To Extend Useful Life of Toa Baja Municipal Solid Waste Landfill

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Abstract

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 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**). The purpose of this project is to identify the main issues affecting Toa Baja Municipal Solid Waste Landfill, and then provide some suggestions to extend the useful life of this landfill.

Introduction and Motivation

If Toa Baja Municipal Solid Waste Landfill (**TBMSWL**) closes completely, what other alternatives are available for waste disposal near Toa Baja?
To answer this question we need to:
Identify existing landfills currently operating on the island, location, owners, and its corresponding daily capacity received on site. 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.

Methodology

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.

Result and Discussion

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

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, the Table 1 provides a 2018 summary of Puerto Rico landfills, operators, and approximately daily solid waste received on each one of them, with a total tons per day around the island.

Table 1 Landfill Systems Actually Operating in Puerto Rico (2018)

Num.	Landfill Town	Operated by:	Comments	
1	Añasco	Municipal	✓ Received	190 tons./ day
2	**Arecibo**	Landfill Technologies	✓ Received	660 tons./ day
3	**Arroyo**	Arroyo Rental Equipment	✓ Received	106 tons./ day
4	Barranquitas	Municipal	✓ Received	229 tons./ day
5	Cabo Rojo	PR Ecopark	✓ Received	100 tons./ day
6	Carolina	Landfill Technologies	Received [9]	362 tons./ day
7	**Cayey**	Municipal	✓ Received	158 tons./ day
8	Culebra (Island)	Municipal	✓ Received	10 tons./ day
9	Fajardo	Landfill Technologies	Received [11]	600 tons./ day
10	**Florida**	Municipal	✓ Received	92 tons./ day
11	Guayama	Lopez Enterprise	✓ Received	91 tons./ day
12	Hormigueros	Municipal	✓ Received	34 tons./ day
13	Humacao	Waste Management	➢ Received	2,700 tons./ day
14	**Isabela**	Municipal	➢ Received	76 tons./ day
15	Jayuya	Municipal	➢ Received	47 tons./ day
16	Juana Díaz	Municipal	➢ Received	200 tons./ day
17	**Juncos**	Municipal	➢ Received	650 tons./ day
18	**Lajas**	Municipal	➢ Received	40 tons./ day
19	Mayagüez	Waste Management	➢ Received	350 tons./ day
20	**Moca**	Municipal	✓ Received	78 tons./ day
21	Peñuelas (A)	Eco System	✓ Received	47 tons./ day
22	Peñuelas (B)	Waste Management (Industrial Waste)	➢ Received	600 tons./ day
23	Ponce	BFI	✓ Received	1,535 tons./ day
24	Salinas	BFI	✓ Received	560 tons./ day
25	Toa Alta	Landfill Technologies	➢ Received	333 tons./ day
26	**Toa Baja**	Landfill Technologies	✓ Received	1,004 tons./ day
27	**Vega Baja**	Municipal	✓ Received	534 tons./ day
28	Vieques (Island)	Municipal	✓ Received	10 tons./ day
29	Yauco	L & M Waste Corp.	➢ Received	525 tons./ day
			Total Approx.	11,921 tons./day

The Municipal Landfills on red color has a Consent Order or Consent Decree
✓ **According to Solid Waste Management Authority (SWMA) (2010) (www.ads.pr.gov) [14]**
➢ **Tons of waste received on 2003 According to CIA Seminar "Recycle 101" [10]**

Case Study

Several landfills in Puerto Rico conducted improvements to daily operations during a long period of time, to adapt the normal operation to the actual agency's regulations. Example of one (1) landfill with good operation is Carolina Municipal Solid Waste Landfill (**CMSWL**). This landfill receives, 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. 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 has a geo synthetic membrane that prevent the percolation of leachate to the subsurface ground. Using the membrane the 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. See Figure 2 for a complete diagram of the process in CMSWL.

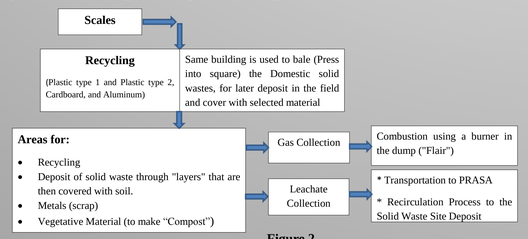

Figure 2
Process and Management of Solid Waste in the CMSWL

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") [13]; 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 3.

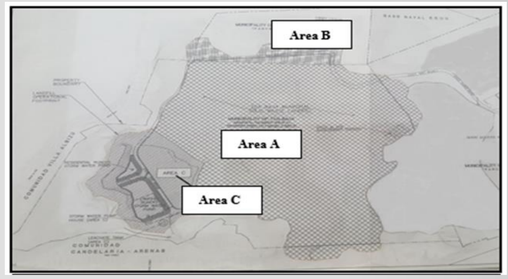

Figure 3
Toa Baja Municipal Solid Waste Landfill Perimeter
(Areas A, B and C) (2008)

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 West side of Area C will continue receiving solid waste deposits, and apparently the slope has a modified ratio, not 3:1 (See Figure 4)

Figure 4
West Side of Area C on Toa Baja Municipal Solid Waste Landfill (February 2019)

Leachate Management

- During the site visit to TBMSWL a leachate issue along the landfill was observed. 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" natural sink, the lowest elevations in the zone (See Figure 5)

Figure 5
Toa Baja Municipal Solid Waste Landfill Runoff Lagoon Area and "El Hoyo de Minga" (February 2019)

Conclusion

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

- Analyze the landfills near Toa Baja town to determine the alternative to transfer the solid waste received in TBMSWL to a near facility. (The waste load of TBMSWL automatically reduces the useful life of any landfill selected)
- Establish a recycling program [15]
- Establish the "Composting Management"
- Improve the leachate management
- Provide slopes stabilization to the landfill [15]
- Provide additional "Storm Water (runoff) Control"
- Improve the "Solid Waste Capacity" [17]

(Follow the Professional Engineer recommendations, including the construction of new waste disposal cell inside the landfill. This new proposed cell, named Area D (See Figure 6), 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])

Figure 6
Toa Baja Municipal Solid Waste Landfill Perimeter
(Existing Areas A, B, C, and Propose Area D) (2018)

References

[1] ELNUEVODIA.COM, "Los federales insisten en el cierre de 12 vertederos de 29 que existen" *El Nuevo Día*, (March 13, 2018) [Online], Available: https://www.elnuevodia.com/noticias/locales/nota/losfederalesinsistenenelcierrede12vertederosde29queexisten-2406065/

[2] Environmental Protection Agency, "La labor de la EPA para atender el tema de vertederos y rellenos sanitarios de Puerto Rico" *EPA Publications* (Sept. 2016) p.4-4, [Online]. Available: https://www.epa.gov/site/production/files/20169/documents/puertorico_landfills fact sheet final spanish translation 0.pdf

[3] J. McPhaul, "Puerto Rico Landfills will Last 25 years more", *Caribbean Business*, vol. 33, Issue 8, p.42-42, March 3, 2005.

[4] M. Figueroa, "Evaluación de Impacto Ambiental - Final: Remediación del Lixiviados Vertedero de Toa Baja", Capstone Polytechnic University of Puerto Rico, San Juan PR, vol. 1, pp. 4-16, 2005.

[5] J. Johnson, "EPA Scrutinizes Puerto Rico Landfills", *Waste News*, vol. 12, Issue 9, p16-16, August 28, 2006.

[6] S. Feliciano, "Evaluación de los Lixiviados Generados en el Vertedero Municipal de Toa Baja", Universidad Metropolitana de Puerto Rico, San Juan PR, vol. 1, pp. 1-30 & pp. 90-99, 2008.

[7] G. E. Alvarado León "La EPA advierte el inminente cierre de más vertederos en Puerto Rico" *El Nuevo Día*, August 14, 2017. [Online], Available: https://www.elnuevodia.com/noticias/locales/nota/laepaadvierteelinminentecierredemasvertederosenpuertorico-2348752/

[8] F. A. Nazario, "Manejo De Los Residuos Sólidos Municipales En Puerto Rico (1966-2016)", *AIDIS (Digital magazine)*, vol. 39, Núm. 2, August, 2016.

[9] Field visit conducted on Carolina Municipal Solid Waste Landfill, Carolina, Puerto Rico, January 2019

[10] Colegio de Ingenieros y Agrimensores (CIA) de Puerto Rico, Seminario "Reciclaje 101", San Juan, PR., mayo 2018.

[11] F. Nazario, "Sistema de Relleno Sanitario del Municipio de Fajardo" [Documento (Memorial Explicativo)] pp. 1 – 8, 2018

[12] Environmental Protection Agency, EPA Administrative Order Amendment Docket No. RCRA-02-2008-7308 for closing the Toa Baja Municipal Solid Waste Landfill pp.1-13 [Online]. available: https://www.epa.gov/sites/production/files/2016-09/documents/toabaja7003amendment.pdf , September 2012.

[13] N. Ríos López y J. Thomas, "Designación del Hábitat Natural Critico Esencial del Coquí Llanero", pp. 1-10 [Documento]. 2007.

[14] Autoridad de Desperdicios Sólidos, Disposición de Residuos Diarios (toneladas) Mapa de Puerto Rico Interactivo, (Sept. 2010) [Online]. Available: https://www.ads.pr.gov/mapas/mapa-srs.html

[15] Environmental Protection Agency, EPA Administrative Order Docket No. RCRA-02-2008-7302 for closing the Toa Baja Municipal Solid Waste Landfill pp. 1-43 September 2008. [Online]. Available: https://www.epa.gov/sites/production/files/2016-09/documents/toabaja7003aoc.pdf

[16] Field visit conducted on Toa Baja Municipal Solid Waste Landfill, Toa Baja, Puerto Rico, February, 2019

[17] F. Nazario, "Sistema de Relleno Sanitario Municipio del Municipio de Toa Baja" [Documento (Memorial Explicativo)], pp. 1 – 6, August, 2018.

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