Legal framework and siting strategy for future landfills in the Buenos Aires area

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Executive summary

About 13,000 ton/day Urban Solid Waste, generated by 13 mio people living in the City of Buenos Aires and surrounding municipalities in the Metropolitan Area, is disposed at three Sanitary Landfills located in the Metropolitan Area.

More disposal capacity is needed in the near future and due to the high urbanization and dense population in the Metropolitan Area, the new Sanitary Landfills have to be located in other municipalities of the Province of Buenos Aires, maybe up to 200 Km from the City of Buenos Aires, to be able to find adequate site locations, where the required permits can be obtained.

This Paper presents the applicable legal framework and methodology that could be applied in the identification and selection of the most adequate locations for the future Sanitary Landfills in the Province of Buenos Aires and in the obtainment of required permits and habilitation.

Primary consideration is directed to the legal framework in Argentina and the present situation regarding handling and final landfill disposal of Urban Waste in the Province of Buenos Aires in general and more specifically in the City of Buenos Aires and the Metropolitan Area.

Parallel consideration are taken as reference, to the criteria and standards for the disposal of waste by landfill and to the strategies and experience regarding prevention, recycling and recovery of Urban Solid Waste in the European Community and to the competence and participation of regional and national authorities in specific EC member as e.g. Denmark

Introduction

Since 1978 and according to (Decreed Law 9111) CEAMSE "Cinturón Ecológico Area Metropolitana Sociedad del Estado" is responsible for the operation of the sanitary landfills used for final disposal in sanitary landfills of the urban waste generated by 13 mio. people living in the City of Buenos Aires and the surrounding 34 municipalities forming the Metropolitan Area in the Province of Buenos Aires The area generates approx. 13,000 ton Urban Solid Waste generated pr. day.
For the final disposal of the generated urban waste that can't be re-used or recycled, CEAMSE presently operates three disposal centers located in the Metropolitan area:

- "Norte III" located in the Municipality of General San Martín
- "Gonzáles Catán" located in the Municipality of La Matanza
- "Ensenada" located in the Municipality of Ensenada

A fourth landfill "Villa Domínico" located in the Municipalities of Avellaneda and Quilmes was closed in 31. January 2004.

In line with CEAMSE's management plan, CEAMSE has during the last years attempted to establish new disposal facilities in the Province of Buenos Aires, far away from the Metropolitan Area and other urbanized and dense populated zones.

During that process locations in 8 Municipalities in the Province of Buenos Aires were identified, some of them located up to 150 Km from the Metropolitan area. Until now these locations were all dismissed due to the massive protest of the inhabitants of the Municipalities and zones where the new landfill where proposed to be established.

The experience made so far by CEAMSE shows, that it is very difficult and time consuming to identify and obtain the approval of new landfill sites located in the Province of Buenos Aires, for the disposal of urban waste generated in the Metropolitan area.

This Paper presents the applicable legal framework and a methodology that could be applied in the planning and the identification and selection of the most adequate locations for the future Sanitary Landfills in the Province of Buenos Aires and the obtainment of required permits and habilitation.

**Applicable legal framework in the Province of Buenos Aires**

A requirement of minimum budget for environmental protection an integral management of urban waste for all Argentina provinces was established in August 2004 (National Law 25916). Objectives of this national law are: reduction of generated waste, re-use and recycling of waste, minimization of the volume of disposed waste, reduction of associated environmental risk and reduction of municipal costs for transfer, treatment, transport and final disposition of the waste.

Minimum requirement for the final disposal of Urban Waste in the Province of Buenos Aires, for the Municipalities not included in (Decree Law 9111), are defined in (Resolution N° 1143/2002). Different design and monitoring requirement are established in this resolution for sanitary landfills depending on the amount of received waste being more or less than 50 tons Urban Waste per day.

The Governor of the Province of Buenos Aires Felipe Solá presented on the 29th of March of 2005 (Law proposal for Integral Management of Urban Waste) based on the norms established in (National Law 25.916).

According to this Law Proposal Integral Management of Urban Waste includes to adequately treat and dispose the waste in a way, that is environmentally sustainable, technically and economically feasible and socially acceptable.
Main issues of the proposed Law are:

- Gradually incorporation of the valorization, reutilization and recycling in the integral management of waste in all the municipalities of the province of Buenos Aires.
- The municipalities of the Province of Buenos Aires will have to elaborate a program for integral management of the urban waste according to the (Proposed Provincial Law) and (National Law 25916).
- CEAMSE will have to present a plan regarding the final disposition of waste for the municipalities included in article 2 and 4 of (Decreed - Law 9,111/78) and for the Municipalities who has signed agreements with CEAMSE according to article 67 of (Law 11,723).
- These programs shall be approved by the Authority of Application of the Province of Buenos Aires, who are responsible for protection of the environment in the Province.
- For approval of the presented programs the Authority of Application will evaluate its environmental impact according to (Law 11,459 and its Regulation Decree 1741/96) it's technical and economical feasibility, its costs related to the environmental and social benefits, and its social acceptability. After approval the program shall be implemented over a period of maximum five (5) years.
- Municipalities linked to CEAMSE according to (Decree - Law 9,111/78) will have one year from the approval of the program to confirm it's adhesion to CEAMSE. If the Municipality do not confirm it's adhesion it will have to present and achieve an approval of it's own program for Integral Management of Urban Waste, specially regarding the final disposal of it's urban waste.
- The Programs for Integral Management of Urban Waste presented by the municipalities must ensure the elimination of uncontrolled disposal of waste in dump sites.
- The municipalities will be obligated to close the existing dump sites according to the provincial (Law 11.723) and the Regulation of the Proposed Provincial Law).
- The Authority of Application of the Province of Buenos Aires will propitiate regional agreements between municipalities to take advantage of scale economies in the Integral Management of their Urban Waste and advance with regional mechanisms of development in the Province.
- The Programs for Integral Management of Urban Waste include the selection of the sites for final disposal of the waste, which can be individual or regional including several municipalities. In the case of jurisdiction and / or regional ambit that cannot comply with the requirement of the proposed law regarding the localization of the sites for final disposal of Urban Waste, a special law will determine the location of the sites.
- The Authority of Application of the Province of Buenos Aires will define the technical guide lines and methodology for the location, design, operation, closure and post closure of sites for final disposition of Urban Waste, according to the regulation of the proposed Law and will be in charge of the control and inspection of these disposal facilities.
- The Authority of Application of the proposed Law will be the organization with major hierarchy on environmental issues in the Province of Buenos Aires (For the time being the "Secretaría de Política Ambiental de la Provincia de Buenos Aires"), who will control the action performed by the organizations responsible for the programs for integral waste management, by means of monitoring, audits or other action it may consider required according to the norms of the proposed Law.
Basic considerations and strategy for siting and approval of new sanitary landfills

There is worldwide an increasing need for sustainable and coherent solutions to the problems related to the management and handling of Urban Waste.

Coherent schemes for collection, treatment and final disposal of waste are needed in all the societies to avoid that the residue are transformed into an always increasing problem. These schemes must include technical solutions, organically and financially viable and adjusted to the users need.

The sanitary landfill is the end station of urban and similar industrial waste that canot be re-used, recycled, composted or further treated to reduce its volume and/or potential risk to humans or the environment. The sanitary landfill is therefore and will continue to be, an essential and indispensable component for the management and handling of solid waste in all the societies of the world.

The disposition of urban waste with high organic content in sanitary landfills, is world wide the typical situation and this situation will continue for many years in the majority of the countries including Argentina. The reason being, that, it takes time to implement national strategies for progressive reduction of the biodegradable fraction of urban waste disposed in sanitary landfills, by means of recycling, composting, biogas production or recuperation of materials and energy, as it has been imposed the members of the European Community, (Council Directive).

A sustainable solution for disposal of the waste can be defined as a situation, where each generation takes care of their own waste, without leaving obligations or risks to their successors. This will imply that no more than 30 to 50 years from the closure of a landfill, the disposed waste must be leached and decomposed to such a state, that the generated leachate can be discharged directly to the recipient. The present conditions in Argentina with disposition of urban waste with organic content and the operation of the landfills is not sustainable.

The total period of time necessary for leaching and decomposition of the waste depends on a number of factors, including the liquid / solid (L/S) relation, where L is the volume of water percolating through the unit weight S of residue. It has been estimated (O. Hjelmar et al., 1995), that for urban waste an L/S value of 3 to 4 m³/ton is needed to reach the required level of stabilization of the waste that permit a direct discharge to the recipient without treatment of the leachate in terms of COD, TOC and total nitrogen. For AOX an even higher total percolation may be required.

Rough estimates has been made in the European Community of the minimum time required for the stabilization of urban waste in sanitary landfills with a filling high of 12 m for different volumes of leachate generated by year expressed in mm/year (pending mainly on the type of final cover and the annual precipitation) and it has been found that:

- For 200 mm/year leachate production the stabilization period is at least 300 years
- For 400 mm/year leachate production the stabilization period is at least 150 years
If the average height of the sanitary landfill is exceeding 12 m and/or the volume of generated leachate is less than 200 mm/year the minimum stabilization period will be more than 300 years.

The philosophy of land filling and the approach to reach the required stabilization of the disposed waste in the European Community varies between Members States. Some States (e.g. Germany and Denmark) attempt to limits the contamination potential of the waste by reducing the content of degradable and/or soluble component prior to disposal, whereas other States (e.g. United Kingdom) attempt to exploit the processes of "biological reactor landfills".

The "biological reactor" attempt to optimize the conversion of the disposed organic waste, reducing its organic content and promoting the generation and extraction of gas. After a 30 year aftercare period - as established in (Resolution 1,143/02) - and operated as biological reactor the potential of contamination from a sanitary landfill with organic waste will be significantly reduced. It may however still be necessary to maintain the active system of contention, with collection, recirculation and/or treatment of leachate, in order to avoid an inadmissible impact on the groundwater and comply with the permissible discharge of liquid effluent to the recipient.

This could be the case if the sanitary landfill operated as a biological reactor is located in an area where there are significant and/or vulnerable groundwater resources and/or were the surface recipient is a lake or stream with reduced flow and consequently reduced dilution capacity.

If the landfill operated as an biological reactor is stead is located in an area where there are no significant groundwater resource and/or were there is a close located recipient of great volume and/or flow as the Río de La Plata or the sea with great dilution capacity, it may it be possible to stop the active systems of contention of the landfill after 30 years operation.

It is the natural condition at the selected site, as the extension and depth of low permeable geological formation, and the design of the landfill tailored to this natural existing condition, that ensures, that the landfill poses no potential hazard to the environment.

Considering the effect of the environmental impact that can be irreversible, one of the main environmental concern related with the establishment of a sanitary landfill, is the potential risk of contamination of useful aquifers and groundwater recourses due to adverse natural conditions at the proposed site.

It can be argued against this concern, that with the existing technology and active systems of contention of the residues and collection and treatment of leachate, there will no risk of contamination of the groundwater resources. As the present situation of disposal and operation of the landfills in Argentina may result in aftercare periods in excess of 150 - 300 years - as mentioned above - the systems then would be required to operate in that same period. And no one can guarantee that a geomembrane and/or a drainage layer with drains for collection of leachate, that can't be inspected or repaired without excavation of the disposed residue that covers it, will be intact and comply with it's functional requirement during such a period.

According to (Resolution 1143/02) an Environmental Impact Assessment (EIA) shall be made for the proposed sanitary landfill according to the requirement of Annex 4 of
(Regulation Degree No 1.741/96) of (Law 11,459). However, the indicative content for the EIA presented in Annex 4 is directed at industries - not landfills. The singularities and the must important aspects to be considered and evaluated in the selection of a landfill site to be included in the EIA have not been contemplated.

Important aspects that must be included in the EIA of a sanitary landfill, that have not been contemplated in this Annex 4, are:

- Presentation of alternative handling system of the waste (waste prevention, recycling, recovery, composting) that has been contemplated, and that justify the need of construction of new sanitary landfills
- Presentation of the alternative location that has been evaluated and compared as a basis for the selection of the most appropriate site proposed
- Description of the consequences if no new landfills are constructed (0 alternative)

**Institutional and operational dimensions**

Safe handling and disposal of waste is not only a question of technical and economical feasibly solutions. The elements in a modern Solid Waste Management (SWM) include both:

Institutional dimensions as

- Waste strategy and policy
- Administration of waste strategy/policy and legislation
- Organization/procurement of waste management services

and operational dimensions as

- Physical system design and day to day operations
- Economics and financing
- Environmental impact from handling and disposal operations

In each circumstance the mentioned dimensions are in practice influenced by a number of external and local enabling or inhibiting factors covering

- Physical environment
- General economic setting
- Culture and traditions

Modern urban and industrial waste management integrate all the mentioned dimensions and the external factors when identifying most appropriate future waste management solution for the local society.

The historical development to an integrated solid waste management system and the competence and participation of regional and national authorities in a specific EC member state e.g. Denmark is presented in the following as an example.

In the first Danish Environmental Protection Act issued in 1974 was it stated that the municipalities were responsible for handling and disposal of municipal waste. The regional authorities (counties) became responsible for regional solid waste management planning covering both municipal and industrial waste (first generations plans). The aim of this plans
were to identify the most feasible treatment technologies and the most appropriate location of treatment and landfill facilities.

In 1982 plus 1986 amendments to the Environmental Protection Act stated that detailed waste surveys should be made by the local authorities ending up in second generation waste management plans on county levels. Based on these regional county plans, each and every municipality should prepare a municipal waste management plan for municipal and industrial waste.

In 1989 the municipal responsibility was extended to include a duty to assign disposal facilities for all waste generated within the municipal boundary. Parallel to this assignment duty the waste producer was given duty to utilize the assigned disposal facility.

In 1993 the third generation solid waste management planning was initiated by issuing a new ordinance stating that each municipality should revise the existing waste plans. These new plans should adopt objectives and strategies in a national waste policy and action plan based on the EU waste directive (91/156/EEC).

During the period 1974 - 1994, 34 intermunicipal waste management associations were formed and a number of new modern and centralized treatment and sanitary facilities were constructed and operated by these organizations. The waste associations were formed as a result of the first generation regional waste management plan. Before 1979 the major part of the waste was disposed on individual small landfills (approx. one landfill per municipality). To day there remains almost only regional landfill serving the municipalities of the region, this development was the natural consequent of more stringent requirement to the design and operation of the landfills and due to the advantage of economies of scale associated with regional waste management schemes. The intermunicipal waste management associations were formed as entirely public owned non profit organization with separate technical administration and political board.

The intermunicipal waste associations in Denmark are primarily responsible for treatment and disposal of waste. Considering collection of waste and recyclable materials, each municipality is responsible for providing this service to the households. The majority of municipalities are having private enterprises to take care of the collection services.

The "monopoly" on public ownership and operation of waste treatment services is now being challenged by private waste contractors wishing to be involved in treatment and disposal of municipal and industrial waste. In the coming years it can be expected that such private waste contractors will be involved in especially construction and operation of waste to energy facilities and of composting/recycling facilities.

The principal objective of Danish waste policy is to reduce the amount of waste and the environmental burden resulting from its disposal.

The priority in waste disposal is adopted from the EU waste directive saying:

- **Priority 1**: Waste prevention through cleaner technology
- **Priority 2**: Recycling through re-use and materials recovery
- **Priority 3**: Energy recovery for energy production of non recyclable waste
- **Priority 3**: Landfill disposal

Administrative tools for enforcing these priorities are:
- Duty for municipal authorities to prepare waste management plans for all generated waste
- Duty for regional authorities to locate and approve new landfill sites.
- Payment of a waste tax for disposing of waste on incineration plants or on landfills. No tax is charged for recycled waste
- Financial subsidy of certain recycling and cleaner technology projects.

The integrated solid waste management system and the competence and participation of regional authorities in a specific EC member like Denmark, is in line, with the main issues of the Law Proposal for Integral Management of Waste, presented by the Governor of the Province of Buenos Aires Felipe Solá (except regarding incineration of waste and payment of waste tax).

Criteria to be applied in the selection of the must adequate sites

As a first step in the process of selection of the must adequate sites for future sanitary landfills a list of criteria to be applied in the selection of these sites should be proposed by CEAMSE and agreed upon with the Authority of Application of the Province of Buenos Aires and other competent organizations at national, provincial and municipal level,

Relevant selection criteria to be included in this list are the following:

- There shall be no significant groundwater recourses that can be used for human consumption or irrigation at the site
- The natural conditions shall restrict the risk of inadmissible contamination of the soil and the ground and surface water around the landfill.
- The geological and hydrogeological condition shall be simple and well defined with extended and low permeable geological formations and good foundation conditions
- A limited number of sites with a large capacity resulting in more than 20 years life time shall be preferred with due consideration to the distance and transport possibilities of the waste
- Areas with low population density and large distance to existing or planed urbanized areas shall be preferred.
- Possibility, rentability and potential alternative use of the area shall be restricted
- The scenic impact of the landfill shall be limited

A comparative evaluation of the proposed sites can then be made using a rating system, where each of the above agreed issues for each site is given a rating using points between e.g. 0 and 5 (for instance max 5 when the site fully comply with the evaluation criteria and 0 when the site don’t comply at all with the evaluation criteria). Further the relative importance of each of the issues can be expressed by assigning an agreed weight to each of the criteria.

The sum of weighed points for each proposed site, resulting from the contemplation of all the criteria considered for each location, will then disclose which sites are the must adequate based on the agreed criteria of selection.

Preliminary identification of potential sites for the future sanitary landfills

As a first step the required volume and minimum area to be allocated for the sanitary landfill shall be established for each predefined region. .The Mayors of the municipalities of
the region and other competent organizations should then be asked to propose potential sites to be contemplated. Based on the knowledge CEAMSE already have regarding potential sites and the information provided by the Authority of Application of the Province of Buenos Aires, a general list shall be elaborated, listing potential sites located in the municipalities of the Province of Buenos Aires within a distance of 200 Km from Buenos Aires City.

The list generated on the above basis can then be complemented with potential sites expeditiously identified on the basis of available cartography, aerial photo and satellite images of land use in the region. Where it is considered appropriate can the so identified sites, be verified by aerial inspection and photos taken from helicopter or small airplane.

The sites in the rough list are then evaluated by application of the criteria that has been agreed to select the most appropriate sites. This evaluation is based on a visit of the proposed site and a systematic review of all the available information regarding biological, topographical, geological and hydrogeological condition, zoning and land use at each location and its surroundings. No field investigation or field measurements are assumed to be performed at this stage.

Other relevant aspects as infrastructure services including the transport distance and the availability and type of transport to each location, are also considered during this depuration process.

The result of the above evaluation of the sites in the first list, is a reduced list where only the potential sites to be further evaluated are included, with indication of the field investigation regarding the biological, topographical, geological and hydrogeological condition at each site and its surrounding, that are required to ensure an adequate level of reliability of the basic information been used in the selection of the most appropriate sites.

**Selection of the most adequate sites**

When the proposed field investigation has been completed a more depth and comparative revision of the suitability of each of the sites included in the reduced list shall be made. The result of this revision is an adjusted version of the reduced list, where the sites are presented in order according to their ranking of environmental suitability.

The most adequate sites, proposed for implementation of the new required sanitary landfills, are then selected based on this ranked list.

A report is elaborated as documentation of the selection process where all the evaluated sites are presented, as well as, the principal reasons that support the selection of the sites considered as most appropriate. This report is submitted to the Authority of Application and other competent authorities and organization, as well as, to the municipalities were it is proposed to establish a new sanitary landfill, for their information and eventual comments.

**Seminar for officials**

It is proposed to arrange a seminar for officials representing regional and local authorities, organizations, environmental entities and NOG in each of the municipalities where it is planed to establish a new sanitary landfill.
At this seminar all the evaluated sites that have been evaluated in the region where the municipality is located shall be presented in an open forum, showing their comparative suitability and the reason that support the construction of a sanitary landfill in this municipality.

The ideas and comments recorded at this seminar will be considered in the final selection of the must adequate sites for the future sanitary landfills to be established.

**Environmental Impact Assessment of the proposed new sanitary landfills**

As a basic document to obtain the required municipal habilitation and the approval of the Authority of Application of the Province of Buenos Aires an Environmental Impact Assessment (EIA) shall be elaborated for each of the new proposed sanitary landfills.

The EIA for each of the selected sanitary landfill will include:

- A description of the sanitary landfill, especially regarding configuration, dimension, main components, characteristic and contamination potential of the disposed waste
- A description of the principal alternative sites that has been evaluated and information about the reason that support the selected sites considering their impact on the environment. Presentation of evaluated alternatives of waste prevention, by recycling through re-use and material recovery and composting and the consequences if no new landfills are established (0 alternative)
- A description of the surrounding that can be significant affected by the landfill
- A description of the short and long term environmental impact of the sanitary landfill
- A description of the mitigation measures that has been foreseen in order to prevent, avoid and / or reduce the environmental impact of the sanitary landfill
- Guidelines for the operation instruction of the sanitary landfill
- Guidelines for the monitoring and control program of the sanitary landfill
- A non technical resume of the information presented in the above listed items
- Presentation of eventual deficiencies in the available information applied in the EIA

**Public consultation**

When the EIA has been completed is it proposed to arrange a public consultation in the municipalities where it is planed to establish a new sanitary landfill.

At this meeting the main content of the EIA shall be presented in an open forum and answers will be given to the questions presented by the public.

The seminar for officials and the public consultation constitute two necessary and fundamental events for an open and transparent information regarding the process of selection of the sites and for a public understanding and acceptance, that the new sanitary landfills are really required and to believe the selected sites in the respective municipalities are comparatively the must adequate and do not constitute a potential risk of inadmissible contamination and / or impact of the environment surround the sanitary landfills.

The seminar for officials and the public consultation are also two important events of reference in the procedure that must be followed to obtain the required municipal habilitation and the approval of the Authority of Application for each of the new selected sanitary landfill to be established in the Province of Buenos Aires.
Conclusion

The experience made so far by CEAMSE shows, that it is not an easy task to provide the required disposal capacity of urban waste for the metropolitan area.

Strategic planning and waste management that integrate both the institutional and the operational dimensions as well as the external and local factors must be applied when identifying the most appropriate future solutions for the society.

The governor of the Province of Buenos Aires Felipe Solá is consent that the solution of problems related to the management and handling of the urban waste in the Metropolitan Area and the Province of Buenos Aires cannot be further postponed and has on the 29th of Marsh of 2005 presented a visionary (Law Proposal)

The siting strategy presented in this paper for identification and selection of the must adequate location for the required future sanitary landfills in the province of Buenos Aires and obtainment of the needed permits and habilitation, are in line with the (Law Proposal) and the strategies and experience regarding prevention, recycling and recovery of urban waste in the European Community and duty of a regional authority to locate and approve new sanitary landfills.

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