

To Extend Useful Life of Toa Baja Municipal Solid Waste Landfill

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Abstract — *The objective of this project is to identify the main issues affecting Toa Baja Municipal Solid Waste Landfill and the reasons it is in the Environmental Protection Agency list for closure; and to provide some suggestions to extend the useful life of this landfill. This research is qualitative not quantitative; data was obtained from interviews, documents, field visits observations, on-line information and audiovisual materials. It is also retrospective because it relies on information already present. The analysis for this study will be examining the data available and trying to organize it in a logical sequence. A landfill is one of few systems for non-hazardous solid waste disposal in which the waste is buried between layers of earth to build up low-lying land, also called sanitary landfill. This method is the most common method of waste disposal but can create other issues like methane gas; liquefaction (condition where saturated or partially saturated soil substantially loses strength and stiffness) and soil and ground water contamination. Solid waste means any garbage and other discarded materials, including solid, liquids, semi-solid, or contained gaseous material resulting from industrial, commercial, construction, mining, agricultural operations and household. The solid waste could be divided into two areas; toxic or hazardous materials, and non-hazardous materials; and according to these two big classifications there are specific areas for final disposition and management. Leachate is the fluids from garbage placed on a specific area for a long time, which if percolate to the subsoil could contaminate the soils and ground water.*

Key Terms — *Compost, Composting, Landfill, Leachate treatment, Recycling, Solid Waste Management.*

INTRODUCTION

The problem statement for this research is to extend the useful life of Toa Baja Municipal Solid Waste Landfill (TBMSWL), located in the town of Toa Baja, Puerto Rico. The main objective is to identify the reasons why Toa Baja landfill is still in the EPA Closure Plan and provide some suggestions to extend the useful life of this landfill and avoid the total closure.

Garbage or solid waste disposal is one of the biggest issues in Puerto Rico for the last 20 years, not only because of the quantity and quality but also, most recently, because of sites available for waste disposal. The Environmental Protection Agency (EPA) and other government agencies regulate the use and operations of Puerto Rico landfills. Some landfills did not comply with the regulations due to different reasons and unfortunately, were closed; others are in the waiting list for closure soon because they are not in compliance with the federal law known as “The Resource Conservation and Recovery Act” (RCRA) [1].

Research Objectives

- Identify existing landfills currently operating on the island; their location, owners, and its corresponding daily capacity received on site, to have an idea how much solid waste is actually handled by landfills. Also, determine what other alternatives are available for waste disposal near Toa Baja if TBMSWL close completely.
- Find the actual solid waste load received in TBMSWL facility (Ton/day).
- Find typical problems encountered in daily operation on TBMSWL. Analyze such information and establish possible solutions to the problems.

- Provide recommendations in order to make improvements to this landfill.

LITERATURE REVIEW

In 2002 the Environmental Protection Agency started to engage directly in dealing with Puerto Rico landfills systems that were not in compliance with the federal regulations [2]. Since that year EPA continues to work closely with local agencies, including the Environmental Quality Board (EQB), to minimize the impact of these systems on the environment. Since 2002 EPA focused on four (4) aspects of landfills systems [2]:

- The closure of open dumps to protect human health and the environment.
- Implement recycling (Process of converting waste materials into new materials)
- Reduce greenhouse gases through collection of gases from landfills, control and energy recovery systems.
- Improve operations in landfills systems [2].

In 2005 John McPhaul, reporter from the *Caribbean Business*, posted an article [3] about the local Solid Waste Management Authority (SWMA) and the relationship with the Puerto Rico landfills. He reported that Puerto Rico SWMA will build new solid waste transfer stations (used to transfer solid waste to alternative landfill sites) “to compensate for the closing in the next five years of five solid waste landfills” (Aguadilla, Añasco, Culebra, Guaynabo, and Toa Baja) “that will have closed after reaching maximum capacity”. The results of the landfills study, conducted by private consultants, showed that some landfills in the island will have a “remaining life expectancy of 20 years, other 30 years, and others between 20 and 30 years [3].”

Students from the Polytechnic University of Puerto Rico, also in 2005, conducted a project [4] named “Evaluación de Impacto Ambiental - Final: Remediación de Lixiviados Vertedero de Toa Baja”. The project consisted in the development of a remediation plan to provide the appropriate leachate treatment to Toa Baja’s Municipal landfill and mitigate the contamination effects on the

environment. The project could be divided in three stages. The first stage was to conduct a study to quantify the daily volume of leachate the Toa Baja sanitary landfill was producing. The second stage was the collection of leachates at key points where the greatest amount was produced, and then provide the appropriate treatment. The third stage proposed was leachate extraction directly from the waste mountain (using wells to pump to a specific area) to provide good control in the management and treatment [4].

One year later, on 2006, Mr. Jim Johnson, reporter from the *Waste News*, posted an article [5] about the EPA and the issue of Puerto Rico landfills. The EPA had asked three municipalities in Puerto Rico to close improperly run landfills. Alan J. Steinberg, EPA regional administrator said landfills in Aguadilla, Santa Isabel and Toa Baja “do not have required protections and should be closed to minimize any risks they may pose to surrounding communities [5]”. The EPA established that Puerto Rico has the primary responsibility to operate the commonwealth's solid waste management program. The landfills in Aguadilla, Santa Isabel and Toa Baja are considered "open dumps" [5].

Another study conducted on Toa Baja landfill was done in 2008 by students from the Metropolitan University in San Juan, Puerto Rico [6]; the focus was leachate generated on the landfill. This study established that leachate from TBMSWL contains toxic organic and inorganic substances dangerous for human health and environment. The study [6] also established that ground water was impacted by leachate percolation from Toa Baja landfill. One of the recommendations in the Metropolitan University study was to conduct corrective actions to prevent the human health risk and soil, air, superficial and ground water contamination [6].

On August 2017, according to the information on line posted by Gerardo E. Alvarado León for *El Nuevo Día* [7], the EPA warns the imminent closure of more landfills in Puerto Rico. The article establishes that “some of the Puerto Rico landfills are operating in non-compliance with the applicable standards and are at risk of receives an order of

closure from EPA” [7]. After the warning, the Director of the EPA in Puerto Rico and the Caribbean, Carmen Guerrero, indicated that closure orders are part of the plan of the federal unit working with landfill sites representing a possible “imminent harm” to health and the environment . "We project that soon will be issued new closure orders, but we cannot say when or to which dumps", said Guerrero. Puerto Rico has 29 landfills operating in the island, 13 already have orders of closure for non-compliance with federal and state standards. Guerrero emphasized about the closures, unless the landfills of Toa Baja and Vega Baja, both in default and close order, built tank cells related to the applicable rules. For purposes of the EPA, the new cells are independent systems and landfills can receive trash to drop it there [7].

On March 13, 2018, in an article posted on line by *El Nuevo Día* [1], the Director of the Puerto Rico Environmental Quality Board, Tania Vázquez, reiterated that about 12 landfills on the island are in the closure plan for violating the federal regulation in “The Resource Conservation and Recovery Act (RCRA)”. Vázquez indicated that “The order of closure of these landfills have been issued on or before 2016 by the federal office (EPA) and includes systems of Cayey y Arroyo, which should cease the operation between this and next year as well as Aguadilla, Arecibo, Florida, Isabela, Juncos, Lajas, Moca, Santa Isabel, Toa Baja and Vega Baja”. Vazquez said that the problem with these weirs or landfills is that they were built before the federal Government stipulate the regulations that should be governed” [1].

METHODOLOGY

We can find information on journals, newspapers, on-line and in universities theses, which mention the issues of Puerto Rico landfills long time ago. With this information added to field visits to existing landfills, we have great sources of information for this project.

Procedure to Follow

Toa Baja Municipal Solid Waste Landfill was and still is, in the eyes of the regulatory agencies, and the people in charge of the landfill (owner and administrator) need to take care of this as soon as possible. The proposed plan to help in the solution of some issues of this landfill includes identifying the location, owners, and the corresponding daily waste received in existing landfills currently operating on the island. Also determine what other alternatives are available for waste disposal near Toa Baja if the municipal landfill close completely.

The first step was to coordinate visits to the Environmental Protection Agency, the Solid Waste Management Authority (SWMA), the Department of Natural and Environmental Resources (DNER) and the Environmental Quality Board, to find information to understand the landfill situation on Puerto Rico.

The second step was to find the actual solid waste load received in TBMSWL (Tons per day) and typical issues or problems encountered in daily operation.

The last step was analyzing the information received or gathered, consult with personnel who are experts on the subject matter to establish possible solutions or recommendations to the actual issues, and provide some suggestions to extend its expected life.

RESULTS AND DISCUSSION

Most of the non-hazardous solid waste are being disposed in landfill systems, many of these in operation prior to the federal regulation concerning the handling and disposal of them. Some of these facilities are vital resources to maximize the operation and use of the land available in compliance with the existing regulations [8].

Overall Existing Conditions

In Puerto Rico exist twenty-nine (29) non-hazardous Municipal Solid Waste Landfills. In Figure 1 you can appreciate a geographic distribution of them, and the actual status according

to EPA regulations. Red means that the landfill has an EPA consent order. Blue means that the landfills have no consent order.



Figure 1
Geographic Distribution of Municipal Landfills

Several of the landfills have a Consent or Administrative Orders, and Consent Decrees. Consent orders is governed by federal and state laws, which vary by jurisdiction. It is generally a voluntary agreement worked out between two (2) or more parties to a dispute. It generally has the same effect as a court order and can be enforced by the court if anyone does not comply with the orders. A consent decree is an agreement or settlement that resolves a dispute between two (2) parties without admission of guilt or liability, and most often refers to such a type of settlement in the United States. In addition to geographic distribution, Table 1 provides a summary of Puerto Rico landfills, operators, and daily solid waste received on each one of them.

Case Studies

Some of the existing Municipal landfills do not have a “Consent Order” by EPA yet. Several of these landfills conducted various improvements to daily operations during a long period of time, to adapt the normal operation to the actual agency’s regulations. Examples of two (2) landfills with good operation are Carolina Municipal Solid Waste Landfill (CMSWL) and Fajardo Municipal Solid Waste Landfill (FMSWL). A site visit was coordinated with the CMSWL manager, to see one normal operation day of the landfill. The visit was on January 2019, with personnel from Landfill Technologies [9] and each landfill area operation was seen.

Table 1
Puerto Rico Landfills and Operators by Town

Landfill Systems Operating in Puerto Rico			
Num	Landfill Town	Operated by:	Comments
1	Añasco	Municipal [10]	*Received 190 tons./ day
2	Arecibo	Landfill Technologies [10]	*Received 660 tons./ day
3	Arroyo	Arroyo Rental Equipment	*Received 106 tons./ day
4	Barranquitas	Municipal [10]	*Received 229 tons./ day
5	Cabo Rojo	PR Ecopark	*Received 100 tons./ day
6	Carolina	Landfill Technologies [9]	Received 362 tons./ day [9]
7	Cayey	Municipal [10]	*Received 158 tons./ day
8	Culebra (Island)	Municipal [10]	*Received 10 tons./ day
9	Fajardo	Landfill Technologies [11]	Received 600 tons./ day [11]
10	Florida	Municipal [10]	*Received 92 tons./ day
11	Guayama	Lopez Enterprise	*Received 91 tons./ day
12	Hormigueros	Municipal [10]	*Received 34 tons./ day
13	Humacao	Waste Management [10]	^ Received 2,700 tons./ day
14	Isabela	Municipal [10]	^ Received 76 tons./ day
15	Jayuya	Municipal [10]	^ Received 47 tons./ day
16	Juana Díaz	Municipal [10]	^ Received 200 tons./ day
17	Juncos	Municipal [10]	^ Received 650 tons./ day
18	Lajas	Municipal [10]	^ Received 40 tons./ day
19	Mayagüez	Waste Management [10]	^ Received 350 tons./ day
20	Moca	Municipal [10]	*Received 78 tons./ day
21	Peñuelas (A)	Municipal [10]	*Received 47 tons./ day
22	Peñuelas (B)	Waste Management [10] (Industrial Waste)	^ Received 600 tons./ day
23	Ponce	BFI [10]	*Received 1,535 tons./ day
24	Salinas	BFI [10]	*Received 560 tons./ day
25	Toa Alta	Landfill Technologies [10]	^ Received 333 tons./ day
26	Toa Baja	Landfill Technologies [12]	*Received 1,004 tons./ day
27	Vega Baja	Municipal [10]	*Received 534 tons./ day
28	Vieques (Island)	Municipal [10]	*Received 10 tons./ day
29	Yauco	L & M Waste Corp.	^ Received 525 tons./ day

The Municipal Landfills in red have a Consent Orders and or Consent Decree
 * According to Solid Waste Management Authority (SWMA) (2010) [13]
 ^ Tons of waste received on 2003 According to CIA Seminar-Recycle 101 [10]

CMSWL is a landfill that carries out various functions related to the management and disposal of solid waste. The landfill receives, as reported by the landfill’s staff, between 6,500 @ 8,000 tons of garbage per month (an average of 362 tons per day) including the material for recycling plastic types 1 and 2, cardboard, paper, and aluminum. Plastic type 1 are plastics like milk containers and water bottles, less thickness than plastic type 2, which are like detergent containers. (See Figure 2)



Figure 2
Recycling Material on CMSWL - Plastic Type 1 and Type 2

The same building for recycling is used to bale (press into squares) the solid waste in a volume of approximately 4 Ft. x 3 Ft. x 2 Ft. (long x tall x thick) each. Then it is transported and placed on the

ground and covered daily with selected material. This action reduces the solid waste volume to be buried daily.

The actual solid waste site deposit on CMSWL (See Figure 3), has a geo synthetic membrane that avoids the percolation of leachate to the subsurface ground. This way soil and ground water contamination is avoided. In addition, the landfill personnel conduct a separation of metals (scrap) and position the metals on a separate area. They also conduct a separation and processing of vegetative material to produce compost [9]. Another procedure in the CMSWL are systems of extraction wells to collect gases for burning.



Figure 3
Actual Solid Waste Site Deposit at Carolina Municipal Landfill (January 2019)

The CMSWL perform the collection of leachates through buried pipes that were placed on top of the membrane to store leachate in a holding tank. Then the leachate is transported by truck to the closer facility of PRASA (Puerto Rico Aqueducts and Sewer Authority) for either its treatment or the reuse of leachate for injecting to solid waste in the field to help accelerate the material decomposition. See Figure 4 for a diagram of the process in CMSWL.

Carolina Municipal Solid Waste Landfill is one of the best operating in Puerto Rico. It is a Public Private Partnership (PPP) between the Municipal administration and Landfill Technologies Company; the municipal administration has an office in the landfill area [9].

Another landfill in Puerto Rico without “Consent Order” is the Fajardo Municipal Solid Waste Landfill (FMSWL). This landfill is also operated by the company Landfill Technologies. The

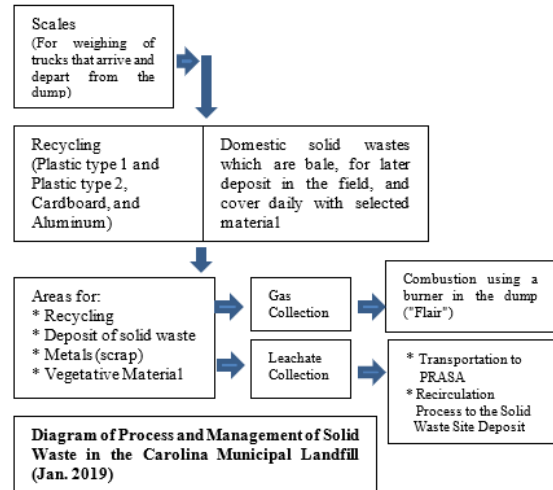


Figure 4

Process and Management of Solid Waste in the CMSWL

FMSWL operates the concept “Gas to Energy”. This is a process where the gas obtained from the landfill process is converted to energy using a special turbine and connected to power lines operated by Puerto Rico Electric Power Authority (PREPA). The FMSWL receives, as reported by the landfill’s staff, 600 tons of garbage per day, and collects the leachates to be recycled to help accelerate the material decomposition and “Vetiver process”. Vetiver is the use of vegetal plants that help in the treatment or elimination of some contaminants on the leachate [11].

Historic Context

In 2008 the EPA issued to Puerto Rico Land Authority (PRLA) an Administrative Order (Consent Order) for closing the TBMSWL. The order was issued to PRLA because until 2005 it was the owner of the main part of the property used as a solid waste landfill. The Administrative Order specified some steps to follow to comply with the closing procedure.

The TBMSWL Facility was created from 1994 to 1995 by the merger of previously separate landfills in the area, operated by Bayamón and Toa Baja towns since at least the early 1970s. Waste deposits at the facility extend in several places into contiguous or adjacent property owned by others, including the United States Naval Base. For purposes of the Administrative Order, three (3) sub-

sections of the TBMSWL Facility were delineated, as follows: Area A was the main part of the landfill consisting of approximately 69 acres; Area B, approximately 7 acres in size, is located north of Area A, and lies within an area designated by the Commonwealth of Puerto Rico as of March 2008 as a critical and essential habitat for an endangered species (“Coqui Llanero”) [14]; and Area C, approximately 12 acres in size, is located in the Southwestern part of the facility, which also is denoted as the "Hoyo" area, because at the beginning the area was located between two (2) mountains [15].

The location and approximate boundaries of areas A, B, and C are shown in Figure 5.

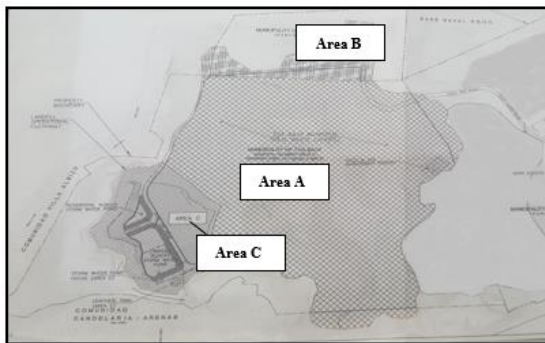


Figure 5
Toa Baja Municipal Solid Waste Landfill Perimeter
(Areas A, B and C) (2008)

The main solid wastes deposited at TBMSWL were primarily household waste and commercial solid waste, including construction debris. On the EPA Administrative Order issued in 2008 [15] a lot of issues with the TBMSWL are mentioned that were identified in previous years by EPA inspections, including, but not limited to:

- Junked automobiles, scrap metal, appliances and other wastes were regularly disposed at the Facility. Such wastes can contribute to the generation of leachate that may contain hazardous constituents [15].
- Methane gas was identified in the area. Methane gas is odorless and, at certain concentrations, is potentially combustible. [15]. (No gas control)
- The Area C facility is located directly adjacent to residential neighborhoods (Candelaria

Arenas Community). The nearest residences are less than 200 feet from the west side toe of the landfill slope [15].

- Leachate releases from the TBMSWL may potentially threaten human health through contamination of drinking water that may be drawn from the underlying aquifer [15].
- Contaminated run-off and ground water from the landfill facility have the potential to adversely impact the adjacent local karst and wetland ecosystems [15].
- The TBMSWL Facility does not have an operational leachate control system and, in the past, did not utilize adequate amounts of daily cover and did not utilize other engineering controls to minimize the amount of leachate generated by the landfill, particularly after a substantial rainfall event [15].

The EPA gave to Puerto Rico Land Authority (TBMSWL Owner) and Landfill Technologies (TBMSWL Administrator) a time frame to fix the issues and submit to EPA a closure plan.

After some years, meetings and improvements, the initial administrative order was amended on September 2012. The purpose of the Amendment was to provide a revised schedule for portions of the work and obligations under the Consent Order and to provide for a recycling and green waste management program that will reduce the volume of waste disposed at the Toa Baja Municipal Landfill, in accordance with policies of the Commonwealth of Puerto Rico and the United States Environmental Protection Agency [12].

In 2012 the TBMSWL was receiving approximately 20,000 tons of solid waste monthly. A new waste disposal cell in Area C of the facility was under construction. The EPA representatives noted that piping for use in storm water management had been received at the site. The EPA representatives observed that the northwest slope of the landfill located adjacent to nearby residences was quite steep and was heavily vegetated [12]. Some of the requirements of the original order were considered obsolete and deleted, and the

Amendment Order included other requirements for the landfill; including, but not limited to:

- Respondents (Owner and Administrator of the landfill) shall cease receiving all waste for disposal in Area A of the Facility no later than September 30, 2014 [12].
- Respondents have submitted a Gas Collection and Control System (GCCS) design, for EPA review. After EPA approval (including any modifications), the GCCS will be implemented and will be operated in accordance with the requirements of the Clean Air Act (CAA) and the Consent Order [12].
- Respondents will submit a Closure Plan for EPA review within 120 days after the effective date of the Amendment. The Closure Plan will meet all the requirements of federal landfill criteria, and will also include interim measures, including earthen cover, storm water control and leachate management to be implemented prior to and in coordination with closure work. After EPA approval (including any modifications), the Closure Plan and the interim measures shall be implemented in accordance with its timetable [12].
- Respondents will submit a “Recycling and Green Waste Management Plan” to EPA for review and approval. After EPA approval (including any modifications), respondents will carry out the Plan according to its implementation schedule [12].

Actual Conditions of Toa Baja Municipal Solid Waste Landfill (TBMSWL)

During the field visit to TBMSWL with a Private Consultant (Engineer) on February 2019 [16] some situations were identified that can be described by items as follow:

Slope Stability

- Slope on the North of Area A of the landfill looks like very stabilized and have vegetation on it. The solid waste deposits on the area were stopped. (See Figure 6).

- Slope on the West side of Area C will continue receiving solid waste deposits, and apparently the slope has a modified ratio, not 3:1 (See Figure 7)



Figure 6
North Side of Area A on Toa Baja Municipal Solid Waste Landfill (February 2019)



Figure 7
West Side of Area C on Toa Baja Municipal Solid Waste Landfill (February 2019)

- The vegetation on part of the west side of Area C of the landfill. This is a new concept named “Vetiver” that helps to reduce the concentrations of contaminants identified on leachate. The leachate is collected from the landfill in a storage tank and has three (3) alternatives: pumping to a sedimentation lagoon, used for Vetiver process (like a recirculation process), or carry out by truck to PRASA (See Figure 8).



Figure 8
West Side of Area C on Toa Baja Municipal Solid Waste Landfill (February 2019)

Gas Collection and Control System (GCCS)

- Landfill gas is generated during the natural process of anaerobic decomposition of refuse contained in a TBMSWL facility. Methane gas is odorless and, at certain concentrations, is potentially combustible [15].
- During the site visit to TBMSWL we observed around the areas a lot of extraction wells, for gas collection and then transport the gas by rubber piping to the “Gas to Energy” facility, inside the landfill. (See Figure 9)



Figure 9

Toa Baja Municipal Solid Waste Landfill Gas Extraction Well (February 2019)

- “Gas to Energy” is a process through which the active gas obtained from the landfill is converted to energy, using a special turbine, and connected to power lines operated by PREPA. “Active Gas” means the gas is collected around the landfill to avoid its expenditure to the atmosphere. In Carolina Municipal Solid Waste Landfill, the active gas is collected for burning, not for “gas to energy” process.

Leachate Management

- During the site visit to TBMSWL a leachate issue along the landfill was observed. It could be said that leachate management on TBMSWL can be divided into two (2) different methods. One method is the collection of leachates from Area C through pipe systems, on top of the membrane, that discharges by gravity on a ground pit. From the pit the leachate is pumped by a submerge pump to a 150,000 gallons tank. From the tank the leachate is transported by trucks to PRASA for final treatment, or could be

used for “Vetiver” process, or pumping to an existing sedimentation lagoon.

- In TBMSWL the only area with membrane to help in the collection of leachates is Area C, the other areas (A and B) do not have installed the membranes, and due to this reason leachates from these areas do not have good control.
- The second method should be the natural collection of leachates from part of Area C and other landfill areas through the ground and/or concrete channels that discharge by gravity into a runoff lagoon and “El Hoyo de Minga”; the lowest elevations in the zone. (See Figure 10)



Figure 10

Toa Baja Municipal Solid Waste Landfill Runoff Lagoon (February 2019)

- The runoff lagoon was initially designed for water retention from rain to provide a good runoff management into the landfill as seen in Figure 11.



Figure 11

Toa Baja Municipal Solid Waste Landfill Runoff Lagoon Area Top View (February 2019)

- Also, in “El Hoyo de Minga” that is a natural sink, leachate due color of water, and odor in the environment can be identified. (See Figure 12)



Figure 12
Toa Baja Municipal Solid Waste Landfill El Hoyo de Minga,
Natural Sink (February 2019)

- “El Hoyo de Minga” is a natural sink that was utilized as improvement design, to collect the runoff from various sinks from the adjacent community. The project included the construction of concrete channel from the community to “El Hoyo de Minga”, but now (February 2019) the channel is partially obstructed by vegetation (See Figure 13)



Figure 13
Toa Baja Municipal Solid Waste Landfill Concrete Channel
from the Community’s Natural Sinks to “El Hoyo de Minga”
Sink (February 2019)

Lateral Expansion

- During the site visit, the lateral expansion of Area C to the West side of landfill was performing. The engineering and other requirements for use of Area C are specified in paragraph "66" of the Consent Order. If so utilized, Area C will be limited to receipt of not more than approximately 1.2 million cubic yards of solid waste [12]. Lateral expansion of a landfill may increase the area available for both direct precipitation and storm water run-on, thus potentially increasing leachate formation within the landfill [15]. On the site visit to TBMSWL it could not be determined how many cubic

yards the landfill has available now for waste deposit on Area C.

CONCLUSIONS

The conclusion or suggestions expressed in this report are based on field visits to landfills, and data available prior to January 2019.

Suggestions and Recommendations

After a careful analysis of the information provided in this report it can be concluded that the first recommendation would be to close TBMSWL. But first we need to answer the following question: If Toa Baja Municipal Solid Waste Landfill close completely, what other alternatives are available for waste disposal near Toa Baja? The answer to this question is the first suggestion:

Analyze the landfills near Toa Baja town to determine the alternative to transfer the solid waste received in TBMSWL to a near facility. According to previous information, the near landfill facilities to Toa Baja are; Toa Alta, Vega Baja and Carolina. The first thing to be evaluated should be the transportation cost. The second issue to be evaluated should be if the landfills selected to carry out the solid waste have enough capacity to receive the new waste load from Toa Baja landfill. As stated before the actual waste load receiving in TBMSWL is approximately 27,000 tons / month. This waste load automatically reduces the useful life of any landfill selected. Third, and not less important, the “Waste Management” in the landfill selected needs to be evaluated, just because the daily operation will be affected with a lot of trucks back and forward and should be taken in consideration the operation hours and equipment needed for the operation of the landfill or landfills selected.

In order to improve the waste management in TBMSWL the recommendation is to analyze and implement the following:

Establish a recycling program for plastics, aluminum, glass, paper and carton; this action would reduce the monthly waste load received in the landfill [15].

Establish the “Composting Management”. Composting is a process where organic matter has been decomposed and recycled as a fertilizer and soil amendment.

Improve the leachate management. One of the big issues in TBMSWL for years is the leachate management, not only for the quality but also the quantity. The diagram in Figure 14 shows a process that would provide an idea of solid waste management in TBMSWL, including the leachate management.

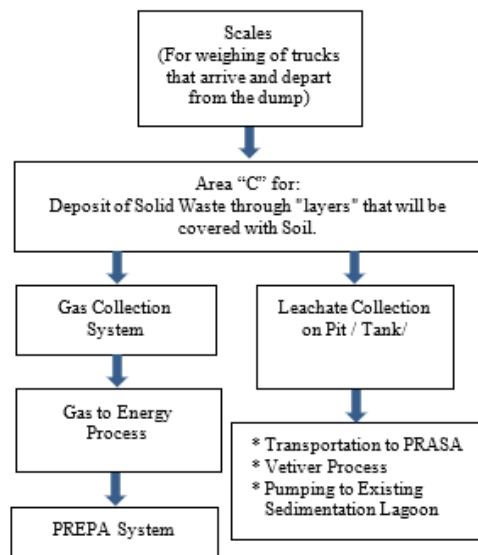


Figure 14
Diagram of Process and Management of Toa Baja Municipal Solid Waste Landfill (February 2019)

Providing an efficient leachate management would improve the landfill operations and greatly help in the human health and environmental preservation avoiding contamination. The TBMSWL administrator must provide leachate control in the field using the resources available including but not limited to: Provide a contract to a Private Consultant (Engineer) to analyze the existing condition of leachate, to avoid for the leachate to reach the runoff lagoon and “El Hoyo de Minga” natural sink and design a good control method for leachate management. Evaluate the construction of a new leachate lagoon or pit, according to agencies standards, and identify in the field the concentration areas where leachate accumulate (lower elevations)

and construct channels to provide alignment of the fluids to the new leachate lagoon or pit. Provide daily monitoring for leachate management, with special attention during raining seasons.

EPA Administrative Order Docket No. RCRA-02-2008-7302 for closing the Toa Baja Municipal Solid Waste Landfill, recommended the slopes stabilization of the landfill. Unstable slopes are a safety issue during grading, pipe systems installation, construction or other physical activities at the landfill. It is suggested in this matter to follow the protocols, guidelines, and regulations concerning slopes stabilization to avoid safety incidents [15].

Provide additional “Storm Water (runoff) Control”. The TBMSWL has a runoff lagoon, but apparently, the lagoon is not working as designed, just because inside the runoff lagoon was identified leachate, mix with runoff water. Due to high altitude of the existing areas of the landfill (Area A, Area B, and Area C) should be mandatory to design by gravity some new runoff channels, in order to provide a good control of runoff, especially during raining season. It should also be taken in consideration the rehabilitation or improvement of the existing runoff lagoon, or the construction of a new lagoon for help in the runoff management. The administrator of the landfill should provide periodic cleaning to the existing concrete channel that connects the sinks from nearest community to “El Hoyo de Minga” natural sink.

Improve the “Solid Waste Capacity”. Last year (2018) an Engineer recommended some improvements to TBMSWL, including the construction of new waste disposal cell inside the landfill; back to back to the East side of Area A. This new proposed cell, named Area D (See Figure 15), will provide additional space for solid waste deposits, and reduce the alternatives to move the solid waste from Toa Baja to others landfills, avoiding in such way, using TBMSWL like a Transfer Station [17]. One inconvenient that the new cell would have, is the propose area for new waste disposal cell it is under the area identifying as a critical and essential habitat for an endangered species, the “Coqui Llanero” [14].



Figure 15
Toa Baja Municipal Solid Waste Landfill Perimeter
(Existing Areas A, B, C, and Propose Area D) (2018)

With the construction of this proposed new waste disposal cell (Area D), the TBMSWL will increase 12 acres, therefore giving some additional years of useful life [17].

As mentioned before, if TBMSWL administrator establishes (or improves an actual) “Recycling Program”, this would reduce the solid waste load received on the landfill and would increase the useful life of the landfill.

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