low cost of off-site management.

Table 4-16: Ratio of On-Site and Off-Site Disposal

Study Area	Waste		Ratio of On-Site Disposal	Ratio of Off-Site Disposal
PIM	General IW		4.5 %	95.5 %
		Non-HIW	4.7 %	95.3 %
		HIW	3.5 %	96.5 %
Bangkok Metropolitan Area[*1]	Non-HIW		29.9%	70.1%
	HIW		56.3%	43.7%

Source: *1: The Study on Master Plan on Industrial Waste Management in the Bangkok Metropolitan Area and its Vicinity in the Kingdom of Thailand, November 2002 (Hereafter, Bangkok Industrial Waste Study)

a.2 Type of On-Site Management

a.2.1. Intermediate Treatment

As mentioned above, the proportion of on-site management in PIM is extremely low. Furthermore, there is almost no difference between on-site management in PIM (ratio of quantitative generation rate) of general Non-HIW and general HIW. An obvious characteristic of on-site management in PIM is that almost none of the factories are conduction intermediate treatment on premises. In particular, there is no treatment whatsoever of general HIW in the 187 factories of the Factory Survey.

As shown in the following table, the Bangkok study results show high prominence between non-HIW and HIW due to the high cost of off-site management, they reduce HIW by treating HIW as much as possible on-site (32.8% of the quantitative generation rate). In addition, Non-HIW was reused or recycled as much as possible (13.1% of the quantitative generation rate).

Table 4-17: Type of On-Site Management

Study Area	Waste		Intermediate Treatment Ratio	Reuse and Recycle Ratio	Storage Ratio	Final Disposal Ratio
PIM	General IW		0.5 %	1.6 %	0.5 %	1.9 (2.4[*2])%
		Non-HIW	0.6 %	1.4 %	0.6 %	2.1 (2.7[*2])%
		HIW	0.0 %	2.1 %	0.3 %	1.1 %
Bangkok Metropolitan Area[*1]	Non-HIW		0.9 %	13.1%	1.8 %	14.1 %
	HIW		32.8 %	1.6 %	0.4 %	21.5 %

Source: *1: Bangkok Industrial Waste Study

Note: *2: This ratio includes residue disposed after intermediate treatment

a.2.2. Reuse and Recycle

Although the proportion of on-site management is 4.5% of the generation amount, which is extremely low, the ratio of reuse and recycle in comparison to other on-site management methods is high at 1.6%. In particular, for on-site management of general HIW, only 3.5% is conducted of the total, but 2.1% of 60% of that goes toward reuse and recycle.

The Bangkok study results show the opposite, with a high ratio of reuse and recycle for general Non-HIW, and a very low ratio for general HIW.

a.2.3. Storage Ratio

The storage ratio, like that for intermediate treatment, is extremely low and hardly done. This fact is likely due to no generation of waste difficult to treat on- or off-site.

a.2.4. On-Site Final Disposal

Although the ratio for on-site management is extremely low, at 4.5% of the generation amount, the final disposal ratio is very high when compared to other on-site management methods, at 1.9%; this becomes 2.4% when residues from intermediate treatment are included. In particular, even though only 4.7% of all general Non-HIW is managed on-site, 2.1%--which is nearly half--is for final disposal.

In comparison to the Bangkok study results, those results showed the opposite with a high final disposal ratio of general HIW and comparatively low for general Non-HIW.

The detailed descriptions of this in descending order are: hazardous wastes are sludge, contaminated plastics and ink residue. In addition, fluorescent lights and batteries were also reported, but done so individually so the weight is unknown. Reports for non-hazardous, in descending order, are cardboard, non-recyclable wastes, and plastic lids. The results suggest these items are for storage waiting for off-site management.

b. Other Industrial Wastes

b.1 Health-care Waste

b.1.1. Condition of Clinics

The conditions of clinics attached to factories, as found in the medical institution survey, are as follows. None of the facilities were very large.

- Average number of clinic employees: 4.1 employees
- Average number of beds: 1.2 beds
- Average daily number of (out-)patients: 19 patients

b.1.2. Discharge Containers

RDC 306/2004-ANVISA regulates discharge containers according to different waste categories. For attached clinics at factories, the ratio which is observed is no more than half of this.

b.1.3. Storage

Of the facilities surveyed, one responded that the hazardous health-care waste and common waste they stored was mixed. Waste is stored in covered containers at 61% of the clinics. One-third of the clinics used cardboard boxes to store Group E (needles, scalpels, etc.) waste.

All of the facilities surveyed responded that they did not have cool storage facilities for certain Group A.3 (Body part) waste.

b.1.4. Intermediate Treatment and Disposal

Intermediate treatment and disposal of at the factories is not carried out.

b.1.5. Recycling

1/3 of the clinics recycle common waste valuables, such as paper and cardboard. Recyclers collect these valuables from each clinic on a regular basis.

b.1.6. Discharge

Waste is discharged from attached clinics according to prescribed categories.

Hazardous health-care waste and non-hazardous health-care waste are not mixed when discharged. Nevertheless, even though Group A, B and E and each class type, are stored separately, 22% of the clinics reported mixed discharge; the clinics' employees are the likely reason for this.

b.1.7. Training and Instructions

All of the clinics reported having written instructions concerning the handling of hazardous health-care waste within the clinic. Also, 100% said there is training/instruction for waste workers for handling hazardous health-care waste. Furthermore, 55% said that this training takes place once a year.

Employees at 88% of the clinics report receiving environmental educational training or information concerning hazardous health-care waste. At attached clinics, 242 people attend the classes on average.

b.1.8. Cooperation for Waste Management Improvements

All nine of clinics surveyed replied that they are able to cooperate on waste management improvement. Concerning efforts they would be willing to make for improvements, all replied "raising the environmental awareness of the public", seven (7) replied they could "minimize waste generation" and six (6) said through "discharging wastes neatly". Also, all replies confirmed that they would cooperate with national and municipal authorities toward waste management improvement.

b.1.9. Priority of Waste Management Improvements

A rise in waste management fees was indicated by 66% of clinics. 78% replied that waste management was a very high priority. Furthermore, 55% said they would welcome technical support from a government organization, whereas 33% were hopeful for financial support.

b.1.10. Intention to Improve Conditions for Collection and Disposal of Hazardous Health-care Waste

In order to improve the current conditions of collection and disposal of hazardous health-care waste, 38% of clinics answered "education to change people's bad habits", and 25% indicated "improvement of landfill operation".

Concerning who should bear the rise in cost for improvement of current collection and disposal conditions for hazardous health-care waste, clinics indicated the following: the State of Amazonas (22%), the City of Manaus (22%), and others (22%). Further, five clinics indicated that the greatest amount they would be willing to pay for collection and disposal was, on average, 145R$/month.

b.2 Construction Waste

b.2.1. Environmental License for Construction Projects

Of the total number of factories, about 60% had obtained environmental licensing to undertake a construction project.

b.2.2. Integrated Management Plan for Construction Waste

Of the total number of factories, about 60% had formulated a construction waste management plan as outlined in CONAMA Resolution 307.

b.2.3. Manifest (Monitoring the Disposal of Construction Waste)

Since Amazonas State does not require the use of a manifest for construction waste, it was used for only 22.9% (in item) of the discharged waste according to the construction waste survey.

b.3 Radioactive Waste

b.3.1. Generation of Radioactive Waste

According to radioactive waste survey and medical institution survey, responses from the factories on their use of radioactive materials, neither claimed to generate radioactive waste. It is therefore assumed, given that the facilities and equipment are relatively new, that radioactive waste is not generated from PIM.

b.3.2. Radioactive Materials Management in PIM

According to radioactive waste survey on 7 factories, the current conditions of radioactive materials management at PIM factories is give below.

- All seven of the factories have obtained licensing for the use of radioactive materials.
- The intended use of radioactive materials is process control, quality control and the like.
- Radiation sources are all shielded, with the exception of one location. At one location radioactive light is used as an irradiation lamp.
- All seven factories use radioactive light emitting equipment in controlled localities.

4.3.5 Off-Site Waste Management identified by Generation Sources Survey

The off-site waste managements are identified by the following generation surveys:

- General industrial waste by the factory survey;
- Health-care waste by the medical institution survey;
- Construction waste by the construction waste survey; and
- Radioactive waste by the radioactive waste survey.

a. General Industrial Waste

a.1 Collection

The following table shows the breakdown of the ratio of the amount of waste discharged from factories which is collected and transported by collection service providers.

Table 4-18: Breakdown of Collection Service Providers

Study Area	Waste		Factory (City) Ratio and Amount*2		Ratio of Private Enterprise and Amount	
			Ratio	ton/day	Ratio	ton/day
PIM	General IW		13.4 %	79.7	82.1 %	485.4
		Non-HIW	10.3 %	48.7	85.0 %	400.9
		HIW	9.3 %	31.0	70.6 %	84.5
Bangkok Metropolitan Area *1	Non-HIW		1.5%	95.8	68.6%	4,444.5
	HIW		0.1%	1.9	43.6%	665.4

Source: *1: Bangkok Industrial Waste Study

Note: *2: In PIM, only a very small amount is collected by the city (0.4%). In contrast, 100% was collected by the city in the Bangkok Industrial Waste Study.

From this table, the majority of general IW discharged from PIM factories is collected by private enterprise (WSCs: Waste Service Companies). It is possible to see the distinct difference between Non-HIW and HIW where most of Non-HIW is collected by WSCs. In contrast, a large amount of HIW is transported by the factory itself. In the Bangkok study, the factory itself transported almost none.

a.2 Type of Off-Site Management

a.2.1. Intermediate Treatment

The following table shows the breakdown (generation ratio) of off-site management based on answers from PIM factories. It is reasonable that the rate of treatment of HIW is higher than Non-HIW. However, the intermediate treatment rate of Non-HIW is extremely high when compared to that of the Bangkok study, where much of the hazardous waste is put through intermediate treatment (28.9% of the generation ratio) in an attempt to render it harmless or reduce the amount.

Table 4-19: Breakdown of Off-Site Management

Target Area	Waste		Intermediate Treatment Ratio and Amount		Reuse and Recycling Ratio and Amount		Direct Final Disposal Ratio and Amount	
			Ratio	ton/day	Ratio	ton/day	Ratio	ton/day
PIM	Industrial Waste		41.6 %	246.4	37.3 %	220.2	16.6 %	98.5
		Non-HIW	37.2 %	175.4	42.4 %	200.2	15.7 %	74.0
		HIW	59.3 %	71.0	16.8 %	20.0	28.4 %	24.5
Bangkok Metropolitan Area *1	Non-HIW		2.5%	159.5	64.8%	4,198.8	2.8%	95.8
	HIW		28.9%	444.1	14.2%	216.1	0.6%	1.9

Source: *1: Bangkok Industrial Waste Study

a.2.2. Reuse and Recycle

It is reasonable that rate of reuse/recycle of HIW is much lower (generation ratio of 16.8%) than Non-HIW (generation ratio of 42.4%). The findings from Bangkok show a very

noticeable difference between the HIW and Non-HIW, where most of the Non-HIW discharged off-site (generation ratio of 64.8%) is reused or recycled.

a.2.3. Off-Site Final Disposal

The rate of direct final disposal of HIW is two times more than it of Non-HIW. It is a serious issue that rate of direct final disposal of HIW is quite high, 28.4%.

In comparison, the findings from Bangkok show a very noticeable difference between the HIW and Non-HIW, where the rate of direct final disposal of industrial waste is much lower than it in PIM, 0.6% for HIW and 2.8% for Non-HIW, especially HIW. In addition, the amount of residue after intermediate treatment and recycling could not be identified.

b. Other Industrial Wastes

b.1 Health-care Waste

b.1.1. Collection

All of the clinics receive collection service for both non-hazardous and hazardous health-care waste. With the exception of one clinic which receives service from SEMMA/SEMULSP, all clinics receive collection service of hazardous waste from private companies. 44% of clinics, however, do not pay fee for hazardous health-care waste. 55% indicated that they set the collection fee, although it varied from place to place.

Despite the fact that 33% of clinics indicated dissatisfaction with current collection service, there were no complaints from clinics in the past year received by collection service providers.

b.1.2. Monitoring of Hazardous Health-care Waste Disposal

All of the clinics indicated that a person has been assigned to be in charge of appropriate collection and disposal of hazardous health-care waste.

b.1.3. Disposal of Hazardous Waste

According to the medical institution survey two-thirds of clinics said that their waste went to an incinerator (120.9 kg/day in amount), whereas the remaining one-third provided no answer (79.6 kg/day in amount).

b.2 Construction Waste

b.2.1. Collection

99.3% (in weight) of construction waste generated was collected and transported by the collection companies that had been contracted for their services.

b.2.2. Recycling

The recycling amount was estimated to be 40 kg/day, which is less than 0.1% of the generation amount of the construction waste generated in PIM.

b.2.3. Treatment and Final Disposal

There was no treatment of the construction waste reported. All of the construction waste discharged was disposed of at the landfills. 96.9 % of construction waste is disposed of at the Manaus City landfill and the remaining at private disposal sites.

b.3 Radioactive Waste

There is no radioactive waste generation from PIM factories.

4.3.6 Off-Site Waste Management identified by Waste Service Company Survey

a. Waste Service Company Survey and Environmental Licensing

a.1 Environmental License Owners

There were 90 waste service companies (WSCs) surveyed from which the following results were found.

- Companies that have obtained environmental licenses: 67
- Companies that have not yet obtained environmental licenses: 23

a.2 Responses from WSCs by business sector and business conducted

The following table is based on the responses from 90 WSCs surveyed showing the business sectors divided into 4 categories of 1) collection and transportation, 2) intermediate treatment, 3) final disposal, and 4) reuse and recycling. Some companies were engaged in multiple practices, so the total number amounts to 127.

Table 4-20: Responses from WSCs according to business sector

Environmental License Ownership	1) Collection and transportation	2) Intermediate treatment	3) Final disposal	4) Reuse and recycling	Total
Yes	41	9	10	42	102
No	7	0	0	18	25
Total	48	9	10	60	127

a.3 Business Sector and Business Conducted (Management Amount) as analyzed by the Study Team

The following table shows the business sector of 67 waste service companies that have environmental licenses based on an examination by the study team with support from the local consultant.

Table 4-21: 67 WSC Environmental License Owners by business sector

Env. License Ownership	Collection and Transportation	Intermediate Treatment	Final Disposal	Reuse and Recycling	Not Classified*1	Total
Yes	26	24	0	21	4	75

Note: *1: The business sector could not be identified on the license. The licenses indicated the following: 1. Distribution and supply of water (2 companies), 2. Spray and cleaning with insecticide (1 comp.), 3. Retailer of wood products (1 comp.)

a.4 Size of WSCs (Number of Employees)

This survey revealed that number of (managerial and operational) at small or very small enterprises with less than 10 employees was 36% (i.e. 32 of 90 companies), but for the 23 enterprises without an environmental license, it was found that 21 were small or very small enterprises. On the other hand, of the 9 large enterprises with over 100 employees, the

number of businesses that specialize in industrial waste management—thus excluding cement production, sale of construction materials and collection or disposal of municipal waste—was three. Presently, these large waste service companies are made up of three central groups.

b. Collection and Transportation

b.1 Amount Collected/Transported

Of the 90 WSCs surveyed, the total amount collected and transported, as shown in the following table, is 3,343 ton/day. This amount is some five times the total amount of 628.9 ton/day of industrial waste discharged from PIM according to the factory survey.

The two companies which are collecting over 300 ton/day are the two companies contracted to collect the municipal solid waste (MSW) of Manaus City. Thus, if this collection amount is taken to be MSW, the remaining collection and transportation amount is 1,071.5 ton/day. The following table summarizes the collection and transportation amount information obtained in the Off-site Survey (Survey of WSCs) and On-site Survey (survey of PIM generation sources: factories, medical institutions, construction). With the exception of the two companies that are clearly collecting MSW, the collection and transportation amount from the Off-Site Survey resembles that which was found for the On-Site Survey (Survey of generation sources) of PIM manufacturing, construction, and health-care waste.

Table 4-22: Comparison of Off-Site Survey and On-Site Survey Results for Collection and Transportation Amount

Unit: ton/day

Waste	Off-site Survey Results	On-site Survey Results
1. Total Amount Collected/Transported	3,342.8	NA
2. Municipal Waste (2 companies)	2,271.3	NA
3. Industrial Waste	NA	591.5
4. Construction Waste	NA	37
5. Health-care Waste	NA	0.4
3 + 4 + 5	1,071.5	628.9

b.2 Conditions of Collection and Transportation

A large amount of recyclable material, such as plastic, paper and cardboard, and metals collected from MFZ is handled by large companies. In other words, the three major waste collection and transportation companies send their employees to waste centers located in the factories of large waste generating companies and have exclusive access to conduct separate collection of their recyclable materials. Based on this study, most used paper and 80% of scrap metal is collected by the three large collection and transportation companies. One of these large companies collects most of the waste plastic, and after separation and removal of foreign material, melts it will an extruder, cools it and makes pellets which are then used as raw material to make recycled plastic resin, and finally plastic products which are sold to manufacturing companies.

There is a factory that reuses waste paper in the study area, but no factory that reuses scrap metal, so with the exception of aluminum, most of the scrap metal is sent to companies in Sao Paulo, Rio de Janeiro and other places.

c. Intermediate Treatment

c.1 Intermediate Treatment Amount

There is a large difference concerning intermediate waste treatment between the WSC respondents (9 companies) and the business practices based on environmental licenses (24 companies). Thus, the amount of intermediate treatment was summarized based on the answers from companies as shown below. This table indicates only one WSC treats 90% of wastes for intermediate treatment.

Table 4-23: Breakdown according to Scale of Intermediate Treatment Companies based on the Responses of Waste service companies (7 companies *1)*2

Unit: ton/day

Scale (Intermediate Treatment Amount)	Intermediate Treatment Companies	Hazardous Waste	Non-Hazardous Waste	Total
Without License	2	0.2	0.7	0.9
1. less than 100ton/day	2	0.2	0.7	0.9
With License	5	41.9	265.6	307.5
1. less than 100ton/day	4	1.3	29.0	30.3
2. 100 to 300 ton/day	1	40.6	236.6	277.2
Grand Total	7	42.1	266.3	308.4

Note: *1: 7 out of 9 companies responded with their intermediate treatment amount

*2: In this study, the largest treatment company of health-care wastes was not included.

The results for intermediate treatment were summarized for the off-site (survey of WSCs) and the on-site (PIM generation sources: factories, medical institutions, construction projects) survey results. The result shows similar values.

Table 4-24: Comparison of intermediate treatment amount for the Off-site Survey and the On-site Survey

Unit: ton/day

Waste	Off-site Survey Results	On-site Survey Results
1. Total Amount of Intermediate Treatment	308.4	246.5
2. Non-HIW of the 1. (above)	266.3	175.4
3. HIW of 1. (above)	42.1	71.1

c.2 Conditions of Intermediate Treatment

There are 25 companies that have environmental licenses for intermediate treatment, but of those, many are actually conducting recycling operations. One waste treatment company is conducting incineration service, and is treating a large amount of waste. The only cement factory in Amazonas State is conducting co-processing in its cement kiln. Based on the study data, the waste primarily being treated/used is waste tires (300 ton/month), waste molding sand (95 ton/month), and sludge from plating (30 ton/month). Mixing in the materials yard, they also input waste to the kiln (into a suspension pre-heater hatch), but the waste is brought

up by a conveyor not an elevator and also requires manpower. Also, there is a little substitution of fuel with waste oil, the authentic treatment/reuse is happen from now.

d. Reuse/Recycle

d.1 Reuse/Recycle Amount

82% (14 of 17 WSCs replied) are small companies which manage less than several ton of waste per day.

The results for reuse and recycle amount were summarized for the off-site (survey of WSCs) and the on-site (PIM generation sources: factories, medical institutions, construction projects) survey results. The off-site survey and the on-site survey results show similar values.

Table 4-25: Comparison of Survey Results (Reuse/Recycle Amount) for WSCs and PIM Generation Sources (factories, medical institutions, construction projects)

Unit: ton/day

Waste	Survey Results of WSCs	Survey Results of PIM Generation Sources
1. Total Amount of Reuse Recycle	178.9 (487.3)	220.2 (466.7)
2. Non-HIW of 1. (above)	167.8 (434.1)	200.2 (375.6)
3. HIW of 1. (above)	11.1 (53.2)	20.0 (91.1)

Note *1: The number in parentheses are the total of intermediate treatment amount and reuse/recycle amount

d.2 Conditions of Reuse/Recycle

There are 60 companies that are conducting the reuse and recycling of waste, including those which do not possess an environmental license. However, upon examination of the environmental licenses themselves, there were 17 companies. Of these 17, there were 11 that had an environmental license code other than for waste management. All of them were conducting the reuse and recycling of industrial waste. Even for those companies that do have licenses, there are many uncertainties concerning their activities. The reason for this is that the environmental license is only specified under "(industrial) activities that have potential environmental impact" for waste treatment and recycle (30＊＊) subcategory 3004 for treatment and recycling of palettes, and 3005 for recycling waste paper products and cardboard, whereas the other activities are ambiguous concerning this point.

The types of waste that are reused/recycled in the study area are limited to: used lubricating oil, used molding sand, aluminum scrap, waste paper, used paint, and used ink cartridges from printers, etc.

e. Final Disposal

e.1 Final Disposal Amount

Out of the WSCs surveyed, nine responded that they conduct final disposal activities. However, the results of examining the environmental licenses of the companies that responded revealed that none of them have environmental licenses for final disposal. Also, IPAAM reported that there is no landfill in MFZ, including the Manaus city landfill, which is not licensed for final disposal. Therefore, the following table summarizes the amount of final disposal based on the respondents.

Table 4-26: Breakdown of the Scale of Final Disposal Amount based on the WSC respondents (6 companies *1)

Unit: ton/day

Scale (Final Disposal Amount)	Final Disposal Company	Hazardous Waste	Non-Hazardous Waste	Total
Without License	6	8.0	2,250.1	2,258.1
1. less than 100 ton/day	4	0.0	3.0	3.0
2. more than 300 ton/day	2	8.0	2,247.0	2,255.0
Grand Total	6	8.0	2,250.1	2,258.1

Note *1: 6 of 9 companies responded their collection amount

In the above table, the 2 companies that conduct final disposal of more than 300 tons/day are the two disposal companies contracted to collect municipal waste in Manaus City and dispose of it using the city landfill. The amount collected and transported by these two companies is 2,271.3 ton/day, which is largely consistent with the final disposal amount. Therefore, the table above does not include the final disposal amount revealed in the On-site Survey of manufacturing (industrial), construction and health-care waste from PIM, which is 135.8 ton/day (98.5 + 37.0 + 0.3, respectively).

It is assumed that this amount of waste is being disposed of in landfill sites other than the Manaus city landfill.

e.2 Conditions of Final Disposal

Final disposal operation of the WSC respondents (9 WSCs) is categorized into the following categories.

Table 4-27: Type of Final Disposal Operation by WSC Respondents (9 WSCs)

Industrial + Health-care + Construction Waste	Construction Waste	Municipal Solid Waste	Wastewater Disposal	Total
1	3	2	3	9

There are two companies which are contracted by Manaus City that collect and dispose common waste. These two companies also collect and dispose medical and construction waste from factories in the industrial districts, etc. However, without their own final disposal sites, they must use the Manaus City final disposal site. There are three companies that dispose of construction waste which also use the Manaus final disposal site. Only one company has its own final disposal site for industrial waste, but the problem is that it began part of its operations before receiving approval for an (operation) environmental license from IPAAM. The EIA for this facility was not approved in a public hearing and has been ordered to suspend operations by the Amazonas State Attorney's Office.

4.4 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.

4.4.1 IWM Issues at Factories (Generation Sources)

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 4-28: 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 4-2, 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 collaborate 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, as shown in Table 4-8: Generation Rate from Responding Factories, into a database and calculate the generation amount. However, there is zero input concerning how to waste managed 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 from factory, 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.

4.4.2 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 (OPCA) 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 4-29: 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 4-30: 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 4-31: 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 4-2 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 4-31: 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.

4.4.3 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.

The Federal legal system serving the nation is quite elaborate and the National Solid Waste Policy (NSWP) was approved by the House of Commons (Camara de Deputados) Representatives on 10 March 2010 and covers all the principles, objectives, tools, guidelines, goals and actions adopted by the federal government, either alone or in cooperation with States, Federal District, Municipalities and private, with a view to integrated and environmentally sound management of solid waste. 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).[1]

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. 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[2], 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.

[1] 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.
[2] Profile of the Companies with Projects Approved by SUFRAMA, December 2008 (Perfil Das Empresas Com Projetos Aprovados Pela SUFRAMA Dez/2008)

- 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.
- 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 administrative parties 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.

5. Master Plan on Industrial Waste Management