

**Integrated
Solid
Waste
Management** | **Novo
Hamburgo
Brazil**



**Detailed Schemes
proposed under
Strategic Action Plan**



Volume II June 2009

**Prepared by
United Nations Environment Programme
Instituto Venturi Para Estudos Ambientais**

Detailed Schemes proposed under
Strategic Action Plan
for
Integrated Solid Waste
Management Plan
Novo Hamburgo - Brazil

(Volume II)

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INTRODUCTION

As a part of the ISWM Plan fourteen schemes have been proposed for the city of Novo Hamburgo. The major schemes identified under the ISWM Plan were based on the goals and targets set under the Strategic Action Plan. These schemes will provide the support mechanism through which the ISWM plan will be implemented. Some of these activities will require new technologies, equipment, infrastructure and human resources while others can be implemented under the existing mechanisms. They will also need the backing and facilitation from the important institutions that are involved in Solid Waste Management. This document is also an involving document. The modification and changes strategic actions under ISWM Plan, to take up the emerging challenges such as special wastes, will also lead towards the development of new schemes and modifications in the current schemes.

This volume is divided into two parts in line with ISWM Plan. Part 1 covers schemes for strategic actions on segregation at source, collection and transportation. Part 2 covers schemes for strategic actions on sorting for material recovery, treatment and disposal with resource recovery.

Description of Schemes under ISWM Plan:

1. Generation, Collection and Transportation

1.1 Establishment of Waste Inventory Cell

Introduction

Integrated solid waste management (ISWM) addresses all types of solid waste from all the sectors within a geographic or administrative boundary. ISWM is a dynamic process for

effectively and efficiently managing the wastes based on 3R approach. Hence various services, from collection to disposal including material and resource recovery, are designed to incorporate the changes in waste streams due to urbanization and economic growth with related changes in the production sector and urban life styles. Therefore, it is vital to continuously collect the data on waste quantities and composition. To keep track of waste data, a Waste Inventory Cell could be established within Novo Hamburgo local government.

Purpose

Waste Inventory Cell of Novo Hamburgo will update waste database periodically to identify the changes in waste quantity and composition with respect to time, seasons of the year, sectors, industrial or economic growth and cross-boundary movement of waste. They will send the regular updates to SEMAM and other relevant offices within NH Municipality to modify the waste related policies and services to effectively and efficiently manage the waste.

Target

The scheme has been developed to achieve the following targets:

- To maintain waste database for waste quantities and composition for all waste generating sectors (residential, commercial, industrial, healthcare facilities and laboratories, construction and demolition, wastewater treatment plants and urban agriculture);
- To develop and maintain "Waste Generation Factors" for above mentioned waste generating sectors;
- To assist NH Municipality in monitoring waste generation;
- To assist NH Municipality in making appropriate modifications in policies and services to effectively and efficiently manage solid waste with maximum material and resource recovery.

Type

Institutional Strengthening.

Lead Agency

NH Municipality Local Government.

Support Agency

The services of an institution, such as a university or a consulting group, may be hired for collection and analysis of waste data.

Location (suggested)

NH Municipality Government Office.

Budget (estimated)

Office expenditures with one staff from internal NH Municipality budget.

External expenditures on data collection & analysis to be allocated by NH Municipality: RS\$50,000 (USD 25,000) per annum.

Time Frame (estimated)

12 months (estimated time to seek approvals within the government on the establishment of the cell and on the budget allocations.

Time schedule for collection and analysis of data and reporting:

| Activity | Jan-Feb | Mar-Apr | May-Jun | Jul-Aug | Sep-Oct | Nov-Dec |
|--|---------|---------|---------|---------|---------|---------|
| Collection & analysis of samples for residential & commercial waste | | | | | | |
| Collection & analysis of samples for industrial waste | | | | | | |
| Collection & analysis of samples for construction & demolition waste | | | | | | |
| Collection & analysis of samples for healthcare waste | | | | | | |
| Data collection from secondary sources | | | | | | |
| Mid-year reporting | | | | | | |
| End of year reporting | | | | | | |

Description

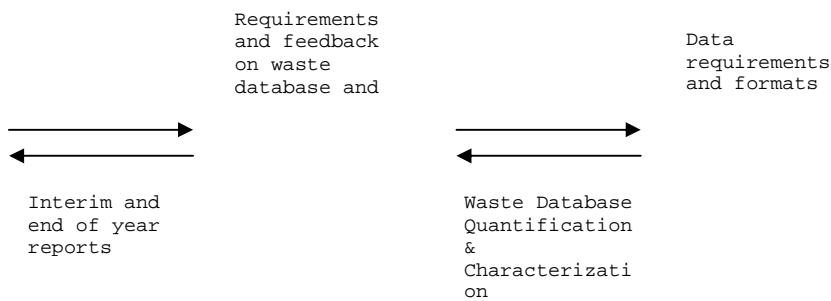
NH is a predominantly urban city, whose economy is based on the industry of shoes and furniture by measure. Economic growth is affecting the pace of construction. Living standards are improving and consumption rates are increasing. All of these factors are resulting into increasing rates of waste generation and introduction of new waste streams such as e-waste. It is difficult to precisely predict the waste quantities and their composition in this dynamic scenario. Hence, ISWM, which is designed to manage the waste would fall short of its objectives if it is not continuously upgraded, in terms of policies and services, with respect to waste quantities and waste streams. Furthermore, continuous monitoring through waste database is required to assess the effectiveness of policies to reduce waste at source as well as to maximize source segregation. The database on waste quantities and composition would also be useful to establish the accurate relationship between waste quantity or composition and other variables. The database would also be useful to support the measures for material and resource recovery and waste exchange platform.

To monitor the waste generation and to continuously update the database, a Waste Inventory Cell would be established within NH Municipality through internal arrangements. This cell would be run by a single staff with the assistance from an external institution, such as a university or a consulting group for data collection and analysis. This cell would generate an interim report and an end of year report. The report would be in line with the formats used for waste data for developing ISWM Plan.

Implementation

The implementation of this scheme would be facilitated by NH Municipality through internal arrangements to setup the cell with a

single staff and to provide office equipment. The budget would be allocated to update database through data collection and analysis. The cell would make arrangements to update the database through an external institution. The cell would produce interim report and an end of year report. The cell would establish active communication channel within all the relevant departments to support the data requirements for implementation/monitoring of ISWM.



Benefits

Following benefits are anticipated from this scheme:

Availability of waste database (inventory) for better understanding of the quantities and composition of waste streams;

Updated database for accurate information;

A tool for monitoring of the implementation and impact of ISWM, especially for policies pertaining to reduction of waste at source and segregation at source;

Accurate information to modify/update the level of collection services;

Accurate information to update material and resource recovery facilities including transfer station, biological treatment and thermal treatment facilities.

Links to other Schemes under ISWM Plan for NH

This scheme is linked with all the other schemes of ISWM:



- Development of Local Policies on Segregation and Collection;
- Development of Awareness Raising Tools for Waste Management;
- Supply of Waste Bags for Segregation of Food Waste;
- Construction/Provision of Collection Points;
- Adaptation of Primary Collection Systems;
- Adaptation of Collection Vehicles – Secondary Collection;
- Upgrading of Transfer Stations for Material Recovery with a concept of an Eco District;
- Feasibility study for Composting and Biogas Plants;
- Recuperation and Adequation of the Central for inert material (C&D) “Aterro do Lima” in the Rondônia district;
- Development of Construction and Demolition (C&D) Waste Management Program;
- Development of Monitoring Mechanism for ISWM.

1.2 Development of Local Policy Framework on Segregation and Collection

Introduction

Currently, most of the waste from residential areas is not segregated at source. Based on the waste data, it is anticipated that if waste is segregated at source in three categories (food waste, hazardous waste, other waste) then on the one hand, the waste would not be contaminated due to presence of hazardous substances, and on the other hand, most of the waste could be recovered. About 54 percent of the residential waste is food

waste; thus, it can be converted into compost. This would help to increase the revenue base by selling the compost and it would also help to reduce the transportation and treatment/disposal costs. The segregation of food waste from other waste would also increase the amount of recyclable plastic, paper, glass, textile, and so on as most of the waste in the present circumstances become dirty due to the presence of food waste. To promote segregation at source, various policies, technical and voluntary measures are required. The first step would be to develop a local policy framework, consisting of regulatory and fiscal policies, to support segregation at source. Novo Hamburgo presents advantages as having a range of environmental laws to support the local public policies for segregation at source.

In addition to segregation at source, the other important issue, for safe handling and maximizing the material/resource recovery, is to adapt the collection system. Currently, the private company VEGA Environmental Engineering, carries out for collection system, equipment and transportation of the waste up to the transfer station and to final disposal of the residual waste at a private landfill located 130Km away from the transfer station. This primary collection system is not fully organized, especially with respect to collection vehicles and equipment for selective collection. This inadequacy allows the mixing of garbage bags, even if the waste is segregated at source; it becomes difficult to separate the materials for recycling / recovery by the cooperated ones in the transfer station. To bring the improvements in this primary collection and transportation, the local policies are required to regulate the services, especially the type, size and operations of the small collection vehicles.

Purpose

A local policy framework would help NH Municipality to achieve its targets for segregation at source to maximize material and resource recovery and to minimize contamination of waste and transportation and treatment/disposal costs (tipping fees). The policy framework would also help to streamline primary collection system and to improve its efficiency as well as to reduce its environmental impact.

Target

To develop a policy framework consisting of regulatory and fiscal policies to maximize segregation at source and to streamline primary collection system.

Type

Regulations and market-based (economic) instruments

Lead Agency

NH Municipality

Support Agency

An external institution/consultant may be hired to identify appropriate policies with respect to local conditions.

Location (suggested)

NH Local Government

Budget (estimated)

R\$20,000 (USD10,000) for external institution/consultant.

Time Frame (estimated)

12 months

| Activity | Jan-Feb | Mar-Apr | May-Jun | Jul-Aug | Sep-Oct | Nov-Dec |
|--|---------|---------|---------|---------|---------|---------|
| Collection & analysis of relevant policies (regulations and market-based instruments) for source segregation and primary collection. | | | | | | |
| Preparing first draft of Policy Framework with respect to local conditions | | | | | | |
| Comments from NH Local Government | | | | | | |
| Preparation of Final Draft | | | | | | |
| Deliberations within Government | | | | | | |
| Putting up for approval of the Government | | | | | | |
| Approval | | | | | | |

Description

The local policy framework would cover policies (regulatory and financial) to promote segregation at source and to streamline primary collection system. The policies for segregation at source would help to achieve the targets on the source segregation. Thus, hazardous waste has to be completely segregated at source. This could be achieved through regulations which can make everyone bound to dispose of hazardous waste separately. The regulations for collection of hazardous waste would be intact to make sure that source segregated hazardous waste is also removed separately and it would not mix with other waste during collection, transportation, treatment and disposal. For segregation of food waste from other waste, a combination of regulations and market-based instruments would be required as the targets are set 50 percent source segregation of food waste in the short term and thereafter, 100 percent source segregation in the long term. Market-based or economic instruments could be a mixture of

incentives and disincentives based policies. The residents, through residents' committees, may be fined for not segregating at source or they may be given a cut in the solid waste collection fees if they are segregating at source. The other way would be to provide incentives for recovered waste plastic, paper, glass, metals and so on at the source.

The policy framework would also cover the policies (mainly regulatory) to streamline the collection of waste from generation point to the transfer stations. The policies would address the size, type and operations of collection vehicles to reduce environmental impact in terms of leakages, odour, noise, dust and air pollution during transportation. The policies would also address the role of collection companies/individuals to properly maintain and clean the collection points.

Implementation

NH local government would implement and hire the services of an institution/individual expert to draft the policy framework in consultation with NH local government staff. Thereafter, NH would seek the approval of the policy framework through proper procedures within the government.

Benefits

Following benefits are anticipated from this scheme:

Availability of appropriate policy framework to create enabling environment for achieving targets on source segregation;

Maximization of material and resource recovery;

Minimization of costs for transportation and treatment/disposal of that amount of waste which is diverted, through source segregation, for material/resource recovery;

Availability of appropriate policy framework to streamline primary collection system;

To minimize the environmental impact of primary collection system;

To support clean and healthy neighborhoods.

Links to other Schemes under ISWM Plan for NH

This scheme is linked with the other following schemes of ISWM:

Development of Awareness Raising Tools for Waste Management;

Supply of Waste Bags for Segregation of Food Waste;

Construction/Provision of Collection Points;

Adaptation of Primary Collection Systems;

Adaptation of Collection Vehicles – Secondary Collection;

Upgrading of Transfer Stations for Material Recovery with a concept of an Eco District;

Feasibility study for Composting and Biogas Plants;

Recuperation and Adequation of the Central for inert material (C&D) “Aterro do Lima” in the Rondônia district;

Development of Construction and Demolition (C&D) Waste Management Program.

1.3 Development of Awareness Raising Tools for Waste Management

Introduction

Integrated solid waste management is a new concept. Conventionally, the residents dispose of their waste and then they are not bothered about how the waste is being managed. The residents get worried when the ineffective collection system fails to clear away all the waste and the remaining waste in the neighborhoods create environmental and public health hazards. Hence, most of the residents, conventionally, care about proper collection system. Most of them might neither be aware of the converting waste a resource nor the costs and efforts required to

properly collect, treat and dispose of the waste. They might not be aware of the contamination of waste by mixing hazardous waste with non hazardous recyclable waste. To promote the segregation at source and to motivate residents to pay solid waste management fees, it is vital to raise their awareness on why and how source segregation could be undertaken by every household. An awareness raising kit/tools consisting of detailed user-friendly materials to understand the process for segregating waste at source in three categories, the advantages of source segregation and proper collection system with maintenance/cleaning of collection points could be useful to promote public awareness.

Purpose

Awareness raising tools developed would be used through public meetings and trainings to raise awareness for source segregation and primary collection system leading to maximize material/resource recovery and to reduce the environmental and public health related impacts of waste in the neighborhoods.

Target

Residents of NH in particular and other waste generators (commercial, industrial, healthcare facilities, etc.) in general.

Type

Posters, pamphlets, covers of school notebooks, bags of PET fiber and video.

Lead Agency

NH Municipality

Support Agency

An external institution (preferably a university) may be hired to develop awareness raising kit/tools in close consultation with NH Municipality.

Location (suggested)

NH Municipality

Budget (estimated)

R\$30,000 (USD 15,000) for developing the kit. The printing and public meetings would require separate funding which could be decided by NH Municipality based on the number and type of awareness raising campaigns it wants to hold. For the covers of notebooks and school bags of PET fiber will need to partner with local companies such as supermarkets and industry of school materials.

Time Frame (estimated)

3 months

| Activity | Jan | Feb | Mar |
|--|------------|------------|------------|
| Developing a visual identity | | | |
| Developing draft pamphlets, posters and bags of PET fiber | | | |
| Comments from NH Local Government | | | |
| Developing video | | | |
| Comments on video from NH Local Government | | | |
| Final draft pamphlets, posters and bags of PET fiber | | | |
| Final copy of video | | | |

Description

Awareness raising kit/tools would be consisted of pamphlets, posters, covers of school notebooks, bags of PET fiber and a video. They are meant to spread messages on why and how to undertake source segregation of waste in three categories, viz.: hazardous,

food waste and other waste. They are also meant to spread message on proper collection system including proper maintenance and cleaning of collection points. The first part would introduce the audience with the benefits of source segregation and maintenance of collection points. The benefits for source segregation would include the maximization of material/resource recovery, minimization of chances for contamination of recoverable and non-hazardous waste and minimization of costs to transport and dispose the waste by diverting recoverable waste. The benefits of a proper collection system include the minimization of environmental and public health hazards such as waste related diseases due to presence of waste in the neighborhoods, odour and presence of mice and insects. The second part would introduce the ways to segregate waste in three categories and to maintain collection points. This would include the introduction of measures to be undertaken by the local government such as availability of plastic bags for food waste. This would also introduce the residents with the policies and technical measures by the local government to promote source segregation such as incentives and disincentives under market-based instruments for segregating food waste, regulations to segregate hazardous waste and operation plan for collection of the waste.

Implementation

NH Municipality by hiring an external institution to develop the kit/tools. NH Municipality would undertake awareness raising campaigns on "as and when required" basis. For the covers of notebooks and school bags of PET fiber will need to partner with local companies such as supermarkets and industry of school materials.

Benefits

Following benefits are anticipated from this scheme:

Availability of awareness raising kit/tools to be used in the public campaigns and workshops to promote ISWM in general and source segregation in particular;

Smooth implementation of policies and technical measures for promoting source segregation and streamlining primary collection system;

Source segregation leading to material/resource recovery;

Leading to minimization of contamination of recyclable and non-hazardous waste;

Leading to minimization of expenditures on transportation and treatment/disposal of recyclable waste.

Links to other Schemes under ISWM Plan for NH

This scheme is linked with the other following schemes of ISWM:

Development of Local Policies on Segregation and Collection;

Supply of Waste Bags for Segregation of Food Waste;

Construction/Provision of Collection Points;

Adaptation of Primary Collection Systems;

Upgrading of Transfer Stations for Material Recovery with a concept of an Eco District;

Feasibility study for Composting and Biogas Plants;

Recuperation and Adequation of the Central for inert material (C&D) "Aterro do Lima" in the Rondônia district;

Development of Construction and Demolition (C&D) Waste Management Program;

Development of Monitoring Mechanism for ISWM.

1.4 Supply of Waste Bags for Segregation of Food Waste

Introduction

Currently, the residents in NH do not segregate food waste from other waste, which results into all the food waste is ending up in landfill resulting into higher costs of final disposal due to the quantity of food waste and the amount of leachate from food waste. Segregation of food waste also increases the chances for recovery of recyclable waste, as it becomes dirty when mixed with food waste. Segregation of food waste from other waste is perceived as a major challenge in NH, as it requires a change in the lifestyle or habits of the residents who perceive segregation at source as an extra and difficult job for them. ISWM Plan for NH also contains policy, technical and voluntary measures to promote segregation of food waste. One of the measures could be the availability of separate bags for throwing food waste to make this task of segregation easier. This would also be taken as an incentive tool for the residents to segregate food waste. However, there could be a danger that residents may throw mixed waste or not properly segregated food waste into these bags. To reduce this possibility, residents' associations and waste collection staff may be trained to identify the bags with mixed waste and then residents' associations may apply other fiscal policies (fines or incentives) as discussed in Scheme 1.2. Number of bags per household could be fixed to avoid the misuse. This scheme could be initially introduced for 3 years to assess its impact.

Purpose

Transparent separate bags would make it easier for the residents to throw food waste into these bags. The transparent bags would make it easier for the residents' associations and collection staff to identify the bags with mixed waste.

Target

Residents in NH

Type

Project

Lead Agency

NH

Support Agency

Municipal Company of Urbanism (COMUR)

Location (suggested)

NH residential areas

Budget (estimated)

R\$60,000 (USD 30,000) per annum

Time Frame (estimated)

3 years (Initially)

| Activity | Year 1 | Year 2 | Year 3 |
|---|--------|--------|--------|
| Supply of transparent bags for food waste | | | |
| Mid-term review of the impact | | | |
| Mid-term report and feedback | | | |
| Final review and report | | | |
| Final decision on the future of this scheme | | | |

Description

Food waste is about 54 percent of total residential and commercial mixed waste (186 tons/day) in NH. Over the time, this percentage might decline; however, overall waste is increasing. Therefore, it could be assumed that food waste generation would be constant in terms of overall quantity. This is about 100 tons/day. As per the target, 50 percent of food waste should be segregated in the short

term. Therefore, bags would be required for about 50 tons/day of food waste. The population of NH is over 255,000 people and if average size of a household is 4 persons then there are 63,000 households. This suggests that each household generates about 1.5 kg of food waste per day. If the waste is collected twice a week then per household would be required 8 bags/month, totaling 504,000bags/month. The bags should be transparent and preferably of biodegradable material to avoid their negative environmental impacts.

Implementation

NH Municipality would carry out a research to identify the appropriate and economic type of transparent bags. They would also train residents' associations and waste collection companies to identify the bags containing mixed waste.

Benefits

Following benefits are anticipated from this scheme:

Accelerated pace of implementing policy measures on source segregation;

Enough quantities of food waste to establish composting plants;

Savings in costs incurred for disposal of food waste at landfill.

Links to other Schemes under ISWM Plan for NH

This scheme is linked with the other following schemes of ISWM:

Development of Local Policies on Segregation and Collection;

Development of Awareness Raising Tools for Waste Management;

Adaptation of Primary Collection Systems;

Adaptation of Collection Vehicles – Secondary Collection;

Upgrading of Transfer Stations for Material Recovery with a concept of an Eco District;

Feasibility study for Composting and Biogas Plants;

Development of Monitoring Mechanism for ISWM.

1.5 Construction/Provision of Collection Points

Introduction

NH is consisting of new and old residential areas. These new residential areas are mainly apartment building complexes within a boundary wall and waste collection bins are installed inside the complex, while waste collection point is constructed outside the complex. The old residential areas have single unit houses and its community collection points are installed on the curb side. Some of the residential areas lack proper collection points. For effective collection system, one of the important issue to be resolved is the provision of collection points. Furthermore, collection points should be maintained and cleaned properly to avoid negative impacts such as incidences of waste related diseases, spread of mice and insects, odour and urban flooding. The collection points should be secured and protected, especially from birds and animals.

Purpose

Collection points would provide the first step towards the target of achieving 100 percent collection and removal of waste. Appropriate collection points, on the one hand, make it easier for households to properly throw their waste, and on the other hand, make it easier for collection companies and staff to properly remove all the waste. Cleaned and well maintained collection points minimize the risks to environment and public health.

Target

Residents and small commercial entities relying on community based collection system.

Type

Project

Lead Agency

NH Municipality

Support Agency

This could be done in partnership with the current contractor for the collection and transportation of municipal waste and consultant could be hired to assess and design the collection points.

Location (suggested)

NH residential and commercial areas

Budget (estimated)

R\$600,000 (USD 300,000)

Time Frame (estimated)

6 months.

| Activity | Jan-Feb | Mar-Apr | May-Jun |
|--|---------|---------|---------|
| Assessment for identification of number and location and designs for collection points | | | |
| Contract for construction of collection points | | | |
| Construction of collection points | | | |

Description

Based on the identification and characterization of the neighborhoods in NH during the data collection for the Plan, the number and location for new collection points to be constructed (including rehabilitation of existing points if required) would be identified. The collection points should be within easy access and depending on the population density these may be located within 100 meters. Size of the collection point is also determined based on the density of the population. It could be as small as 1m³ and made of steel or plastic like a bin or it can be as big as 5m³ and constructed with bricks or concrete. There could be three earmarked compartments. Smaller for hazardous waste and bigger

for food waste. The collection point should be protected from outsiders to secure these from animals and birds.

Implementation

NH can use the services of a consultant to identify the location and design the collection points in line with local conditions. NH can contract out to a civil works contractor to construct these collection points. Also, this could be done in partnership with the current contractor for the collection and transportation of NH municipal waste.

Benefits

Following benefits are anticipated from this scheme:
Well built and protected collection points to avoid nuisance;
Smooth collection of all the waste, especially for source segregated waste.

Links to other Schemes under ISWM Plan for NH

This scheme is linked with the other following schemes of ISWM:
Development of Awareness Raising Tools for Waste Management;
Adaptation of Primary Collection Systems.

1.6 Adaptation of Primary Collection Systems

Introduction

Officially NH employs only one private contractor for the collection service. However, there are various small companies and individuals involved in informal primary collection of waste. This situation has generated a dispute between the compactor trucks from the municipal collection and the various types of pushcarts and charts pushed by animals. There are two aspects of this informal gathering system. One is the inappropriate vehicles. The other one is the very poor social and health conditions of the

street pickers. Front-loaded tricycle with which they will roam the streets calling for recyclable materials and/or pickup for recyclable materials may be some options.

As there are small-scale enterprises and cooperatives that engage in primary collection, due to interest in recyclable materials, policy measures (Scheme 1.2) on standardization should be adopted. Once the private contractor use only compactor trucks for collecting MSW, the smooth implementation of the policies to improve the condition of collection equipment and collection vehicles from the informal collectors, it also will improve the selective collection of waste in NHM. This may require the assistance of the Municipality to upgrade their equipment and vehicles.

The Law of Sanitation n° 11.445/07 requires municipalities to structure its sanitation policy from sectoral plans. In addition, the law is an important legal instrument because it allows municipalities to contract, without bidding, organizations (associations or cooperatives) formed exclusively by individuals of low income recognized by the public as garbage collectors and collectors of recyclable materials, with use of equipment compatible with the technical, environmental and public health.

The federal government created the Interministerial Committee for the Inclusion of Recyclable Material Scavengers for the purpose of discussing with the National Movement of Collectors (Scavengers) of Paper, public policies and actions that promote growth of category. Also it established by Decree n° 5940/2006, under the direct and indirect federal administration, the *solidarity selective collection of recyclable waste* - the material discarded by public

institutions is destined to associations and cooperatives of scavengers duly authorized.

The National Congress has a bill, sent by President Lula in September 2007, establishing the National Policy on Solid Waste. In the text of the project, waste collection is an essential tool for practice called reverse logistics, a mechanism that requires companies committed to the final destination of their products, packaging materials or post-consumer - thus encouraging the waste return to chain. This instrument also promotes the partnership between scavengers of recyclable materials, municipalities and society in general.

Source: www.mma.gov.br/srhu

Purpose

Small-scale collection enterprises would be enabled to upgrade their collection equipment and vehicles. This would lead to efficient and environmental friendly primary collection system. The efficient and effective primary collection system would be beneficial for their owners, as they can earn more by collecting more waste. Also, the individuals and cooperatives will count on Municipality effort to upgrade their collection charts and to establish a central selection point where they can sort the waste collected by the standard vehicles.

Target

Small-scale enterprises, Cooperatives and Individuals providing primary waste collection service.

Type

Project

Lead Agency

NH Municipality

Support Agency

An external institution/individual to prepare detailed primary collection system with information of appropriate vehicles and equipment and their techno-economic analysis. The consultant would also make action plan for the government suggesting the ways and means to assist the waste collection small-scale enterprises, cooperatives and individuals to upgrade their equipment and vehicles.

Location (suggested)

NH Municipality.

Budget (estimated)

R\$40,000 (USD 20,000) for consultancy. Based on the expert recommendations, NHM may allocate the budget to assist primary collection small-scale enterprises, cooperatives and individuals to upgrade their equipment and vehicles.

Time Frame (estimated)

12 months for report and 3 years to upgrade primary collection system (total 4 years).

Description

There are two aspects of the project. One is to identify the appropriate type of equipment and vehicles for primary collection in line with the local conditions of different districts of NH. The other one is to develop a set of recommendations for NHM to assist the small-scale enterprises, cooperatives and individuals to upgrade their equipment and vehicles. For vehicles, the choice

could be made from a wide range and most of these could be suitable for one or the other district of NH.

Some of the vehicles could be available locally, which will also be a part of the report. The following are only illustrative examples.



The report should also provide a detailed action plan or recommendations on how to assist these small-scale enterprises, cooperatives and individuals. There could be various ways, including low-interest loans, duty-free equipment and vehicles, lease of vehicles, social programs to generate jobs and income, etc. The recommendation may also include the capacity building of local companies for operation and maintenance of the new equipment and vehicles.

Implementation

NH Municipality would implement in collaboration with the local companies, based on the recommendations in the report.

Benefits

Following benefits are anticipated from this scheme:
Efficient and effective primary collection system;

Reduced environmental and public health hazards from primary collection System;
Improvement the of scavengers work conditions through their organization and training;
Increase collection of recyclable materials;
Increase scavengers income;
Reducing socio-cultural disruption, poverty and/or unemployment.

Links to other Schemes under ISWM Plan for NH

This scheme is linked with the other following schemes of ISWM:
Development of Local Policies on Segregation and Collection;
Development of Awareness Raising Tools for Waste Management;
Supply of Waste Bags for Segregation of Food Waste;
Construction/Provision of Collection Points;
Pilot Projects for Recycle and Reuse of Waste.

1.7 Procurement of Compactor Self-propelled Pocketed – Secondary Collection

Introduction

Currently, the transfer station *Roselândia* has two functions: sorting for material recovery and transferring waste from small primary collection vehicles to big vehicles for onward journey to disposal facility to save the transportation costs. Economically, the lack of scale does not allow the daily removal of waste from *Roselândia* to the landfill, which is located 130km away from NH. At the transfer station the waste is deposited directly on the ground causing irreversible damage to the environment, either by leachate from rainfall on waste not covered, either by the generation of gases, odors, proliferation of vectors, or the dirt near the sorting facility, associated with poverty and the generation of public health problems.

The transfer station use equipment such as track-type tractor, truck and backhoe while loading waste on the big trucks up to the disposal facility. In practice, maintaining equipments permanently available for the transfer station, may not be economically the most viable option.

Purpose

With the procurement of a Self-propelled or Towable Compactor Pocketed Vehicle for compression, bagging and disposal of waste at transfer station, there could be substantial savings in landfill costs and prevents pollution caused by vehicles that transport the waste to the landfill. In addition to that there could be environmental benefits as this type of vehicle is designed to handle waste in a practical and hygienic way.

Target

NH Municipality for resource efficiency and public benefits.

Type

Project.

Lead Agency

NH Municipality.

Support Agency

An external institution/expert could be hired to assess the Ecosol technology and assisting in negotiations.

Location (suggested)

NH Municipality - Transfer Station of *Roselândia*.

Budget (estimated)

Initially R\$10,000 (USD 5,000) for assessment of demand, identification of appropriate type of vehicle and developing

procurement documents. Then based on the assessment, further budget could be allocated to buy the required vehicle at once or in phases.

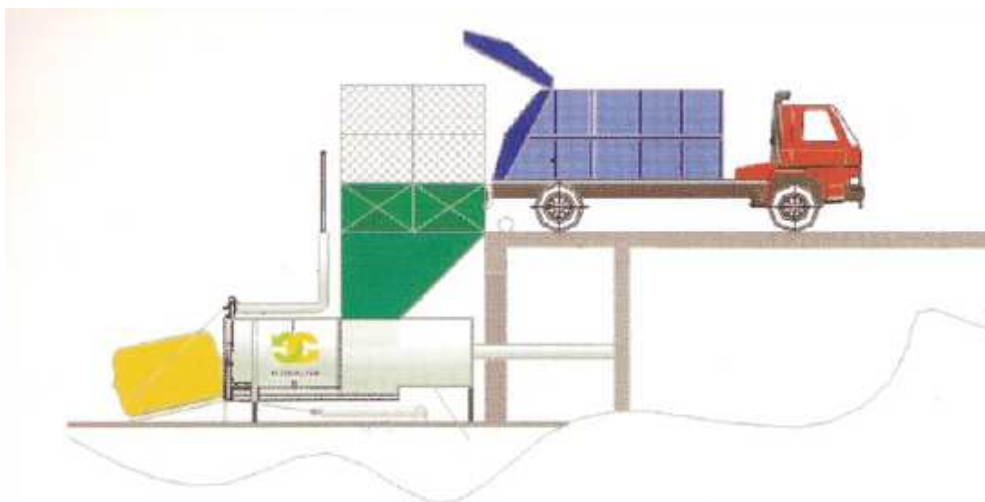
Time Frame (estimated)

6 months.

| Activity | Jan-Feb | Mar-Apr | May-Jun |
|---|---------|---------|---------|
| Assessment of <i>Ecosol</i> technology and identification of appropriate type of vehicle with techno-economic study | | | |
| Comments from NHM | | | |
| Development of tender documents to acquire the vehicle | | | |

Description

The system of collection, compression and bagging *Ecosol* is suitable for collection and disposal of garbage, in a practical and hygienic way. Versatile, can be used for all types of waste or products that enable the compression and bagging for transportation and/or storage. The *Ecosol* technology presents suitable equipment to adapt to the current needs of municipalities, to operate in the solution of collection, compaction and disposal of waste.



Plant of compactation and pocketing

Pocketing (Bagging) - The refill port located on the back of the equipment, packs from 30 to 50 meters of material (polypropylene laminated) that enable the production from 6 to 10 bags. The weight of the material of the bags may vary from 120 to 200 g/m² depending on the type of waste to be pocketed. The shutdown of the bags is guided by ropes held by clamps that direct the node to the center of the bags. Once closed the bag, another hydraulic system is activated, facilitating discharge and closing the bottom of the next bag.



Landfill in waterproof bags

Self-propelled compactor Pocketed performs the collection of waste in a quick, simple and secure way. Tubular-shaped and constructed of steel, the cargo box stores 6 m³ of compacted waste (approximately 24 m³ of loose garbage).



Compactor Pocketed - Self-propelled

The unit allows compression and pocketing a daily processing of about 100 tonnes. The system is continuous operation, creating bags of 5.5 m³, weighing between 4 and 5 tons per bag, depending on the type of waste to be pocketed.



Compactor Pocketed - Towable

Implementation

Based on the instructions from the external expert would carry out this assessment and will also identify the most suitable type of Compactor Pocketed Vehicle for the local conditions. Based on the approvals from NHM, this external expert would prepare tender documents to assist NHM in acquisition of the vehicle.

Benefits

Following benefits are anticipated from this scheme:

Substantial savings in landfill costs;

Prevention of pollution caused by vehicles for transporting waste from transfer stations to landfill (130km away from NH);

Minimization of environmental and public health impacts;
Restoration of polluted areas.

Links to other Schemes under ISWM Plan for NH

This scheme is linked with the other following schemes of ISWM:
Development of Operational Plan for Collection and Transportation;
Upgrading of Transfer Stations for Material Recovery with a concept of an Eco District;
Pilot Projects for Recycle and Reuse of Waste.

2. Sorting, Treatment and Disposal

2.1 Upgrading of Transfer Station for Material Recovery with the concept of "Eco District"

Introduction

It is evident from waste data of NH that there are substantial quantities of recyclable materials. The first precedent for the establishment of an industrial district for recycling - Eco District - is the segregation of waste at source in sufficient volumes to attract processing and recycling / recovery industries. Second is the infrastructure at the transfer station for sorting recyclable materials in safe and hygienic conditions. This recyclable waste could be utilized by establishing recycling industries, which either treat this waste to convert this waste into a useful source for industries or use this waste directly into industrial process to produce consumer products. Both of these types of recycling industries could be clustered and located into "Eco District" with preferential policies and infrastructure to encourage recycling. The current statistics show that there is a huge quantity of industrial non-hazardous waste (processing waste) per year.

In the concept of “Eco District” the heart is the sorting facility with proper equipment to compact the final waste for transportation to the peripheral organs that are the recycling industries installed around it. Ideally, all elements of a product should circulate indefinitely - less material, more thinking - turning waste into wealth through the reintroduction of the materials into market circuit. These changes also lead to reorganization of the role of business in the economic cycle. Manufacturers of finished products become also producers of secondary raw materials and services. This strategy allows it achieves economies of fees associated with waste, with the disappearance of these.

Challenges

Licensed area, Fiscal incentive, Financial Resources, Training, Social Inclusion.

Purpose

Upgraded transfer station with the inclusion of the sorting plant and a licensed area to host recycling industries, would increase the rate of material recovery which would benefit from two aspects. Firstly, it would reduce the amount of final waste leading to savings in resources required to transport, treat and dispose final waste. Secondly, it would be source of income, as this recyclable waste could be sold directly to recycling sector. The sorting facilities aim to include the workforce of the informal scavengers and recycling cooperatives. Plus, this new arrange would provide preferential policies and infrastructure to encourage the establishment of recycling industries and it will boost a new industrial cluster resulting into environmental friendly economic activities.

Target

Eco District in NH – with the following objectives:

To promote 3R approach at wider scale;
To encourage establishment of recycling industry;
To boost economic activities without seriously affecting the environment.

Type

Project.

Lead Agency

NH Municipality Local Government.

Support Agency

An outside organization or a consultant could be hired to develop a feasibility study for setting up Eco District (transfer station+ sorting facility + recycling business plants). The feasibility study would also include the recommendations on preferential policies and infrastructure for recycling industry.

Location (suggested)

Transfer station of Roselândia or industrial area.

Budget (estimated)

The real estimates could only be available after the feasibility study. For feasibility study, the budget estimate is about: R\$200,000 (USD 100,000).

Just to illustrate the concept of Eco District, follow the images below:



Image 1: Eco District: inside square - sorting, storage, room for workshops, library, room for meals, community hall; around - processing and recycling companies.



Image 2: Eco District: aerial view



Image 3: Type of vehicle (tricycle) to be used in transporting materials segregated within the Eco District. May be an option for selective collection in schools and condominiums.

Benefits

Following benefits are anticipated from this scheme:

Research in recycling plants show that about 30% of urban waste is recyclable solid. In NH the average found for recyclable was 33%, which corresponds to 1,746 tons of recyclable solid waste generated per month. Considering ten cents of a dollar per kg this is equivalent to an income of U\$174,600. This value, represented in jobs means a significant possibility of reducing the unemployment rate of labor unskilled.

Links to other Schemes under ISWM Plan for NH

This scheme is linked with the other following schemes of ISWM:

Establishment of Waste Inventory Cell

Development of Local Policies on Segregation and Collection

Development of Awareness Raising Tools for Waste Management

Supply of Waste Bags for Segregation of Food Waste

Construction/Provision of Collection Points

2.2 Feasibility study for Composting and Biogas Plants

Introduction

As could be seen through the data collected in the field, the waste generated in NH is characterized by high percentage of organic waste (over 50%). These organic wastes (source of nutrients, minerals, etc.) are actually the villain of urban waste. Upon being deposited in their natural state, at the transfer station or landfill without treatment, along with other wastes (some potentially toxic), enter into fermentation (anaerobic), generating, among other byproducts, foul smelling gases and organic acids. Gases attract vectors (flies, mosquitoes, cockroaches and rats), which find within waste the body of an ideal habitat for the proliferation and spread of disease. Organic acids, in turn, dissolve paints, resins and printed newspapers, corrode batteries and incorporate toxic substances to its original composition, such as heavy metals, joining other fluids present in the waste. Inevitably these liquids percolating mass of trash (a fact exacerbated by the rain), and there they are called "slurry" that could reach and pollute groundwater and surface water, often used for human and animal consumption. It is important to clarify that neither the usual water treatment removes these dissolved chemicals. That is, both the garbage and the methods poorly operated landfills can pollute soil, air, water bodies and, of course, reach the food chain.(*source: UFV/LESA*)

The abundance of biomass sources available in Brazil, the wide range of processes used for its recovery and diversity of energy obtained for use by the end user brought the country to develop a broad spectrum of activities in the field of biomass. Brazil has

favorable climatic conditions to explore the immense energy from organic waste and release biogas and fertilizer. Numerous advantages can be described to the deployment unit for the production of biogas, but one of the most convenient is in terms of environmental impact, because no damage to the environment will be caused by a biodigester to generate biogas.

Investigation of alternative systems of power generation have focused on the process, leaving in the background one of the main goals that are the costs. The shortage is most evident in the case of systems simpler and more economical (*Sganzerla, 1993*).

Purpose

Study of technical and economic feasibility based on the use of organic waste, seeking solutions of composting and biodigestion systems, economic and environmentally friendly for the local conditions.

Target

To enlist several technologies for biogas and composting plants viable for small-scale processing to avoid disposal of organic waste at the landfill.

Description

Biogas plant - a plant in which occurs biological degradation of organic animal products in anaerobic conditions for the production and collection of biogas.

We can briefly say that the anaerobic digestion of organic waste is a biochemical process that uses bacterial action to fractionate complex compounds and produce a combustible gas, called biogas consisting of methane and carbon dioxide. The place where you

develop these decomposition reactions is the digester or biodigester (*Nogueira, 1986*).

Composting plant - a plant in which occurs biological degradation of organic animal products under aerobic conditions.

Composting is an aerobic biological process and controlled that transform organic waste into waste stabilized with properties and distinct character of the material that originated it. It is generally performed in courtyards in which the material is arranged in a conical hills, known as compost heaps, or piles of prismatic form with the Simola section to triangular, called composting windrows (*Bidone, 1999*).

Location

Transfer Station Facility of *Roselândia*.

Type

Project.

Lead Agency

NH Municipality Local Government.

Support Agency

An outside organization/expert could be hired. The feasibility study would also include the recommendations on preferential policies and infrastructure for composting/biogas Plant.

Budget (estimated)

Initially R\$20,000 (USD 10,000) for assessment of demand, identification of appropriate type of plant and developing procurement documents. Then based on the assessment, further budget could be allocated to implement the required technology.

Time Frame (estimated)

6 months.

| Activity | Jan-Feb | Mar-Apr | May-Jun |
|--|---------|---------|---------|
| Assessment of existing technologies and identification of appropriate type for local conditions with techno-economic study | | | |
| Comments from NHM | | | |
| Development of tender documents to acquire and implement the appropriate technology | | | |

Benefits

Following benefits are anticipated from this scheme:

Elimination of several outbreaks of environmental pollution (soil, air and water);

Control of proliferation of biological vectors (flies, mosquitoes, cockroaches and rats) of great significance in the transmission of infectious diseases;

Improvement of public health across the region;

Generation of direct and indirect jobs;

Technical training for operational staff who will operate these systems.

Links to other Schemes under ISWM Plan for NH

This scheme is linked with the other following schemes of ISWM:

Establishment of Waste Inventory Cell;

Development of Local Policies on Segregation and Collection;

Development of Awareness Raising Tools for Waste Management;

Supply of Waste Bags for Segregation of Food Waste;

Construction/Provision of Collection Points;

Pilot Projects for Recycle and Reuse of Waste.

2.3 Recuperation and Adequation of the Central for inert material (C&D) "Aterro do Lima" in the Rondônia district

Introduction

C&D waste represents a considerable portion of the waste produced by modern society, which creates several environmental problems such as lack of appropriate places for the disposal of such waste. In addition to environmental benefits, the correct management of C&D waste can also bring social benefits such as employment generation, economic benefits, direct and indirect, and thus improving the urban environment and quality of living.

Purpose

Recuperation and sizing, layout and operation of the central facility of inert materials in the district of *Rondônia - Aterro do Lima*, based on a technical study (*Ref.: project contract 008-2008*). The recuperation of this area predicts the controlled deposition of inert waste from construction and demolition that contemplates the future use of this area for other purposes. The recovery of the area, including its interior, will restore the site without the removal of waste - applying remediation techniques to ensure no contamination of natural resources, technically and economically feasible for the municipality.

Location

The land where is located the "Aterro do Lima" is situated in the floodplain of the Sinos river, being surrounded by vegetation and wetlands, with its original boundaries to the river banks. The land, however, is cut in plans for the construction of the Avenue of the Municipalities, as well as the existence of an Environmental Protection Area - APA, both provided for in the Master Plan approved in Novo Hamburgo in 2004.



Figure 1- Boundaries of the land and landfill neighbors.

Background of the Area

The operations in the "Aterro do Lima" started around the year 1994, managed by the Department of Environment and having ceased its activities in early 2008 by court order. The landfill received materials collected by the city, as well as from individuals, containing inert waste arising from construction and demolition, tires and furniture.



Figure 2 - Overview of the region - south view.

Target

The scheme has been developed to achieve the following targets:
Recuperation of a contaminated area – *Aterro do Lima*;
Installation of a landfill for C&D waste;
Establishment of plant for receiving and sorting of C&D waste;
Temporary stock of materials like wastes of pruning, bulky wastes and dead animals.

Challenges

In the adjustment of the Central and adequacy of the landfill, the city will have to make the expropriation of the land neighbor, as shown in *figure 1-Boundaries of the land and landfill neighbors*.

Type

Project.

Lead Agency

NH Municipality Local Government.

Support Agency

This could be done in partnership with the Union of Construction Industries or an outside engineering company could be hired.

Budget (estimated)

Total: R\$8,823,871.60 (approximate value in USD: 5,190,512.7).

| Implementation | Phase 1 | Phase 2 | Phase 3 (final) |
|----------------------|-----------------|-----------------|-----------------|
| R\$582.991,60 | R\$3.083.285,00 | R\$2.613.720,00 | R\$2.543.875,00 |
| U\$342,936.23 | U\$1,813,697.05 | U\$1,537,482.35 | U\$1,496,397.05 |

Time Frame (estimated)

| Implementation | Phase 1 | Phase 2 | Phase 3 (final) |
|------------------|-----------|-----------|-----------------|
| 06 months | 45 months | 38 months | 37 months |

Description

Like the vast majority of Brazilian municipalities, Novo Hamburgo also lacks specific statistical data on the generation of C&D waste. Therefore, the estimates used for this project are based on the data characterization and quantification of solid waste for NH ISWM Plan - about 64.000 ton/year - which are in line with data from other municipalities. Since there is no record on quality and quantity of waste from pruning, weeding and great volume waste, we considered the similar data from other municipalities.

The table below shows the summary of the waste to be received at the Central, as the classification of the ABNT, indicating the estimated amount to be received.

| Classification | Waste received | Estimated quantity |
|----------------|--|--------------------|
| C&DW – class A | brickwork, mortar, concrete | 3,168 t/m |
| | clean soil, soil dirty | 1,425 t/m |
| C&DW – class B | papers, plastics, metals, woods | 80 t/m |
| C&DW – class C | plaster, non-recyclable inert | no ref. |
| C&DW – class D | Contaminated demolition waste of radiology clinics, industrial plants, paints, greases, oils, solvents, etc. | no ref. |
| Bulky waste | furniture, appliances | no ref. |
| | Pruning, weeding | 607 t/m |
| Dead animals | Dead animals | 30 animals/m |

This data refers to the total generation of the municipality, considering the collection of 100% of C&D waste. For definitions of

its composition were considered the estimates provided by the characterization and quantification for NH ISWM Plan.

| Waste type | Participation in the composition of C&D waste (%) | Estimated quantity (t/m) |
|------------|---|--------------------------|
| Concrete | | |
| Mortar | | |
| Brickwork | 60 | 3,168 |
| Ceramics | | |
| Soil | 27 | 1,425 |
| Wood | 1,5 | 80 |
| Others | 11,5 | 607 |

The above table represents only an estimate that can safely be applied to project implementation with regard to construction, not including, for example, the execution of large civil works or infrastructure and demolition, and other exceptional activities. From the operation of the Central of Inert, these averages should be adjusted to the local situation, for greater reliability.

Implementation

It was considered for the purpose of calculations, a density of 1.2 t/m³ for the crude waste (Pinto, 1999), and estimated at 1.5 t/m³ for the compacted waste on the soil, based on the density and proportion of soil present in the waste.

a) Receiving of waste

No waste can be disposed at the landfill without the knowledge of its origin and composition. The first step in the process of receiving, therefore, is the visual inspection of the cargo at the entrance, to identify its contents. When the load contains more than 10% of materials different from the C&DW Class A, such as plastics, cardboard, paint cans, shall not be admitted to downloading at the Central. After visual inspection, the truck passes through the scale, which has its weight recorded by the

person who will authorize the downloading according to its content, as described below:

- i. in the Receiving and Sorting area of Construction Waste and Demolition and Bulky Waste will be received loads heterogeneous, containing C&DW, plastics, cans of paint, plaster, bulky items like furniture, appliances, tires and other components to be sorted and segregated into their respective storage areas;
- ii. bulky waste loads containing pruning and weeding will be unloaded in the area of Sorting and Storage of Pruning and Weeding;
- iii. homogeneous cargos such as soil excavation or earthwork, asphalt, etc., which are not mixed with other waste, will not go through screening, and deposited directly on the landfill;
- iv. clean soils will be stored separately, in order to use on the slopes and in the coverage of the landfill, and to facilitate the placement of grass.

In the case of cargo originating from large generators, which carriers must be registered with the municipal authorities, those that contain more than 10% of materials different from C&DW will be instructed to return to the origin and carry the correct separation of waste. Below the basic layout of the scheme of the areas of receiving, sorting and storage:

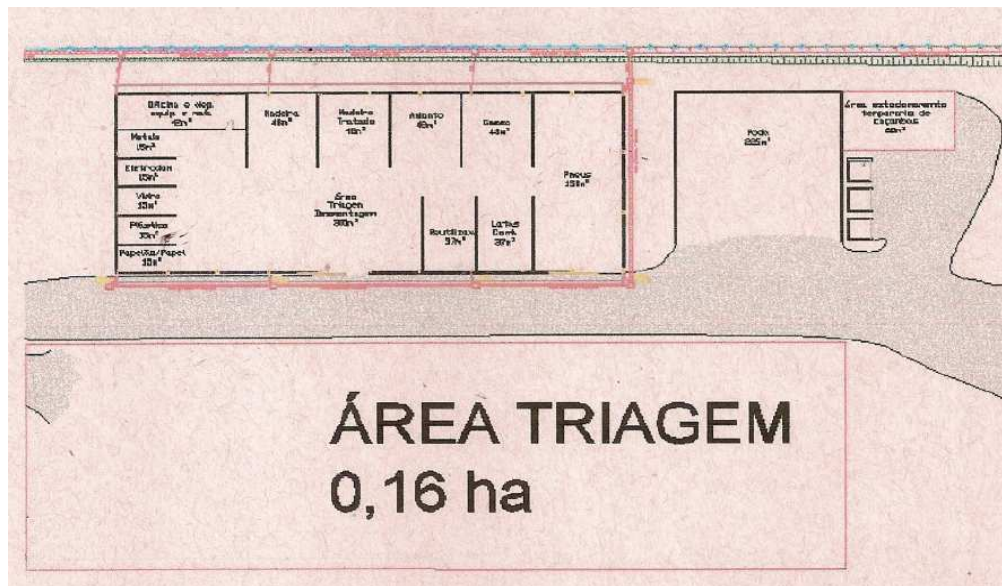


Figure 4- Schematic of the areas of receiving, sorting and storage

b) Waste Sorting

The sorting process is extremely important for the proper functioning of the Central, aiming to better use and waste disposal. After the authorization to discharge in the area of Receiving and Sorting of Construction and Demolition and Bulky Waste, the material is unloaded and spread out (for this service is fundamental to the presence of a wheel loader full time on site), then a team will hold its manual sorting, separating the materials that will not be disposed in landfill and sending them segregated to their respective areas of temporary storage. The remainder will be disposed at the inert landfill of inert. To do this transport to the grounding area will be needed two dump trucks and a wheel loader.

c) Area for temporary storage of waste class D

Waste class D, according to ABNT-NBR: 15112 are those hazardous wastes coming from the construction process, such as paints, solvents, oils and others, or those infected come from demolition, renovations and repairs of radiology clinics, industrial

plants and others. Such waste will be segregated from others during the sorting and stored in the specified area for this purpose until his removal to industrial or hazardous waste landfills.

d) Final Destination

Inert waste from construction and demolition class A and class C, will have its final destination in Central Inert Landfill of Lima (*Aterro do Lima*), with its disposal on the landfill, or storage in a storage area for reuse.

Below summary of the types of waste to be received, sorted and their respective destinations:

| Classification | Waste received | Destination |
|---------------------------|---|---|
| C&DW – class A | brickwork, mortar, concrete, clean soil, soil dirty, asphalt, reusable materials. | landfill of the Central of Inert |
| C&DW – class B | papers, plastics, metals, glasses. | storage for recycling |
| | treated wood, clean wood. | storage for reuse |
| C&DW – class C | plaster | storage for non-inert landfill |
| | non-recyclable inert | landfill of the Central |
| C&DW – class D | contaminated demolition waste of radiology clinics, industrial plants, paints, greases, oils, solvents. | storage for industrial landfill |
| Bulky waste | furniture, appliances | storage for reuse or recycling |
| | pruning, weeding | storage for the Central of <i>Roselândia</i> |
| | tires and other dry wastes | storage for recycling |
| Dead animals | Dead animals | Storage for destination to be defined by Municipality |

Volumetric capacity

A projection from the per capita generation related to population growth is given below, and comparing with the capacity of the landfill. It was considered for the calculation, 313 days per year. For calculation of volume, it was considered a density of 1.2 t/m³

for crude waste, and 1.5 t/m³ for the waste compacted on the landfill soil.

| Year | Population (inh) | C&DW Generation (t/year) | Volume after Compactation (m³) |
|-------------|--------------------------|-------------------------------------|--|
| 2007 | 253067 | 63,014 | 42009 |
| 2008 | 255676 | 63,663 | 42442 |
| 2009 | 258311 | 64,319 | 42880 |
| 2010 | 260974 | 64,983 | 43322 |
| 2011 | 263664 | 65,652 | 43768 |
| 2012 | 266382 | 66,329 | 44219 |
| 2013 | 269128 | 67,013 | 44675 |
| 2014 | 271902 | 67,704 | 45136 |
| 2015 | 274705 | 68,402 | 45601 |
| 2016 | 277357 | 69,107 | 46071 |
| 2017 | 280398 | 69,819 | 46546 |
| 2018 | 283288 | 70,539 | 47026 |
| | Total | 800,543 t | 533,695 m³ |
| | Landfill capacity | 803,700 t | 535,800 m³ |

Benefits

In addition to environmental benefits, the correct management of C&D waste can also bring social benefits such as employment generation, economic benefits, direct and indirect, and thus improving the urban environment and quality of living.

Links to other Schemes under ISWM Plan for NH

- Establishment of Waste Inventory Cell;
- Development of Local Policies on Segregation and Collection;
- Development of Awareness Raising Tools for Waste Management;
- Upgrading of Transfer Stations for Material Recovery with a concept of an Eco District;
- Development of Construction and Demolition (C&D) Waste Management Program;
- Development of Monitoring Mechanism for ISWM.

2.4 Development of Construction and Demolition (C&D) Waste Management Program

Introduction

The municipal Law 1098/2004 and the Resolution CONAMA 307/2002 prohibit the dumping of C&D waste in the sanitary landfills, in areas of "going out", slopes, bodies of water, vacant lots and in areas protected by law, or without the express authorization of the competent environmental agency. The management plan should establish the management and distribution of environmentally appropriate waste. However, the absence of any city level guidelines for C&D waste management implemented results in huge quantum of debris ending up in the landfills or being dumped in low-lying areas including river banks & beds. The first step to fulfill the Law should be involve the generators, the collectors, the population and the secretary of the environment in order to implement a Construction and Demolition Waste Management Program.

Purpose

Development of Construction and Demolition (C&D) Waste Management Program based on the manual of basic guidelines for the management of waste from civil construction, which was prepared jointly by the Department of Environment, Society of Architects and Civil Engineers (NH), Union of Construction Industries (NH), Regional Council of Architects and Engineers (RS) and FEEVALE University, in 2005.

Targets

Facilitate the action of all stakeholders;
Discipline its action by institutionalizing activities and flows;
Encourage adoption by the stakeholders making advantageous the new procedures;

Improving the management and supervision of these agents involved;

Ensure an appropriate segregation, identification and quantification of C&D waste;

Prevent disposal of construction and demolition waste in irregular areas;

Prevent the illegal transport, having a strict control on entry of such waste in authorized areas;

Stimulate the process of reuse and recycling;

Awareness of the population for avoiding disposal of household waste in the containers (*papa-entulho*) for collecting inert materials.

Challenges

As the city of Novo Hamburgo has no licensed area available for deposition of C&D Waste, so is common the population dispose demolition debris anywhere, dribbling the surveillance of public control. For the effectiveness of the Program, the implementation of the Voluntary Points of Collection (Ecopoints) and/or the Central of Inert is vital.

Type

Program.

Lead Agency

NH Municipality Local Government.

Support Agency

SINDUSCON-NH (Union of Construction Industries).

Location (suggested)

NH Municipality Government Office.

Budget (estimated)

R\$30,000 (USD 15,000) for developing tools for the Program. The printing and public meetings would require separate funding which could be decided by NH Municipality and SINDUSCON-NH based on the number and type of awareness raising campaigns it wants to hold.

Time Frame (estimated)

6 months.

| Activity | Jan/ Feb | Mar/Apr | May/Jun |
|--|-----------------|----------------|----------------|
| Developing a visual identity | | | |
| Developing draft booklet, posters, banners | | | |
| Comments from NH Local Government and SINDUSCON | | | |
| Developing public meetings agenda | | | |
| Comments on public meetings agenda from NH Local Government and SINDUSCON | | | |
| Final draft booklet, posters, banners | | | |
| Final public meetings agenda | | | |

Description

The development of Construction and Demolition (C&D) Waste Management Program would be consisted of awareness tools based on the manual of basic guidelines for the management of waste from civil construction, which was prepared jointly by the Department of Environment, Society of Architects and Civil Engineers (NH), Union of Construction Industries (NH), Regional Council of Architects and Engineers (RS) and FEEVALE University, in 2005. These tools are intended to guide the development of a Management Plan for Waste to be organized and implemented by the generators, which contain the procedures necessary for the proper separation of materials used in construction and demolition and the correct handling, separation, transportation and final

destination of these waste, in particular allowing their use as aggregates for making bricks, cords of curb, asphalt sub-base, among others.

The booklet will bring guidelines on how to elaborate the C&D Waste Management Plan, including model forms necessary for approval of the construction work by the municipal authorities. The posters and banners are meant to spread messages on why and how to undertake source segregation of waste in four categories (A, B, C and D) according to CONAMA n°307/2002. They are also meant to spread message on proper collection system including proper maintenance and cleaning of collection points. The first part would introduce the generators with the benefits of source segregation and disposal of on proper collection points. The benefits for source segregation would include the maximization of material/resource recovery, minimization of chances for contamination of recoverable and non-hazardous waste and minimization of costs to transport and dispose the waste by diverting recoverable waste. The second part would introduce the population to the difficulties faced by private collectors for C&D waste regarding to the containers (*papa-entulho*) placed on the streets, which end up being used for household waste disposal by the population.

Implementation

Once the ISWM Plan has identified the stakeholders involved with the generation, collection and transportation of C&D waste, its characteristics and quantities, and assessed the operation of public and private organizations that operate in this sector, a set of actions should be put into practice to the success of the Program.

First action: designation of a local technical team, responsible for security, efficiency and maintenance of the Management Program of construction and demolition waste. This team should be qualified and shows permanent character of facilitator and mediator. It should also check results on interactions in partnerships and maintain a process of monitoring and continuous improvement.

Second action: awareness of the whole population in order to cultivate new habits conducive to success of the program. For that the need to create tools that promote the spread of posture to be adopted in the management of waste, reaching all types of generators, the community and government agencies.

Third action: Install the voluntary collection points for small generators in the character of a public service (Ecopoints), the construction and management will be in local government or the private sector, depending on definitions political-administrative and managerial.

Fourth action: the organization of service network covering all parts of the chain operatively linked to the transport, handling, processing and disposal of small and large volumes of civil construction waste.

Fifth action: install units for Sorting and Recycling, enabling big generators to exercise of their responsibilities in relation to their waste. One option is the implementation and operation of these units through public/private partnership. These units fully implemented and operated by private generators, can count with the municipality as a partner to buy the recycled material in these

units for use in sub-base of local municipal roads, affordable housing in the municipal public housing program.

Sixth action: Another important factor is the supervision, which should act differently. Through information and guidance to adhere to the new areas licensed for the disposal of waste. This guidance will be based initially in the prevention of fining, establishing a compromise between generators, collectors, receivers of waste and municipal government.

Benefits

Following benefits are anticipated from this scheme:

Reducing costs arising from the corrective actions;

Gradually decreased degradation of beds of water courses, the silting of rivers and streams, clogging of drainage systems and the degradation of the urban landscape;

These actions taken together avoid the frequent adoption of countermeasures by the government. These, besides overburden the taxpayers, also encourage the continuation of irregular deposition, because these sites are served by public cleaning service. Thus, the generator is failing to fulfill its responsibilities and yet socialize with the community the costs of its failure.

Links to other Schemes under ISWM Plan for NH

This scheme is linked with the other following schemes of ISWM:

Establishment of Waste Inventory Cell;

Development of Local Policy Framework on Segregation and Collection;

Development of Awareness Raising Tools for Waste Management;

Recuperation and Adequation of the Central for inert material (C&D) "Aterro do Lima" in the Rondônia district;

Pilot Projects for Recycle and Reuse of Waste;

Upgrading of Transfer Stations for Material Recovery with a concept of an Eco District.

2.5 Pilot Projects for Recycle and Reuse of Waste

Introduction

Recycling plants have been gaining ground in Brazil and, when inserted into appropriate public policies, have contributed decisively to the solution of urban impact and cost generated by the disposal of waste. Despite this growth trend, the lack of government encouragement and investment in applied research, have led to the recycling industry in Brazil to import waste. Only in 2008 were imported 14 thousand tons of PET (Limpeza Pública Magazine, Ed. 71, 2009).

According to "*Entrepreneurs of Garbage*" (Márcio Magera, 2005), the waste in Brazil is still considered a problem of public authority and not an environmental problem that concerns the whole society. It also says, "the policy to be adopted for the survival of cooperatives is much more complex and demands the adoption of professional management, using technological resources and technically trained staff to work with waste, with the participation of society ...". We conclude therefore that the recycling of post-consumer materials, for processing into other products, should be a better option explored as a viable business activity, integrated into all sectors of society, given the volumes involved, the economy and rationalization of natural resources, energy and value-added materials and the environmental impact caused by its non-rational disposal after use.

In this context, pilot projects suggested here, would involve institutions that through their skills and knowledge, may

contribute to the local recycling chain went out of "limbo" up to a professional market with high added value and earnings consistent with other more developed markets.

Purpose

Development of Pilot Projects that will generate new business for the local recycling market, based on local market and laboratory studies.

Targets

Identify and test technologies for recycling and recovery of materials;

Bringing research institutions of the local community needs;

Understand recycling as an industry and business, therefore, a source of employment and income.

Type

Institutional Strengthening. For each project, include the partnership between the municipality, universities and business organizations, according to the waste stream.

Lead Agency

NH Municipality Local Government.

Support Agency

Universities, Union of Industries, Cooperatives, SENAI (National Service to Support Industry), SEBRAE (The Brazilian Service of Support to Small and Medium Business), and others.

Location (suggested)

Labs of Universities and municipal departments.

Budget (estimated)

The budget would be allocated through several lines of research from federal government and industries. For example, in research of recycling of polymers, a plastic industry or its national union. Institutions such as Sebrae and Senai would care for the training of the cooperative on business management and entering it in the local cluster.

Time Frame (estimated)

Two years from the cooperation agreement signed.

Implementation

The implementation of this scheme would be facilitated by NH Municipality through arrangements to setup for each project a cooperation agreement between the university, Sebrae/Senai, industry and/or association, having as the object of study a local recycling cooperative.

Possibility for the use of less sophisticated technologies for materials more available in the waste generated in NH, existence of demand and acceptance in the local market for products made from these recycled materials and present a viable route from a business and eco-friendly, are the ultimate goals of the pilot projects. As a reference, some Brazilian experiences existing are described below.

a) Recycling/Reuse of C&D waste

The recycling of construction and demolition waste in Brazil is very early, reducing to some local initiatives. One major example is the city of Belo Horizonte, where the recycling of CDW has as its principal use as a base for paving. According to the municipality, the cost of production of paving with the use

of aggregate from the town is about 22% less than conventional. Moreover, before the installation of recycling plants, the annual cost of removing debris resulting from clandestine deposition was the order of 1 million dollars. Recycling in the form of aggregates is most widely used form of CDW recycling in Brazil. The properties and application of alternative recycled aggregate will depend on the composition and content of the waste used. Recycling can be implemented as a single dominant phase, as in the case of recycled aggregate concrete (containing only concrete) and recycled ceramic aggregates (containing only red and white pottery). A second alternative is the generation of CDW recycled aggregate mixed by simultaneous processing of waste mortar, red tile, white ceramic, concrete, rocks, and others. Depending on the size of the municipality, may be interesting that the steps of sorting, recycling and landfill are met in the same installation. Recycling plants in Brazil, in general, are not configured this way (*SIMPEP XIII - Bauru, SP, Brazil, 06 to 08 November 2006: Management of construction waste - an introduction to the legislation and implementation - Authors: Karina Ivy Wiens and Jorge Hamada / UNESP*).

b) Recycling/Reuse of Plastic (Polymers)

Solid municipal waste contains a large volume of polymers and its final disposal is a serious environmental problem. Consequently, the recycling of the principal polymers present in the solid waste is an alternative. Among the main applications of recycled polymers in Brazil are the household appliances. The recycled PET is used as textile fiber (41%), non-woven blankets (16%), cords (15%), unsaturated resins (10%), packaging (9%), bristles brooms and brushes (5%) and other products (4%).

According to research on the Index of recycling in Brazil, carried out by *Plastivida* (trademark owned by ABIQUIM - Association of Chemical Industries) and published in 2008, the idle capacity of recycling can be translated by the lack of effective action by the Municipality. In Brazil, among the 5,564 municipalities, only 7% have selective collection. The research also shows that in Brazil there are only 780 industries of recycling plastics and nearly half of them are located in the state of Sao Paulo. The breakdown by type shows: 510 (65%) are recycling companies, in other words, sell just the plastic material; 126 (16%) are recycling companies vertical in sorting; 110 (14%) recycling companies vertical in processing; and 34 (4%) recycling companies vertical in sorting and processing. Currently, the annual growth rate of the recycling companies is 14.6% and direct employment is 17.4%.

In 2007 the consumer goods were that more demanded recycled plastic. Goods Semidurable: 52.3% (household appliances, textile industry, toys, disposable, cleaning, shoes and accessories); Durable Goods: 18.7% (automobiles, electronics and furniture); Agriculture: 9.6%; Construction: 11.9%; Other applications: 7.5% (source: IBGE - Brazilian Institute of Geography and Statistics).

The reuse or returning of packages, the recovery of resin constituents of plastic materials, energy recovery, in that order, are presented as recyclable plastic processes with contextualized effort in the world , requiring the relevant legislation, implementation of appropriate technologies and environmentally sound as well as integrated efforts of

governments, society, research institutions and companies, as pointed out by the study of *Plastivida*.

Challenge

Cooperation from all stakeholders.

Benefits

Contribute to a better planning strategies that facilitate the implementation of recycling business, making this implementation more professional, cheaper and with greater chances of success;
Creation of jobs with the possibility of better remuneration.

Links to other Schemes under ISWM Plan for NH

This scheme is linked with the other following schemes of ISWM:
Development of Local Policy Framework on Segregation and Collection;
Establishment of Waste Inventory Cell;
Development of Awareness Raising Tools for Waste Management;
Upgrading of Transfer Stations for Material Recovery with a concept of an Eco District.

2.6 Implementation of Voluntary Collection Points (Ecopoints)

Introduction

As the city of Novo Hamburgo has no licensed area available for deposition of C&D Waste from small generators as well as for bulky waste, is common the population dispose demolition debris and furniture anywhere, dribbling the surveillance of public control. The individuals are disposal this type of waste in irregular areas, modifying the landscape along of secondary roads, without concern regarding the existence of hazardous material or not. As showed in the pictures below.



Discard of residential waste on vacant lots between houses



Discard of residential waste along of secondary roads



Discard of residential waste inside the C&D waste containers (*papa-entulho*)

Purpose

Implementation of Voluntary Collection Points (Ecopoints) for small generators to ensure a reduction in waste disposal in irregular

areas, and also to support the Development of Construction and Demolition (C&D) Waste Management Program.

Description

The Ecopoints are sites for voluntary discard, available to the population of Novo Hamburgo with no cost, in which the residents throw small quantities of construction and demolition waste and useless objects, including clean recyclable materials. They are distributed by the city through its Sub-Secretariat (north, south, west, east), in the case of known points and easy access by the population.

Target

Give to the population of NH the appropriate infrastructure to support policies and projects of segregation at source and proper and safe disposal of household waste.

Type

Project.

Lead Agency

NH Municipality.

Support Agency

Vega Environmental Engineering was hired for implementation, operation and maintenance of the Ecopoints.

Location (suggested)

The Sub-Secretariats of NH Municipality.

Budget (estimated)

For the first year R\$287,931.80 (USD143,965.90) and monthly cost R\$28,793.18 (USD14,396.59).

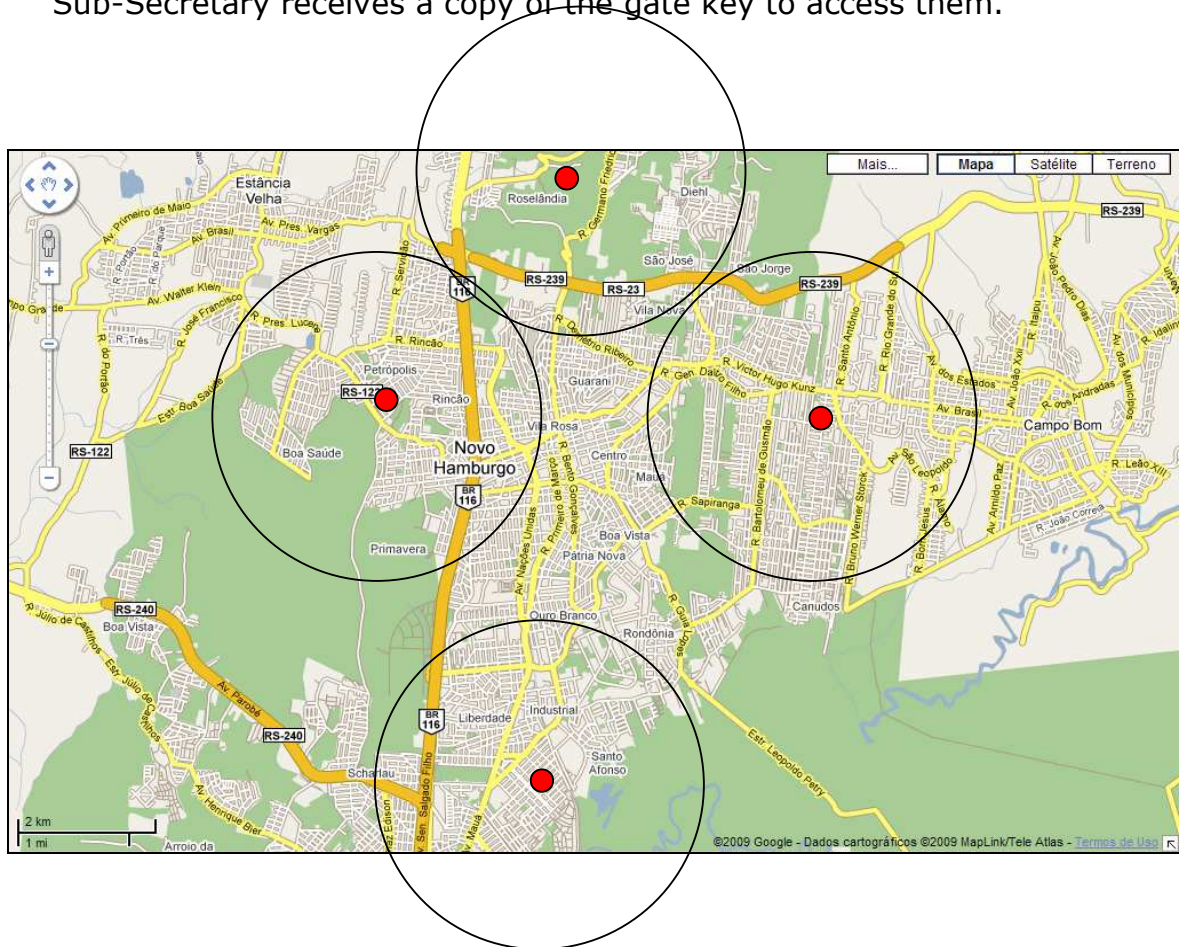
Time Frame (estimated)

6 months.

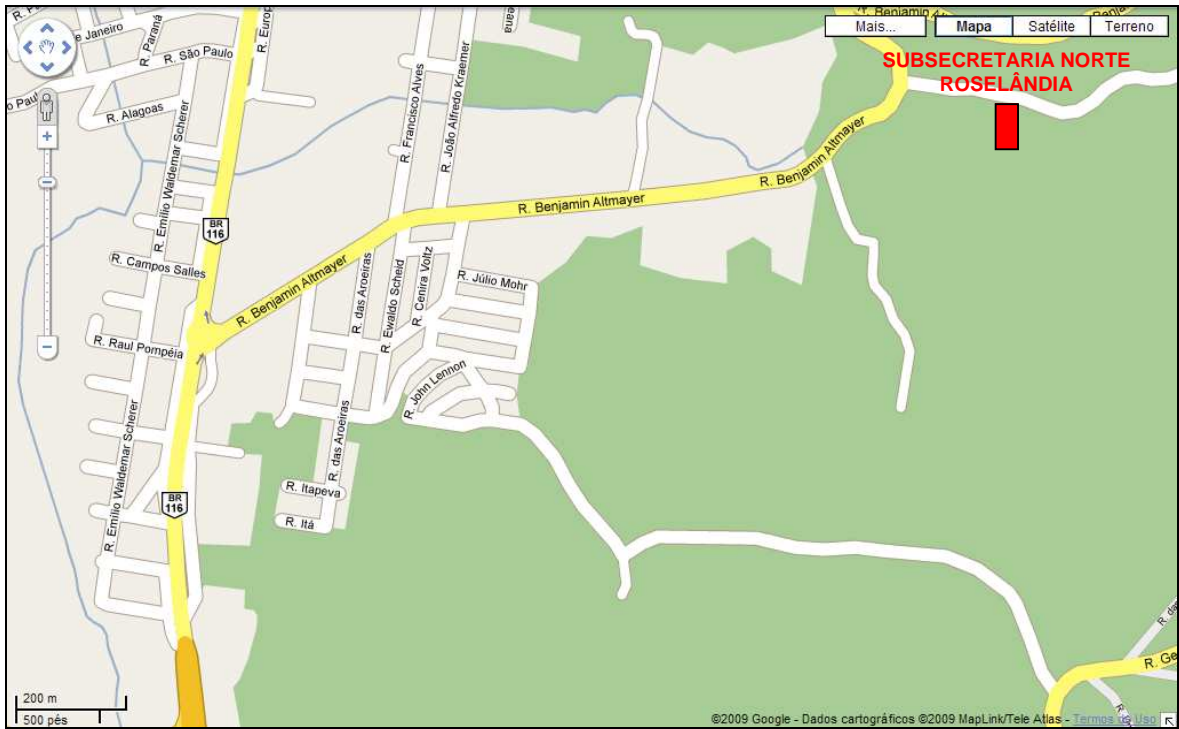
| Activity | Jan-Feb | Mar-Apr | May-Jun |
|--|---------|---------|---------|
| Construction of the infrastructure of the 04 Ecopoints | | | |
| Appreciation from NHM | | | |
| Development of tender documents to acquire the appropriate containers and implementation of logistics to transport the waste to the proper destination | | | |

Implementation

All Ecopoints have to be part of the Sub-Secretariat, but with independent entries, thereby avoiding any kind of flow, or persons, or vehicles. As the Ecopoints are part of the Sub-Secretariat, each Sub-Secretary receives a copy of the gate key to access them.



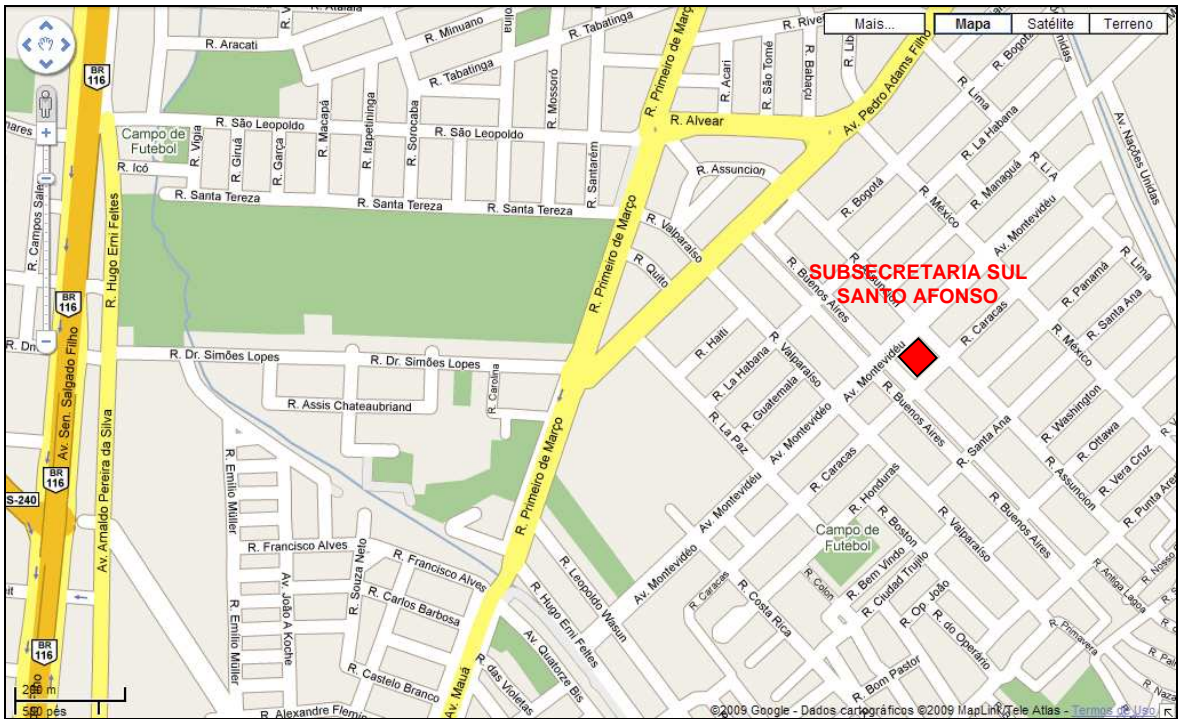
Location of the four Sub-Secretariats



Location of SUB-SECRETARIAT NORTH – ROSELÂNDIA (Rua Benjamin Altmayer, n.º 1.501)



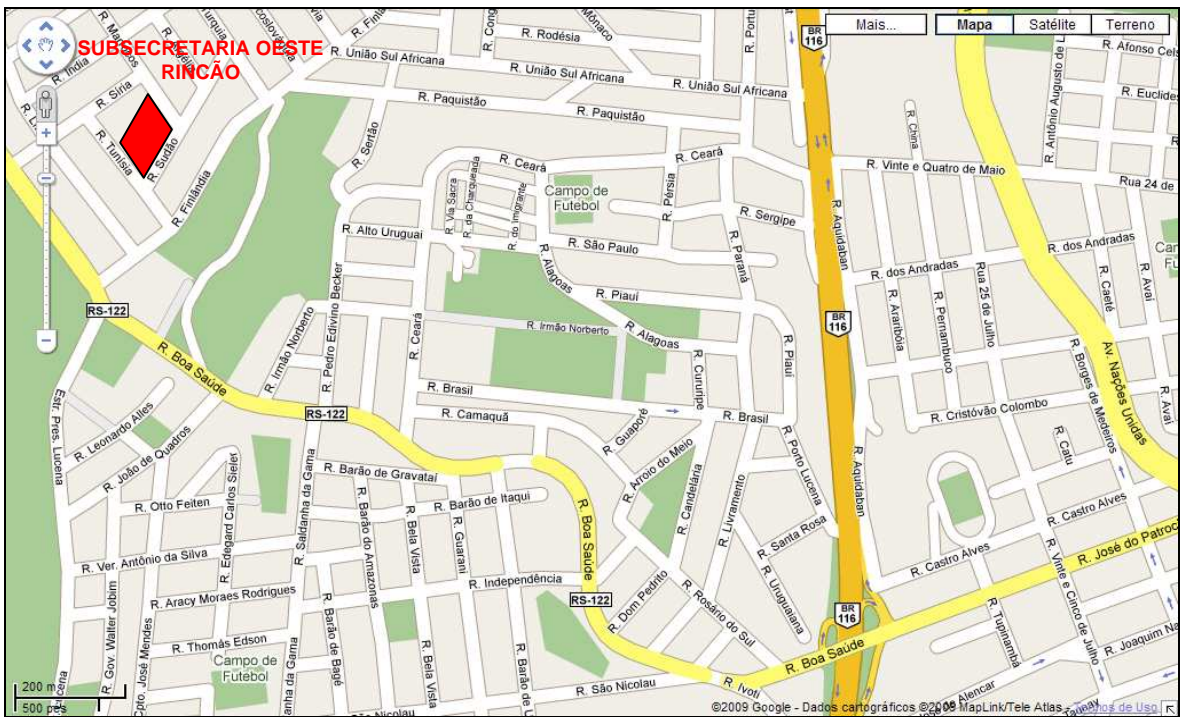
Area available at SUB-SECRETARIAT NORTH



Location of SUB-SECRETARIAT SOUTH - SANTO AFONSO (Rua Montevidéu, s/nº.)



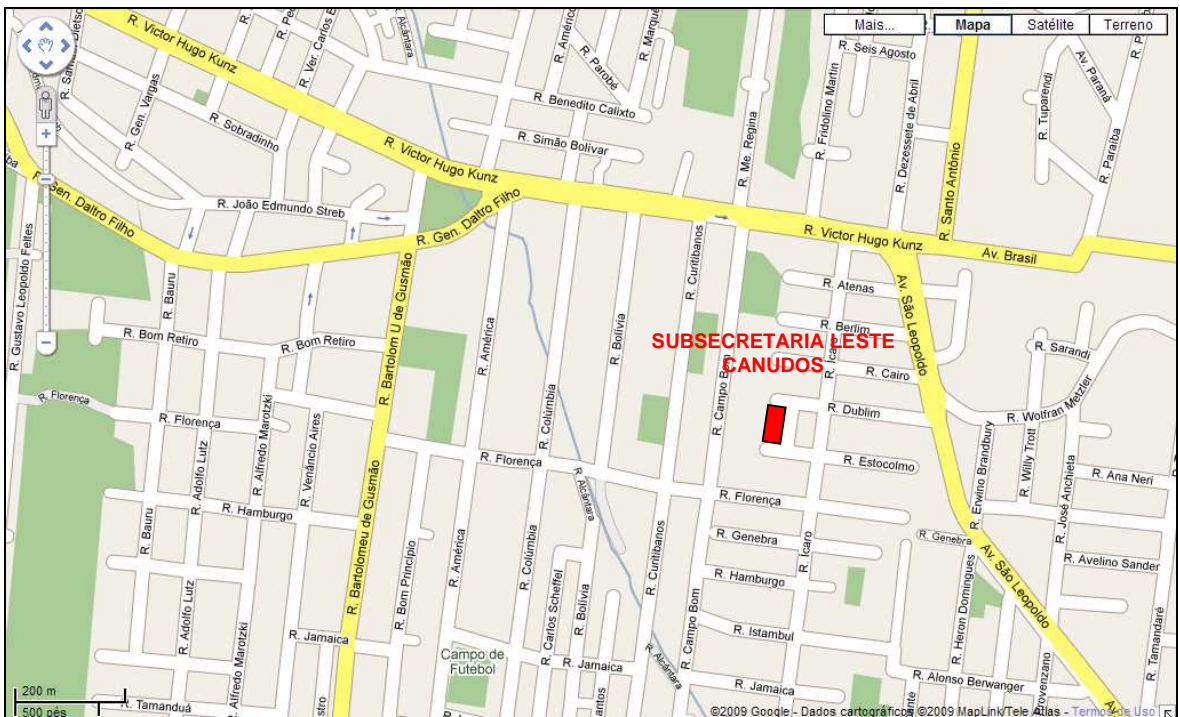
Area available at SUB-SECRETARIAT SOUTH



Location of SUB-SECRETARIAT WEST - RINCÃO (Rua Marrocos, nº. 100)



Area available at SUB-SECRETARIAT WEST



Location of SUB-SECRETARIAT EAST - CANUDOS (Rua Dublin, nº. 809)



Area available at SUB-SECRETARIAT EAST

Benefits

- Reduction in waste disposal in irregular areas;
- Contribute to keep the city clean;
- Prevent public health problems due to the presence of vectors in the waste accumulated in the outlying streets;
- Reduce cost with street cleaning;
- Encourage people for segregation and disposal of household waste properly.

Links to other Schemes under ISWM Plan for NH

- This scheme is linked with the other following schemes of ISWM:
- Establishment of Waste Inventory Cell;
- Development of Local Policy Framework on Segregation and Collection;

Development of Awareness Raising Tools for Waste Management;
Development of Construction and Demolition (C&D) Waste
Management Program.

2.7 Feasibility Study for Decentralized Sorting Plants

Introduction

Over the years, as a result of rising unemployment in the region, the collection of dry garbage in the streets of NH has become a common practice, causing inconvenience to traffic, mistreatment of horses pulling the carts, the driving often is done by children who should be in school. Also common are the scavengers that use small metal cars pulled by themselves, causing dirt on the streets due to the selection made in the garbage cans.

Although the city has a Central Sorting Plant at the Transfer Station *Roselândia*, the main point to be considered in the implementation of selective collection in NH is this informal gathering, held by approximately 300 scavengers and 200 carters, who collect recyclables such as cardboard, paper, PET bottles and other materials to be selected in the backyard of their home villages located in the periphery, making the municipal collection ineffective, as when the collection truck passes, much of the waste has already been taken by the informal gathering.

The recyclable material collected by pickers is stored for days, waiting to be sold to middlemen, priced below market. The non-recyclable wastes remain close to the homes of the pickers and teamsters. Added to poor sanitation conditions existing nurture the proliferation of vectors of infectious diseases. In almost all irregular housing units and districts of low economic class, the selling of recyclable material is a source of income, often the only form of livelihood of many families. One of the places of greatest

concentration of this type of activity is the *Vila Palmeira*, in *Santo Afonso* district where most residents subsist of this activity.

In this context, actions are necessary to maintain this activity, but in an organized and regulated manner, with training of human resources in order to provide higher income and social inclusion of waste pickers and their families by offering alternatives such as building of sorting plants with an appropriate management model.

Purpose

Implementation of Sorting Plants for Recyclable Waste in predetermined areas of the city, to organize and regulate the activity of scavengers, providing more income.

Target

- To develop a social inclusion program for families who make a living out of the sorting activities;
- To encourage establishment of recycling business;
- To increase the amount of waste recycled/recovered;
- Formalize waste collection held by the scavengers, avoiding competition with the municipal collection.

Type

Project

Lead Agency

NH Municipality Local Government

Support Agency

An outside organization or a consultant could be hired to develop a feasibility study for setting up the Decentralized Sorting Plants. The feasibility study would also include the recommendations on preferential location and infrastructure for sorting process.

Location (suggested)

The four Sub-Secretariats may be a reference for location.

Budget (estimated)

The real estimates could only be available after the feasibility study. The budget would be allocated through several lines of social programs from federal government and private institutions. For feasibility study, the budget estimated is about: R\$40,000 (USD 20,000).

Time Frame (estimated)

6 months.

| Activity | Jan-Feb | Mar-Apr | May-Jun |
|---|----------------|----------------|----------------|
| Identification of the areas and registration of the local scavengers | | | |
| Assessment of existing technologies and identification of appropriate type for local conditions with techno-economic study | | | |
| Comments from NHM | | | |
| Development of tender documents to acquire and implement the appropriate technology | | | |

Implementation

Through joint action of several Municipal Secretariats, Union of Community Associations and the Trusteeship Council, the activity of scavengers and carters will be regulated, and the organization of cooperatives will be stimulated. The municipality shall provide to the cooperatives, sorting plants and marketing of recyclable material around the neighborhoods where they live, besides a social inclusion program for families who have your way of life in this activity.

The Federal Government through the Ministries of Environment, Cities and Health, finances infrastructure projects, in the area of solid waste. The resources are from the Union Budget (fiscal sphere, parliamentary amendments), or from multilateral credit agencies - FGTS, CAIXA and BNDES - by means of credit lines. The release of resources of the institutions of the federal government for municipalities shall be subject the existence of legal instruments to regulate and charge for services, and as a specific budget to cover the operation of the units deployed as way to ensure the sustainability of the system. That sustainability should be seen in a comprehensive manner involving the environmental dimensions, social, cultural, economic, political and institutional. This means involving the legislative and local communities in order to obtain the resources and ensure continuity of activities, identify technologies and appropriate solutions to the local reality.

Benefits

Following benefits are anticipated from this scheme:

- Stimulate the organization of cooperatives;
- Inclusion of families that have in this activity your livelihood;
- Better income with the direct commercialization of the recyclable material;
- Control of proliferation of biological vectors (flies, mosquitoes, cockroaches and rats) of great significance in the transmission of infectious diseases;
- Improvement of public health across the peripheral districts;
- Generation of direct and indirect jobs;
- Technical training for operational staff who will operate these systems.

Links to other Schemes under ISWM Plan for NH

This scheme is linked with the other following schemes of ISWM:

Development of Local Policies on Segregation and Collection;
Development of Awareness Raising Tools for Waste Management;
Supply of Waste Bags for Segregation of Food Waste;
Construction/Provision of Collection Points;
Pilot Projects for Recycle and Reuse of Waste.

As a reference, the concept of “Ecosol” Dry Waste Sorting Plant is described below:

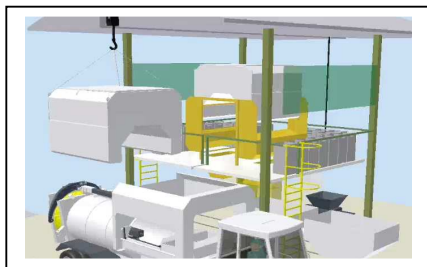
The sorting plant of dry waste is a vertical construction of two floors that receives the containers with recyclable waste and that automatically directs the waste to a sorting platform.



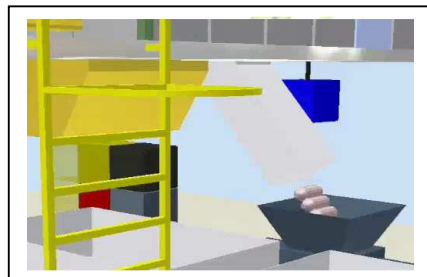
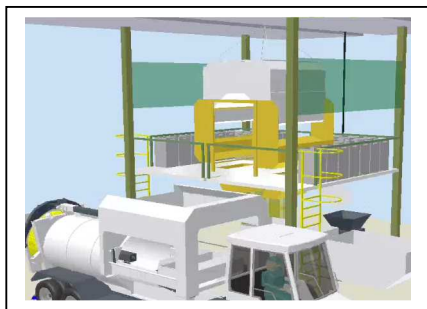
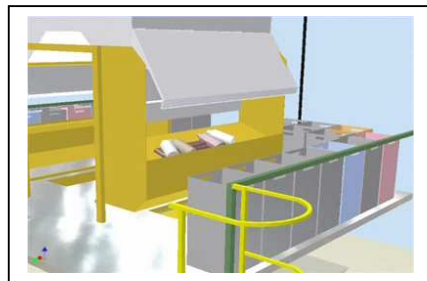
Metal structure of steel A36; Roof: 8.5m x 15.0m (127m²); Overall height: 7.50m, 2nd floor: 6.5m x 6.5m (42m²); height of 2nd floor to the ground: 2.90m; Equipment Standard: 02 containers of 8m³; Sorting Equipment, Electric Hoist with 3 ton capacity; Internal light; Internal system of water and sewer.



The system platform enables operators to make an efficient selection. The residues selected are driven by gravity to the presses and the remains and liquids are conducted to appropriate containers.



The whole process is extremely hygienic and offers full protection to operators, allowing the installation of the plant near the urban area.





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