

USE OF OLD LANDFILLS IN FLORIDA

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ABSTRACT

Many of the municipalities in Florida are looking for some return on their old, closed landfills and many of the more populated regions of the state are under increasing developmental pressures to use old landfill properties. While the Florida Department of Environmental Protection has limited data on use of old landfills in the state, recreational uses are the most popular and appear to be the best options for maintaining environmental protection, ensuring public safety and for providing a successful alternative use of the landfill property. Construction of structures over old landfills, especially residential housing, continues to raise concerns and is not recommended. Four case studies are presented as examples of some uses of old landfills in Florida.

INTRODUCTION

As have many other regulatory agencies in the country, over the past ten to fifteen years the Solid Waste Section of the Florida Department of Environmental Protection (Department) has focused much of its attention on the proper design and construction of landfill liner systems. In fact, the Department began requiring liners for landfills in 1985 which was nearly six years before the U.S. Environmental Protection Agency promulgated its Subtitle D liner requirements. Since some of these lined facilities are nearing closure, the Department has begun to focus more on the problems associated with closure and long-term care of landfills and many landfill owners are looking for ways to use these landfill areas after closure.

The Department has also received many notifications that old landfills were unexpectedly discovered during various construction projects. On other occasions, construction projects were planned over known landfill areas and the Department was asked to evaluate and approve projects associated with them. Furthermore, many municipalities in the more populated regions of the state are under increasing developmental pressures to construct projects over or near old, known landfill areas. Some of these projects have lead to considerable concerns by the Department and the public for both the health and safety of individuals living or working at these projects and the potential environmental impacts resulting from disturbing these old landfills.

The purpose of this paper is to briefly summarize some of the Department's experiences on use of these old landfills and to share some lessons learned from these projects.

GENERAL USE OF OLD LANDFILLS

Surprisingly, one of the earliest uses of landfills in Florida was to assist with mosquito control. Florida typically averages between 45 to 65 inches of rainfall per year in various parts of the state and, due to its flat topography and shallow water table, has many wetlands and water bodies of varying sizes. These wet areas are rich breeding grounds for mosquitoes. Since mosquitoes carry and transmit diseases to humans and livestock, their control was important in the development of the state. Consequently, in the early 1900's (possibly as late as the 1950's or early 1960's) municipal solid waste (MSW) was often used as fill in low, wet areas to make the land more suitable for farming and other forms of development and to control mosquitoes. This has resulted in many hundreds of old, relatively small, MSW landfills throughout the state most of which have little or no records of their operation or locations. These landfills are often discovered during new construction projects today, and the environmental impacts, if they exist from these old sites, have to be addressed at that time.

The Department began requiring permits to construct and operate MSW landfills in January 1975. Closure permits for landfills were not required until July 1985. Liner systems also began to be required for new landfills in 1985. These new requirements resulted in the closure of many existing landfills. At this time the Department has records of approximately 400 landfills that were permitted to operate and are now closed in the state. Most of these sites have been left closed and are used only as passive green spaces. However, as Florida's population continues to grow, there have been increased developmental pressures to convert these passive green spaces into other uses. These pressures have caused the Department to consider developing rules for use old landfill areas.

In 1988, the Department added its basic regulatory requirements for use of old, closed landfills to its Solid Waste Management Facilities rule, Chapter 62-701, Florida Administrative Code (F.A.C.). The language is contained in Rule 62-701.610(7), F.A.C. and reads:

Use of closed landfill areas. Closed landfill areas, if disturbed, are a potential hazard to public health, ground water and the environment. The Department retains regulatory control over any activities which may affect the integrity of the environmental protection measures such as the landfill cover, drainage, liners, monitoring system, or leachate and stormwater controls. Consultation with the Department is required prior to conducting activities at the closed landfill areas.

In 2001, the Department again revised its solid waste rule to address the relocation of on-site wastes at closed landfills. Specifically, Rule 62-701.610(8), F.A.C. reads:

Relocation of waste. The owner of a closed landfill may request permission from the Department to move waste from one point to another within the footprint of the same solid waste disposal unit. If the landfill has a valid closure permit, the permittee shall seek a modification to reflect the relocation of waste. The Department shall approve such a request upon a demonstration that:

(a) The activity will not cause or contribute to any leachate leakage from the landfill, and will not adversely affect the closure design of the landfill;

(b) Any leachate, stormwater runoff, or gas which is generated by the activity is controlled on site;

(c) Any hazardous waste which is generated by the activity will be managed in accordance with Chapter 62-730, F.A.C.;

(d) Immediately after the activity is completed, the landfill will be covered, vegetated, and graded to comply with the closure requirements that apply to that landfill, which shall include a final cover of at least two feet of soil; and

(e) The appropriate District Office of the Department is notified at least seven days before the activity takes place in order to have the opportunity to inspect the site.

An obvious point from consideration of these regulations, is that the Department has little rule language that actually addresses the use of old, closed landfills. While owners are required to consult with the Department before disturbing an old landfill, there are many occasions where this does not occur. And in the past the Department has not provided much guidance on what uses of landfill areas would be acceptable and how they should or should not be developed. But as was stated earlier, because of developmental pressures, there continues to be increasing interest by landfill owners to find alternate uses of these areas. As a consequence, while there are more and more successful uses of landfills today that have been decided in consultation with the Department, there are also many instances where the Department was not consulted and the alternate uses have been very unsatisfactory.

For example, some of these alternate uses for landfills in Florida are summarized in Table 1. This table lists the county, the name of the landfill and the redevelopment scenario for 55 closed landfills in Florida. The uses can be grouped into four categories: recreational, commercial, residential and schools. Based on the Department's records, 56.4 percent of the 55 landfills were used for recreational purposes, 27.3 percent for commercial, 9.1 percent for residential and 7.3 percent for schools. In general, the Department has been very pleased with the recreational uses of the landfills for activities such as golf courses and driving ranges, soccer fields, ball parks and community parks.

While there are some important considerations for construction, these uses can be very satisfactory.

The construction of commercial structures, schools and residential homes and apartments over or near landfills, however, can pose some serious engineering difficulties as well as unacceptable human health risks that can lead to very unsatisfactory results. For example, as is shown in Figure 1, the playground of a Head Start school in Duval County was constructed directly over an old MSW incinerator ash disposal area. In this case, the ash was exposed at the ground surface. Also, some counties have been able to acquire land at very low prices that included old landfills. This land has then been used to build public schools. While the economics make this option attractive, the concern by the public for the safety of the children can make it difficult to implement.

Due to the difficulties encountered in dealing with these old landfills, on May 3, 2001 the Department issued recommendations for managing the problems arising from construction near or over them. These recommendations are contained in a document entitled, "Guidance for Disturbance and Use of Old Closed Landfills or Waste Disposal Areas in Florida," see DEP (2001). This document addresses topics such as: relocation of wastes, waste characterization, waste processing and use, water quality monitoring and cautions for construction. It may be obtained off the Department's Solid Waste Web Page at: www.dep.state.fl.us/waste/categories/solid_waste/default.htm.

FOUR CASE STUDIES

Successful use of old landfills requires a great deal of advanced planning, proper construction and subsequent monitoring and maintenance. Landfill owners need to consider several factors such as:

- Site location and topography
- Character of the waste
- Closure requirements and maintenance of the closure system
- Monitoring and control of landfill gas
- Monitoring of water quality
- Structural stability of the landfill when used
- Human health and safety with the proposed use
- Economics of the use proposal
- Community involvement and support

Four landfills have been selected from Table 1 to use as case studies. All four of these projects included construction over or near their landfills. The first two cases had difficulties or raised human health concerns that may have been due to the owners failing to consider some of the above factors. The other two cases were considered successful.

Hampshire Homes Landfill

The Hampshire Homes Landfill was located in the City of Miramar, Broward County, Florida. This site received primarily construction debris wastes from all the homes that were built as part of a very large subdivision project known as the Hampshire Homes Subdivision. The parcel where the landfill was located had the lowest elevation in the subdivision and was planned for use as a dry detention area for stormwater. Construction debris from the subdivision was used as fill to prepare the bottom elevation of the dry detention area. Reportedly, other non-construction debris wastes managed to find their way into the landfill as well at night and on the weekends. When the subdivision project was nearly completed, the construction debris wastes were graded, covered with two feet of soil and then covered with sod. Then twenty additional homes were constructed around the perimeter of the waste disposal area. Upon completion of the subdivision, the common backyard shared by these twenty residences became an attractive playground for the many children living in the homes.

In 1996, about five years after completion of the project, children began to notice sinkholes opening up in the common backyard. Parents peered into these sinkholes and reported seeing various types of waste material including wood, buckets, tires and other construction debris. In an effort to resolve this problem, the developing company excavated the wastes from the common backyard. As can be seen in Figure 2, the once attractive common playground for children became a lake with protruding wastes in place of sandy beaches. The enraged homeowners also feared that the waste disposal areas extended under their houses. A ground penetrating radar survey was conducted and showed that none of the homes were actually constructed over the wastes. However, the homeowners were still angered because their property values had been reduced as a result of the negative publicity. To resolve this problem, the developing company, also concerned with its image, worked with the homeowners and agreed on an undisclosed compensation for each homeowner located near the waste filled areas. The lake was eventually backfilled with clean fill and returned to its originally planned use as a dry detention area.

Gunn Highway Landfill

The Gunn Highway Landfill is located off Gunn Highway in Tampa, Hillsborough County, Florida. The county operated the landfill as a trench-type facility for the disposal of MSW from 1958 to 1962. The landfill disposal areas occupied approximately fifteen acres. After the landfill was closed, the property was subdivided and developed. A total of thirteen apartment buildings and a clubhouse were constructed over the waste-filled areas of the landfill. According to an investigation report by a consulting firm, see Geraghty & Miller (1996), the foundations for these structures were built as follows:

The complex is founded on timber piles and post-tensioned concrete structural slab systems due to the subsurface conditions. The construction drawings approved by Hillsborough County for the apartment complex indicate that a synthetic membrane was to be installed beneath the slabs to block and disperse the migration of methane gas, generated by the decomposition of solid waste.

Even though efforts were made during construction to prevent methane gas generated by the waste from seeping into the structures, problems were discovered in the late 1980's. In addition, differential settlement of the waste has resulted in cracks in the overlying structures in spite of the attempt to establish an adequate pile foundation system for those structures.

Numerous investigations have been conducted at the property evaluating whether methane gas has migrated into the on-site structures and evaluating the potential for the gas to migrate off-site through utility trenches containing electrical conduits, sanitary sewers and stormwater pipes. Some gas monitoring data report methane gas concentrations in the soils at levels significantly higher than 100 percent of the lower explosive limit (LEL) for methane. Methane gas has consistently been detected under the slabs at the clubhouse and at many of the apartment buildings. Fortunately, methane gas has not been detected in the first floor apartments. Additional ventilation has been added to on-site structures and concrete floors have been resealed to try and minimize the risks from methane gas accumulation. While investigators now believe that the levels of methane gas are decreasing at the site, indicating that the Gunn Highway Landfill may have passed its peak methane generation rate, gas monitoring is still continuing and is likely to be required for many more years.

Dyer Road Landfill

Dyer Road Landfill is located off Dyer Road west of Riviera Beach in Palm Beach County, Florida. It was operated by the Solid Waste Authority of Palm Beach County during the 1970's and 1980's and received MSW, construction and demolition debris and trash. The landfill is located on a 405-acre parcel and the waste-filled areas occupy 253 acres of the parcel. The landfill was closed in 1990 and capped with a PVC liner system. A landfill gas extraction system was also installed to collect and burn the combustible gases generated by the decomposing wastes.

The Solid Waste Authority desired to use this closed landfill for recreational purposes. In February 1996, it began construction of a project to convert the landfill into a beautifully landscaped park called Dyer Park. By September 1997 the project was essentially completed. Dyer Park now includes mountain bike trails, equestrian and hiking trails, soccer fields, ball fields and a surface water system that provides a habitat for birds and other wildlife. Pictures of the soccer field (constructed in a valley between the disposal areas) and mountain bike trails (constructed over waste) for this facility are

shown in Figures 3 and 4. According to news reports, the design and construction of this project cost \$5.6 million, or approximately \$22,150 per acre, see Hodgkins (1997). At this time, the Department is not aware of any adverse environmental or human health consequences associated with the use of Dyer Road Landfill as a recreational park facility.

St. Lucie County Northeast Airport Landfill

This landfill is located adjacent to the St. Lucie County Airport in St. Lucie County, Florida. The site had an area of 300 acres with the waste being deposited into unlined trenches on approximately 150 acres of the total property. The landfill began operation in 1968 and received MSW, and industrial, medical and hazardous wastes. In addition, white goods, scrap automobiles and land clearing debris were deposited on the surface of the landfill. The landfill was operated during this period with little or no federal or state regulation. In 1974, the landfill was closed to public dumping since its operation was attracting birds and causing a bird hazard threat to the nearby airport. In the 1980's, groundwater contamination from volatile organic compounds (VOCs) was confirmed on-site, and the Department required remediation and official closure of the landfill. The county began the process of considering options for closure.

Limited municipal funding was available for closure. In addition to the landfill closure process itself, several other issues required attention including preventing contamination of nearby private potable wells and the protection of an existing endangered species habitat at the site. The county considered three closure options having estimated capital costs ranging from \$4.3 million to \$7.4 million and annual operation and maintenance (O&M) costs ranging from \$150,000 to \$260,000. A feasibility study was conducted, and the county selected a landfill closure option that included a groundwater recovery and treatment system, a design for habitat protection and a municipal golf course as a revenue generator. The closure permit was issued in 1991 and the construction process began.

The remedial system was installed to extract contaminated groundwater through a system of several vertical recovery wells, screened in the intermediate aquifer at the site, and 5,500 linear feet of shallow horizontal interceptor trenches. This prevented contaminated groundwater from moving off-site or escaping in the deeper aquifer. The VOC contaminated groundwater would then be treated in two 900,000 gallon per day stripping towers and discharged into the on-site lake system for the golf course. The lake system was designed for zero discharge. It was believed that percolation out the bottom of the lakes and use of the treated groundwater for irrigation of the golf course would be adequate to maintain the water balance for the project.

The closure plan for the landfill was designed with a permeable barrier layer rather than a geomembrane or clay layer. Since the project included a groundwater recovery

and treatment system, the Department agreed that allowing rainwater infiltration into the waste to "flush" the VOCs to the recovery system for treatment was preferred to other lower permeable cap designs. Consequently, the landfill final cover consisted of six inches of topsoil to support vegetation underlain by eighteen inches of native soils.

Habitat protection was included in the project by allowing land areas for animal species of concern. Approximately 60 acres of land were set aside for gopher tortoise habitat, and 88 gopher tortoises were relocated to the on-site preserve. Five acres of land were used for a family of Florida Scrub Jays that were nesting on the southeastern corner of the site. Finally, the golf course design included six on-site lakes that enhanced the aquatic life habitat.

The project construction was certified complete in June 1993 at a reported cost of \$7.32 million or \$48,800 per landfill acre, see Hazen and Sawyer (1993). During the first year of operation, the golf course attracted over 70,000 residents and tourists and had revenues of \$1.8 million that were well in excess of the annual O&M costs for the year. The site continues to be a successful revenue generator for the county as well as providing environmental protection. The site has operated as designed with the exception of the water balance. Shortly after completion of the project a series of tropical storms impacted the southeast coast causing severe flooding of the lakes and the golf course. The South Florida Water Management District provided relief by allowed limited and controlled off-site discharging of the water through an emergency order. Since that time, the permit has been modified to allow for discharges during a large storm events.

LESSONS LEARNED

The Department only has limited experience with use of old landfills at this time, but some general lessons from these uses are still clear. While some of these "lessons" are not new, they confirm what others have seen and experienced with landfill closures and reinforce the continued need for proper engineering design and construction of these projects. Some general lessons are as follows.

1. The potential for old landfills to generate dangerous levels of methane gas over many years must never be ignored or overlooked in any landfill use project. Even when engineering controls are added to a project to manage the gas, problems can still develop. Care must be taken to have redundant systems in place to ensure the protection of human health.
2. Design and construction of structures over old landfills must include a thorough understanding of the foundation requirements for the structures. A two-foot soil layer over waste will not normally be an adequate foundation for an overlying structure. In some cases, support pilings may also not be adequate.

3. Regulators need to develop clear regulations to help guide the use of old landfills.
4. Properly designed, constructed and operated landfill use projects can provide environmental protection of the wastes, be protective of human health and allow for alternate beneficial uses of the landfill. Recreational uses seem to be the best options for old landfills. Construction of structures over old landfills, especially residential housing, should be avoided.

REFERENCES

DEP (2001), "Guidance for Disturbance and Use of Old Closed Landfills or Waste Disposal Areas in Florida," Florida Department of Environmental Protection, Solid Waste Section, Tallahassee, Florida, 70 pgs.

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Hodgkins, L. S. (1997), "The County Landfill That Became A Park," The Florida Specifier, September 1997, page 12.

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Table 1. Typical Use Options for Old Landfills in Florida

County	Landfill Name (if known)	Redevelopment Scenario
Bay	Majette LF	Bay Dunes Golf Course
Broward	21st St. Manor Dump	Elementary school
Broward	Copans Rd. LF	Commercial/retail operation (Wal-Mart)
Broward	Davie LF	Community park (previous Superfund site)
Broward	Deerfield Beach LF	Office complex
Broward	Hampshire Homes LF	Residential
Broward	Hollywood YT LF	Community soccer fields
Broward	Wingate Rd LF	Golf driving range (current Superfund site)
Clay	Old dump	Community park
Duval	Brown's Dump (Incinerator Ash)	Elementary school
Duval	Crystal Springs Rd. LF	Community park (after remediation)
Duval	Fifth & Cleveland Ash LF	Head Start School and ball field
Duval	Forest Street Incinerator LF	Head Start School and playground
Duval	Sunbeam Rd. LF	Proposed golf course
Duval	Stetson Road LF	Soccer field
Escambia	Beulah LF	Radio controlled airplane park
Flagler	Flagler Co. Central LF	Radio controlled airplane park
Hillsborough	City of Tampa LF	Restaurant/office complex
Hillsborough	Columbus & McDill Rd LF	Chamber of Commerce Building
Hillsborough	Gandy & Church St. LF	Jai Ali Building
Hillsborough	Handly and Barry Rd. LF	Apartment Complex and Residences
Hillsborough	Water & Dale Mabry Rd LF	Burger King Restaurant
Hillsborough	Mango & Manhattan Rd. LF	Recreation Facility
Hillsborough	Seneca & Dixon Rd. LF	Car Dealership
Hillsborough	Yukon & Tampa Rd. LF	Residential
Hillsborough	30th St and Hillsborough River	Rogers Park Golf Course
Hillsborough	Himes & Gandy Rd. LF	Apartment Complex
Hillsborough	Gunn Highway LF	Apartment Complex
Lee	Harlem Heights LF	Community park w/ soccer fields
Manatee	SR 70 LF	Sports complex (w/ballfields)
Marion	Martel LF	Proposed golf course
Miami-Dade	Ojus LF	Community park
Miami-Dade	58th St. LF	Community park (previous Superfund site)
Orange	West 50 LF	Gunite processing facility
Orange	Pine Hills LF	Sports complex (w/ballfields)

Table 1. Typical Use Options for Old Landfills in Florida (Continued)

County	Landfill Name (if known)	Redevelopment Scenario
Orange	Bray's Pit	Yard trash processing facility
Orange	Old dump	Commercial/retail operation
Orange	Old dump	Commercial
Orange	Grinder LF	Sports complex (w/ballfields)
Orange	Old dump	Commercial
Palm Beach	Cross State LF	Turnpike toll plaza
Palm Beach	Boynton Beach LF	Proposed communitiy park
Palm Beach	Dyer Rd. LF	Community park w/mountain bike trails
Palm Beach	West Lake Park Rd. LF	Part of community golf course
Palm Beach	Lantana Rd. LF	Radio controlled airplane park
Palm Beach	Lantana Trash Dump	Commercial
Pinellas	Old dump	Community golf course
Pinellas	Toytown LF	Proposed golf course
Sarasota	17th St. LF	Major league sports stadium
Sarasota	Old dump	Community golf course
Seminole	Pile Pit Landfill	Golf Driving Range
Seminole	Sanlando LF	Sports complex (w/ballfields)
St. Lucie	St. Lucie Co. NE Airport LF	Fairwinds golf course
Volusia	New Symrna Beach Airport LF	Radio controlled airplane park
Volusia	Plymouth Ave LF	Proposed golf course



Figure 1 - Head Start School at MSW Ash Landfill



Figure 2 – Hampshire Homes Subdivision Waste Excavation Area



Figure 3 – Dyer Park Soccer Field



Figure 4 – Dyer Park Mountain Bike Trail