BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

VILLAGE OF GLENVIEW, an Illinois municipal corporation; and SOLID WASTE AGENCY OF NORTHERN COOK COUNTY, an Illinois statutory solid waste agency;	
Complainants,	PCB Case No. 2023-049
v.	
CATHOLIC BISHOP OF CHICAGO, an Illinois corporation sole; and ILLINOIS ENVIRONMENTAL PROTECTION AGENCY, an agency of the State of Illinois;	
Respondents.	

NOTICE OF MOTION

TO: Attached Service List Via Email

PLEASE TAKE NOTICE THAT today I caused to be electronically filed with the Clerk of the Illinois Pollution Control Board, via the "COOL" System, CATHOLIC BISHOP OF CHICAGO'S MOTION TO DISMISS, true and correct copy of which is attached hereto and hereby served upon you.

CATHOLIC BISHOP OF CHICAGO

<u>/s/ Jonathan H. Ebner</u>

Jonathan H. Ebner
BAKER & McKENZIE LLP
300 East Randolph Street, Suite 5000
Chicago, Illinois 60601
Telephone: (312) 861-2933
Facsimile: (312) 861-2899
Email: jon.ebner@bakermckenzie.com

SERVICE LIST

Don Brown
Clerk of the Board
Illinois Pollution Control Board
60 E. Van Buren Street, Suite 630
Chicago, IL 60605
Don.Brown@illinois.gov
(Via Electronic Filing)

Village of Glenview
Solid Waste Agency of Northern Cook County
Derke J. Price
Gregory W. Jones
ANCEL GLICK, PC
140 S. Dearborn Street, 6th Floor
Chicago, IL 60603
dprice@ancelglick.com
gjones@ancelglick.com

Illinois Environmental Protection Agency
Kevin Garstka
Elizabeth Dubats
Assistant Attorney General
Environmental Bureau
69 W. Washington Street, 18th Floor
Chicago, IL 60602
Kevin.Garstka@ilag.gov
Elizabeth.Dubats@ilag.gov

CERTIFICATE OF SERVICE

I, Jonathan H. Ebner, caused to be served this 16th day of November, 2022, true and correct copies of the NOTICE OF MOTION and CATHOLIC BISHOP OF CHICAGO'S MOTION TO DISMISS upon the persons listed on the Service List via electronic mail with return receipt.

/s/ Jonathan H. Ebner

Jonathan H. Ebner
BAKER & McKENZIE LLP
300 East Randolph Street, Suite 5000
Chicago, Illinois 60601
Telephone: (312) 861-2933
Facsimile: (312) 861-2899
Email: jon.ebner@bakermckenzie.com

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

VILLAGE OF GLENVIEW, an Illinois municipal corporation; and SOLID WASTE AGENCY OF NORTHERN COOK COUNTY, an Illinois statutory solid waste agency;	
Complainants,	PCB Case No. 2023-049
v.	
CATHOLIC BISHOP OF CHICAGO, an Illinois corporation sole; and ILLINOIS ENVIRONMENTAL PROTECTION AGENCY, an agency of the State of Illinois;	
Respondents.	

CATHOLIC BISHOP OF CHICAGO'S MOTION TO DISMISS

Respondent The Catholic Bishop of Chicago, for its Motion to Dismiss, pursuant to Sections 101.506 and 103.212(b) of the Illinois Pollution Control Board Rules (hereinafter, "the Board Rules"), and to Section 2-619 of the Illinois Rules of Civil Procedure, moves to dismiss the Complaint, and states as follows.

I. Introduction

The Respondent owns and operates a closed landfill located in unincorporated Cook County, pursuant to several permits issued by IEPA (the "Des Plaines Landfill"), including Permit Nos. 1974-24-DE and 1974-24-OP, as supplemented. On October 25, 2019, IEPA issued a permit for the operation of a Compost Facility at the Des Plaines Landfill. This followed a lengthy permitting process in which the Complainants – the City of Glenview, which is adjacent to the Des Plaines Landfill and SWANCC, which operates a competing business in close proximity to the

Des Plaines Landfill – objected to the Compost Facility, and raised the very same concerns about the Des Plaines Landfill and the Compost Facility that they now raise in this action.

Complainants have filed this action three years after the permit was issued, in an effort to circumvent well-established Board procedures in what is really an effort to protect their economic interests, not to enforce Illinois environmental law. Further, procedurally, Complainants lack standing to challenge Respondent's permits and the permits issued for the compost facility, and their pretextual allegations of violations by Respondent not only lack merit, but have already been considered and rejected during the permitting process. As a result, the Complaint should be dismissed as "duplicative" under the Board Rules.

II. Factual and Procedural Background

The Complainants first took interest in the Des Plaines Landfill several years ago when a third party, Patriot Acres LLC, applied to IEPA to construct and operate a compost facility at the Des Plaines Landfill. In the more than 18 months that followed, the Complainants alleged a number of environmental concerns related to the Des Plaines Landfill and asserted that siting a compost facility at the Des Plaines Landfill would exacerbate these alleged concerns. IEPA duly considered all of these comments and the related responses from Respondent and Patriot Acres LLC, resulting in a permitting process that extended until late 2019. Following a review of all relevant information, IEPA issued the two required permits for the construction and operation of the compost facility in October 2019 (2018-090-SP and 2018-471-DE/OP). While the compost permitting process was ongoing, IEPA also continued to oversee and issue the requisite permits to the Respondent for its continued ownership and operation of the Des Plaines Landfill.

The Complainants filed the instant action on October 12, 2022.

The Respondent received the Complaint by US mail on Monday, October 17, 2022. *See* Section 101.300(c)(2), Board Rules. ("Service by U.S. Mail or Third-Party Commercial Carrier with Recipient Signature. If a recipient's signature is recorded by the U.S. Postal Service or a third-party commercial carrier upon delivery of a document, service is complete on the date on which the document was delivered, as specified in the signed delivery confirmation."). Thus, service was complete as of that date.

III. Argument and Authorities

A. Legal Standards

The Board Rules contain the following relevant Sections:

> Section 101.506 Motions Attacking the Sufficiency of the Petition, Complaint, or Other Pleading
>
> All motions to strike, dismiss, or challenge the sufficiency of any pleading filed with the Board must be filed within 30 days after the service of the challenged document, unless the Board determines that material prejudice would result.
>
> * * *
>
> **Section 103.212 Hearing on Complaint**
>
> a) *Any person may file with the Board a complaint against any person allegedly violating the Act, any rule or regulation adopted under the Act, any permit or term or condition of a permit, or any Board order*. When the Board receives a citizen's complaint, *unless the Board determines that such complaint is duplicative or frivolous, it shall schedule a hearing*. [415 ILCS 5/31(d)(1)] The definitions for duplicative and frivolous can be found at 35 Ill. Adm. Code 101.Subpart B.
>
> b) Motions made by respondents alleging that a citizen's complaint is duplicative or frivolous must be filed no later than 30 days following the date of service of the complaint upon the respondent. Motions under this subsection may be made only with respect to citizen's enforcement proceedings. Timely filing the motion will, under Section 103.204(e), stay the 60 day period for filing an answer to the complaint.
>
> * * *
>
> **Section 101.202 Definitions for Board's Procedural Rules**

> "Duplicative" means the matter is identical or substantially similar to one brought before the Board or another forum.
>
> * * *
>
> "Frivolous" means a request for relief that the Board does not have the authority to grant, or a complaint that fails to state a cause of action upon which the Board can grant relief.

B. The Complaint Should Be Dismissed Based on Lack of Standing

Although Complainants have couched their claims in terms of purported violations of Illinois law and the Respondent's permits, it should be recognized that the Complaint is really an attempt to do indirectly what the Complainants know they may not do directly: challenge the issuance of permits issued by the IEPA after they have been issued in accordance with applicable due process. As the Complainants must know – given SWANCC's involvement in seminal a case that went to the Illinois Supreme Court, they cannot challenge the issuance of Respondent's permits:

> Significantly, plaintiffs are statutorily precluded from legally challenging the Agency's decision to grant a development permit for a pollution control facility. **2** An Agency decision granting a permit cannot be appealed to the Pollution Control Board, which is only authorized to hear appeals where the Agency denies a permit or grants only a conditional permit. (415 ILCS 5/40(a)(1) (West 1992).) Further, the Act only authorizes judicial [review of Pollution Control Board permitting decisions, and not Agency permitting decisions. (415 ILCS 5/41(a) (West 1992).) Consequently, judicial review of Agency decisions granting development permits for solid waste disposal sites is precluded and the instant plaintiffs cannot challenge the Agency's decision to grant the balefill development permit.
>
> Yet, what the plaintiff municipalities cannot do directly they attempt to do indirectly through their complaint challenging the Cook County board's zoning ordinance authorizing the siting and development of the balefill.

City of Elgin v. Cty. of Cook, 169 Ill. 2d 53, 61-62 (1995); *see also Landfill, Inc. v. Pollution Control Bd.*, 74 Ill. 2d 541, 559 ((1978) ("A third-party challenge to the allowance of a permit is dissimilar to a hearing upon permits applicant's petition to review the Agency's denial of a permit.

Furthermore, to permit challenges to the allowance of a permit before the Board undermines the statutory framework."); *City of Waukegan v. Ill. EPA*, 339 Ill. App. 3d 963, 974 (2d Dist. 2003) ("there is no basis under the Act for the City to seek review of the Agency's permitting decision by the Pollution Control Board to rot bring an enforcement action.").

Hypocritically, the *City of Elgin* case involved SWANCC defending the permit it received when it originally opened its facilities. 169 Ill. 2d at 56-58. SWANCC was ultimately successful against a third-party challenger. As a matter of law, third parties simply have no standing to challenge permits after issuance, whether they are neighboring municipalities or business competitors, even if they pretextually couch their claims as alleged violations of the Act or of the permits. *Id*. at 61-62.

Complainants make it clear that they are also challenging IEPA's recent issuance of the permits for the compost facility: "The Respondent and IEPA have, inexplicably, now continued this malfeasance by approving a permit application authorizing construction and operation of a compost facility *on top of the already leaking Landfill* ('Compost Facility')." Complaint, ¶5. Again, Complainants may not do an end-run around the statutory framework applicable to the Des Plaines Landfill, which limits enforcement actions to actual violations, not indirect attempts to challenge permitting decisions. Further, Complainants admit that they are directly challenging IEPA's issuance of the permit for the compost facility: "IEPA should never have issued a permit for the Compost Facility and doing so is direct violation of the Act and therefore beyond lEPA's powers." Complaint, ¶48. Based on the authorities set forth above, the Complainants lack standing as a matter of law to make these arguments.

<u>C. Counts I and II Should Be Dismissed as Duplicative</u>

The Board Rules allow dismissal when a complaint is "duplicative," which is defined by the Board Rules as follows: "'Duplicative' means the matter is identical or substantially similar to one brought before the Board or another forum." Section 101.202, Definitions for Board's Procedural Rules. The Complainants were heavily involved in the recent permitting process for the compost facility. During the process, Complainants alleged that Respondent raised arguments substantially similar, if not identical, to the claims made here. Namely, Complainants alleged at that time that the Respondent was in violation of the Act with respect to operation of the Des Plaines Landfill, and that the proposed compost facility would exacerbate those violations. Further, the IEPA was aware of the Complainants general allegations of noncompliance as it has issued the various supplemental permits for the Des Plaines Landfill, including Supplemental Permit No. 2019-356-SP, referenced by Complainants, and the latest supplemental permit issued in January 2022 (#2021-317-SP).

As noted, Complainants were integrally involved during the Respondent's permitting process and had several objections and comments which are nearly identical to the issues they have raised in the Complaint. Most of the correspondence was initiated by SWANCC, but as seen below, the City of Glenview subscribed wholesale the objections. These communications were received by IEPA on July 5, 2019 (attached hereto as Exhibit 1) and August 2, 2019 (attached hereto as Exhibit 2).

On February 4, 2019, APTIM, Glenview and SWANCC's environmental consultant, sent correspondence to IEPA (Exhibit 1, p. 10), which contains the following excerpts:

- "The high leachate levels indicate that storm water is likely penetrating the existing landfill cap. This mounding of leachate indicates radial flow away from the center of the landfill."

- "Based on the high leachate levels above the groundwater table within the landfill, APTIM continues to be concerned that the landfill final cover is not effective in minimizing storm water from infiltrating the cap."
- "Due to the fact that the proposed compost facility intends to use significant volumes of water to condition compose piles, locating a compost facility on top of this landfill will likely increase the leachate levels within the landfill."
- "The mounding of leachate demonstrated in the attached figures, and resulting radial flow away from the facility, indicate that the potential for groundwater contamination from this unlined landfill is significant around the entirety of the landfill, and will likely be exacerbated by the addition of a compost facility."

On June 18, 2019, D. Van Vooren (SWANCC Executive Director) send an email to IEPA (Exhibit 1, p. 3) with attached letter from APTIM (June 17, 2019) (Exhibit 1, p. 6), which contains the following excerpts:

- "High leachate levels within the Landfill has [sic] been identified as the primary issue affecting the performance of the landfill gas control system. Outward advective movement of both leachate and landfill gas have been implicated as the source of the three (3) groundwater contamination plumes at the Landfill."
- "The Landfill final cover system is therefore acknowledged by the applicant to not be effective or functioning appropriately to minimize infiltration of precipitation through the final cover system and becoming leachate."
- "APTIM has identified significant concerns with the proposed compost facility design that will adversely affect the existing, ineffective Landfill final cover and will likely increase infiltration of precipitation into the Landfill."

- ". . . the all-weather surface design [proposed to be used by the compost facility] will increase the quantity of water that can infiltrate through the final cover into the waste mass, resulting in an increase in leachate generation."
- Re: claim that compost facility will reduce slope of Landfill final cover: ". . . the existing Landfill final cover is ineffective in preventing water from infiltrating through the waste mass. Increasing the time that water travels along the existing Landfill final cover also increases the time that water has potential to infiltrate into the waste mass. Increasing the time at which water can infiltrate will result in an increase in the overall quantity of water that will infiltrate through the Landfill final cover into the waste mass, generating an increased amount of leachate."
- "Remediation of leachate mound continues to be unaddressed."
- "Due to the build-up of leachate in the Landfill, both leachate removal and landfill gas collection systems are not effectively operating . . ."

On June 18, 2019, D. Owen (Village of Glenview, Deputy Village Manager) sent correspondence to IEPA (Exhibit 1, p. 13), which contains the following excerpts:

- "Please note that the Village of Glenview has coordinated with SWANCC to study the potential negative impacts of the Patriot Acres development and is aligned with the comments provided by SWANCC Executive Director Van Vooren . . ."

On July 18, 2019, D. Van Vooren (SWANCC Executive Director) sent an email to IEPA (July 18, 2019) (Ex. 2, p. 4) with attached letter from APTIM (July 18, 2019) (Ex. 2, p. 6)

- "The presence of a leachate mound indicates that the waste is saturated, which increases the risk of slope failure."

- "Our concern is that the Applicant has assumed geotechnical properties of the waste that result in a significantly greater factor of safety value than may reflect current conditions of the Landfill. Prior to development of the proposed compost facility and Landfill modifications, an accurate slope stability analysis should be completed to ensure stability of the Landfill slopes and prevent unreasonable risk for the local environments and properties."

Thus, this matter as pleaded is substantially similar to the Complainants' earlier allegations brought forth during the IEPA permitting process, and should be dismissed as duplicative pursuant to Board Rule 103.212(a).

D. The Complaint Should Be Dismissed for Lack of Specificity

The Complaint references the following permits: "Permit Nos. 1974-24-DE, 1974-24-OP, and Supplemental Permit No. 2019-356-SP." Complaint, ¶1. No more detail is alleged with respect to the permits or their terms. The Complaint makes specific violations of statutory violation. *See, e.g.*, Complaint at ¶¶23, 32, 36. In stark contrast, the Complaint is incredibly vague on details and conclusory regarding the permit violations.

The Complaint generally alleges – repeatedly – that Respondent is in violations of the terms of its permits, but never specifies the terms of the permits, what the purported violations are or any support for its allegations.

- "the Landfill remains in violation of the Act and in violation of the Respondent's Permits…" Complaint, ¶4.

- "COUNT I RESPONDENT'S FAILURE TO REMEDIATE THE ONGOING POLLUTION OF GROUND AND SURFACE WATERS IS A VIOLATION OF THE ACT AND THE RESPONDENT'S PERMITS" Complaint, p. 3.

- "THE RESPONDENT'S PERSISTENT FAILURE TO CONTROL THE LEACHATE AND GAS HAS MORE RECENTLY CAUSED SLOPE FAILURES AND NEW SEEPS IN FURTHER VIOLATION OF THE ACT AND ITS PERMITS" Complaint, p. 11.

- "The proposed Compost Facility located on top of the existing cover system will prevent the remediation of the cover system and impede the placement of additional extraction points—thereby perpetuating an ongoing violation of the Act and the Permits." Complaint, ¶43.

This level of pleading fails even from a notice pleading standard to advise the Respondent of how it is allegedly violating the terms of its permits, and the Complaint should be dismissed on this basis, as well. *See, e.g.,* 35 Ill. Adm. Code 103.204(c) ("The complaint must … contain: **2)** The dates, location, events, nature, extent, duration, and strength of discharges or emissions and consequences alleged to constitute violations of the Act and regulations. The complaint must advise respondents of the extent and nature of the alleged violations to reasonably allow preparation of a defense.").

E. Count II Should Be Dismissed for Lack of Ripeness

Complainants' allegations with respect to the not-yet-operational compost facility necessarily rely on speculation: "The Compost Facility Will Cause Even Greater Pollution..." Complaint, p. 13. Complainants have not demonstrated any actual violation with respect to the Compost Facility and this claim is inherently unripe.

IV. CONCLUSION

For the foregoing reasons, the Defendant Catholic Bishop of Chicago respectfully requests that this Tribunal grant its Motion to Dismiss and dismiss the Complaint with prejudice, and for all such further relief as may be appropriate.

Dated: November 16, 2022

Respectfully submitted,

/s/ Jonathan H. Ebner
Jonathan H. Ebner
BAKER & McKENZIE LLP
300 East Randolph Street, Suite 5000
Chicago, Illinois 60601
Telephone: (312) 861-2933
Facsimile: (312) 861-2899
Email: jon.ebner@bakermckenzie.com

Attorneys for Respondent Catholic Bishop of Chicago

EXHIBIT 1

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 · (217) 782-3397
JB PRITZKER, GOVERNOR JOHN J. KIM, DIRECTOR

217/524-3301

JUL 05 2019

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
7015 0640 0002 6944 8011
7015 0640 0002 6944 8028

Catholic Bishop of Chicago
c/o Catholic Cemeteries
Attn: Roman Szabelski
1400 South Wolf Road
Hillside, IL 60162-2197

Patriot Acres
Attn: Mathew Smarjesse
811 Milwaukee
Glenview, IL 60025

Re: 0310630001 – Cook County
Des Plaines Landfill
Log No. 2018-090
Permit Landfill 807 file
Permit Correspondence

0318125005 – Cook County
Patriot Acres
Log No. 2018-471
03T Permits, Compost
Permit Correspondence

Dear Mr. Szabelski and Mr. Smarjesse:

Catholic Bishop of Chicago as owner and operator of the Des Plaines Landfill and Catholic Bishop of Chicago. as owner and Patriot Acres as operator of the proposed Patriot Acres landscape waste composting facility, is hereby notified that the Illinois Environmental Protection Agency (the Illinois EPA) intends to consider information, that was provided by a third party, in its review of your permit applications, which we have designated as Log No. 2018-090 (Des Plaines Landfill) and Log No. 2018-471 (Patriot Acres). Log No. 2018-090 requests authorization to modify a portion of the existing final grade ground surface with the proposed end use of a compost facility for the Des Plaines Landfill. Log No. 2018-471 requests authorization to develop and operate the landscape waste composting facility.

Specifically, the Illinois EPA intends to consider information presented in the June 18, 2019 e-mail from David Van Vooren and Donald Owen (attached). The June 18, 2019 e-mail expresses concern over potential environmental issues pertaining to the permit applications.

If the Catholic Bishop of Chicago, an Illinois Corporation Sole, and Patriot Acres wish to respond to this notice by providing the Illinois EPA with information addressing the issue described above, it should do so by sending such information, original and two (2) photocopies, directly to the attention of Jacki Cooperider regarding Log No. 2018-090, and original and two (2) photocopies, directly to the attention of Derek Rompot regarding Log No. 2018-471, at the address below:

Permit Section, Bureau of Land #33
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

Illinois EPA is requesting submittal of the information by 5:00 p.m. on July 19, 2019. Submission by this date and time is necessary to help insure that the Illinois EPA has time to fully consider the information before making a final decision regarding applications Log Nos. 2018-090 and 2018-471. If the information cannot be submitted to the Illinois EPA by 5:00 p.m. on July 19, 2019, the Illinois EPA's deadline for taking final action on the application, which is currently July 26, 2019, will need to be extended.

Should you have any questions regarding this application or about this letter, please contact either Jacki Cooperider at 217/785-0100 or Derek Rompot at 217/524-3262.

Sincerely,

Kenneth E. Smith

Kenneth E. Smith, P.E. Manager
Permit Section
Division of Land Pollution Control
Bureau of Land

KES:TWH:JMC:DCR:3010630001-807LF-018090-Wells2.docx
JMC DCR 0318125005-comp-2018-471-Wells2.docx

Attachment: E-mail from David Van Vooren
E-mail from Don Owen

cc: John Lardner, JPL Environmental Engineering

Rompot, Derek

From:	David Van Vooren <dvv@swancc.org>
Sent:	Tuesday, June 18, 2019 9:11 AM
To:	Rominger, Kyle; Timm, Jay; Smith, Kenn
Cc:	Cooperider, Jacki; Rompot, Derek; Don Owen; James Tigue; 'Raymond Rummel (rrummel@elkgrove.org)'; 'George Van Dusen'; Moose, Devin; Labelle, Spencer J
Subject:	[External] RE: Patriot Acres IEPA Log No. 2018-471 & IEPA Log No. 2018-090 Des Plaines landfill "leachate and gas load"
Attachments:	SWANCC - Patriot Acres Draft Denial Review No. 2.pdf

Mr. Smith & Mr. Rominger,

On behalf of the Solid Waste Agency of Northern Cook County, I am forwarding correspondence prepared by SWANCC's consulting engineers, Aptim, setting forth serious questions about Patriot Acres' application for a compost facility. SWANCC commissioned this review in reply to the Applicant's recent response to IEPA's denial letter and specifically concerns the issues of leachate and gas load on the underlying landfill. As we continue to work through the Applicant's response to IEPA, I will continue to share any additional concerns.

In addition, on May 28, 2019, I informed IEPA that the Cook County Board forwarded Patriot Acres' request for an extension of their "special use permit" to operate a compost facility (the permit expired on May 10, 2019) to the Cook County Zoning Committee for review. I am now informed that the request will be heard at the Committee's July 2019 meeting and not its June 26th meeting. Without a valid special use permit for Patriot Acres, it would be pre-mature for the IEPA to issue any findings on the permit request before it. Instead, a denial would be appropriate.

As always should you have any questions please do not hesitate to contact me.

Sincerely

David Van Vooren
Ex. Director SWANCC

APTIM
1607 E. Main Street, Suite E
St. Charles, IL 60174
Tel: +1 630 762 1400
Fax: +1 630 762 1402

June 17, 2019

Mr. Dave Van Vooren
Executive Director
Solid Waste Agency of Northern Cook County
77 Hintz Road, Suite 200
Wheeling, IL 60090

Subject: Review of Second Draft Denial Response | IEPA Log # 2018-090 - Des Plaines Landfill

Mr. Van Vooren:

At the request of the Solid Waste Agency of Northern Cook County (SWANCC), Aptim Environmental & Infrastructure, LLC (APTIM) is submitting this review of the second draft denial response submitted by Patriot Acres, LLC (applicant) to the attention of Ms. Jacki Cooperider of the Illinois Environmental Protection Agency (IEPA) in March 2019. The second draft denial response attempts to address seven (7) comments provided by the IEPA. Our review focused on the applicant's response to Comment 6 provided by the IEPA, which states the following:

> *"Please provide discussion and calculations regarding the effect the increased load on the final cover will have on leachate and gas production and how the landfill will address the increased leachate and gas load."* (Emphasis added by APTIM).

Upon our review of the draft denial response presented by the applicant, it was determined that the response does not conform to the IEPA's request and omits design considerations that have potential to exacerbate ongoing environmental contamination at the Des Plaines Landfill (Landfill).

Ongoing environmental concerns at the Landfill

On February 4, 2019, APTIM submitted an evaluation of the leachate levels within the Landfill to Ms. Jacki Cooperider of the IEPA (**Attachment 1**). This evaluation demonstrated that, as of September 2017, a leachate mound approximately 43-ft. above surrounding groundwater levels was present within the Landfill. APTIM noted that this leachate mounding demonstrates that the Landfill final cover is not effective in minimizing storm water from infiltrating the Landfill. High leachate levels within the Landfill has been identified as the primary issue affecting the performance of the landfill gas control system. Outward advective movement of both leachate and landfill gas have been implicated as the source of the three (3) groundwater contamination plumes at the Landfill.

In this second draft denial response, the applicant has determined that, "Leachate from the landfill is primarily the result of infiltration of precipitation through the protective and cover soil." The Landfill final cover system is therefore acknowledged by the applicant to not be effective or functioning appropriately to minimize infiltration of precipitation through the final cover system and becoming leachate. APTIM has identified significant concerns with the proposed compost facility design that will adversely affect the existing, ineffective Landfill final cover and will likely increase infiltration of precipitation into the Landfill.

Removal of vegetation will increase infiltration

As part of the proposed compost facility design, the applicant intends to remove the vegetation and upper 6 inch soil layer from the Landfill final cover and replace it with a surface layer designated as the "all-weather surface". The all-weather surface will be placed on top of the existing final cover soils and consist of a 12-in. layer of broken block/brick/concrete overlain by 6-in. of asphalt screenings. According to the applicant, the all-weather surface will allow drainage to flow both vertically through the asphalt screenings and broken block/brick/concrete layers and horizontally along the existing final cover soils.

APTIM

By removing vegetation from the Landfill final cover, evapotranspiration will no longer be utilized to remove water from the Landfill prior to infiltrating through the final cover into the waste mass. Evapotranspiration accounts for a significant quantity of water being removed from the final cover which consequently decreases the quantity of water that can infiltrate through the final cover. The all-weather surface design will not provide an evapotranspiration pathway for water to be removed from the final cover. Therefore, the all-weather surface design will increase the quantity of water that can infiltrate through the final cover into the waste mass, resulting in an increase in leachate generation.

The United States EPA created a program called the Hydrologic Evaluation of Landfill Performance (HELP) model that models rainfall, runoff, infiltration, and other water pathways to estimate leachate generation at landfills and other land disposal systems. We suggest that the HELP model be utilized to compare the estimated leachate generation at the Landfill using the existing Landfill final cover configuration and the all-weather surface from the proposed compost facility design. Results of the HELP model will prove that the all-weather surface will increase leachate generation at the Landfill.

Incomplete determination of impermeable soils

As discussed previously, the applicant indicates that the all-weather surface will allow drainage to flow vertically through the asphalt screenings layer and horizontally along the existing final cover soils. The applicant collected one (1) Shelby Tube sample to evaluate the hydraulic conductivity of the existing Landfill final cover to determine compliance with Title 35 Illinois Administrative Code (IAC) Part 830.205(b)(1)(A)(i), which states the following:

> *"(A) Compost areas must be: (i) Located on relatively impermeable soils, as demonstrated by actual measurements;"*

The IEPA defines impermeable soils as those that have hydraulic conductivity values less than $1x10^{-5}$ centimeters per second (cm/s).

However, the information provided by the applicant does not confirm compliance with Title 35 IAC 830.205(b)(1)(A)(i) for multiple reasons. The applicant indicates that the thickness of the Landfill final cover ranges from 10 to 25 ft. which likely consists of variable soils with different soil properties throughout the Landfill final cover. One Shelby Tube sample is not sufficient in determining the hydraulic conductivity of the existing Landfill final cover to confirm compliance. In addition, the single Shelby Tube sample obtained by the applicant was collected more than 100-ft. outside of the proposed compost facility footprint. Furthermore, the laboratory test completed on the Shelby Tube sample to determine the hydraulic conductivity was run with a confining pressure that is significantly greater than the anticipated pressure on the Landfill final cover, resulting in an altered hydraulic conductivity value.

Based on the lack of appropriate information provided by the applicant, compliance with Title 35 IAC 830.205(b)(1)(A)(i) has not been demonstrated.

Reduction in slope will result in increased infiltration

In addition to modifying the Landfill final cover configuration, the applicant intends to reduce the slope of the Landfill final cover to a 2% slope across portions of the proposed compost facility. By reducing the slope, the time that water travels along the Landfill final cover increases. As noted previously, the existing Landfill final cover is ineffective in preventing water from infiltrating through to the waste mass. Increasing the time that water travels along the existing Landfill final cover also increases the time that water has potential to infiltrate into the waste mass. Increasing the time at which water can infiltrate will result in an increase in the overall quantity of water that will infiltrate through the Landfill final cover into the waste mass, generating an increased amount of leachate.

Recirculated water will increase leachate generation

As part of the stormwater management system of the proposed compost facility design, the applicant intends to collect both stormwater runoff and compost leachate in stormwater detention basins. The collected stormwater runoff and compost leachate will be recirculated and applied to the compost piles to add moisture.

As a result of this proposed operation, water that currently lands on the Landfill and the proposed compost facility only during rain events would then be recirculated and applied to the compost pad again on a routine basis. Despite the stormwater detention basins being lined with geomembrane, collected water within the stormwater detention basins will be applied to the Landfill through reapplication, negating any reduction of the total volume of water that can infiltrate through the Landfill final cover. Rather, the total volume of water that lands on the Landfill and proposed compost facility would be increased, which will result in an increased quantity of water that will infiltrate through the Landfill final cover into the waste mass, generating an increased amount of leachate.

Remediation of leachate mound continues to be unaddressed

The applicant concludes their response to Comment 6 within this second draft denial by determining that decreased leachate disposal rates indicate that leachate storage within the Landfill is being reduced. This determination cannot be substantiated because the applicant does not consider the potential increases in both infiltration and leachate generation that will occur upon development of the compost facility, as discussed in the preceding sections.

The applicant determined that the volume of leachate disposal has historically increased or decreased based on the pattern of annual precipitation, which indicates that leachate levels within the Landfill are directly related to water infiltrating through the Landfill final cover. As demonstrated by the applicant, annual precipitation quantities have increased over the past three years. However, leachate disposal rates have decreased during this time period. As a result of the decreased leachate disposal rates, a leachate mound approximately 43-ft. above surrounding groundwater levels was occurring within the Landfill as of September 2017, based on leachate level measurements from leachate extraction wells. Due to the build-up of leachate in the Landfill, both leachate removal and landfill gas collection systems are not effectively operating according to the annual Evaluation of Remedial Measures (EMR) reports. Based on our review of previous EMR reports, the Illinois EPA has agreed with this conclusion.

In order to ensure that the environmental management systems at the Landfill are effectively operating to address the ongoing environmental contamination, the build-up of leachate in the Landfill must be reduced through increased leachate disposal and minimizing leachate generation through infiltration. Furthermore, dedicated piezometers need to be installed to measure leachate levels within the Landfill on a semi-annual basis to provide an accurate depiction of the effectiveness of leachate level reduction efforts. At present, leachate level measurements are obtained from leachate extraction wells, which result in lower leachate level measurements than are actual present within the Landfill. Leachate level measurements from dedicated piezometers will show that the applicant's determination is not accurate.

Conclusion

The response provided by the applicant does not conform to the IEPA's request and omits design considerations that will exacerbate ongoing environmental contamination at the Landfill. The applicant has not provided calculations or demonstrations to support their claim that leachate generation will decrease due to the proposed compost facility design. The applicant's determination that the existing Landfill final cover is impermeable has not been demonstrated through actual measurements. Instead, the applicant has provided evidence that indicates that the existing Landfill final cover is permeable and needs to be improved. In addition, the removal of vegetation, the reduction in slope, and the recirculation of water onto the Landfill final cover are all likely to increase infiltration.

Sincerely,

Devin Moose, P.E.
Director of Solid Waste
Aptim Environmental & Infrastructure, LLC

ATTACHMENT 1

IEPA Correspondence (February 2019)
Depiction of Environmental Concerns

APTIM

APTIM

APTIM
1607 E. Main Street, Suite E
St. Charles, IL 60174
Tel: +1 630 762 1400
Fax: +1 630 762 1402

February 4, 2019

Ms. Jacki Cooperider, P.E.
Illinois Environmental Protection Agency
Bureau of Land/Permit Section
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

Subject: Des Plaines (Sexton) Landfill | Depiction of Environmental Concerns

Ms. Cooperider:

Aptim Environmental & Infrastructure, Inc. (APTIM) is submitting this response to email correspondence provided by the Illinois Environmental Protection Agency (IEPA) on January 29, 2019. Within the email, the IEPA requested APTIM to identify areas with significant leachate head levels (20 feet above the shallow groundwater table) within the Des Plaines (Sexton) Landfill. This request followed an earlier conversation on January 23, 2019 when APTIM expressed concern that locating a proposed compost facility on top of the unlined landfill would increase leachate levels.

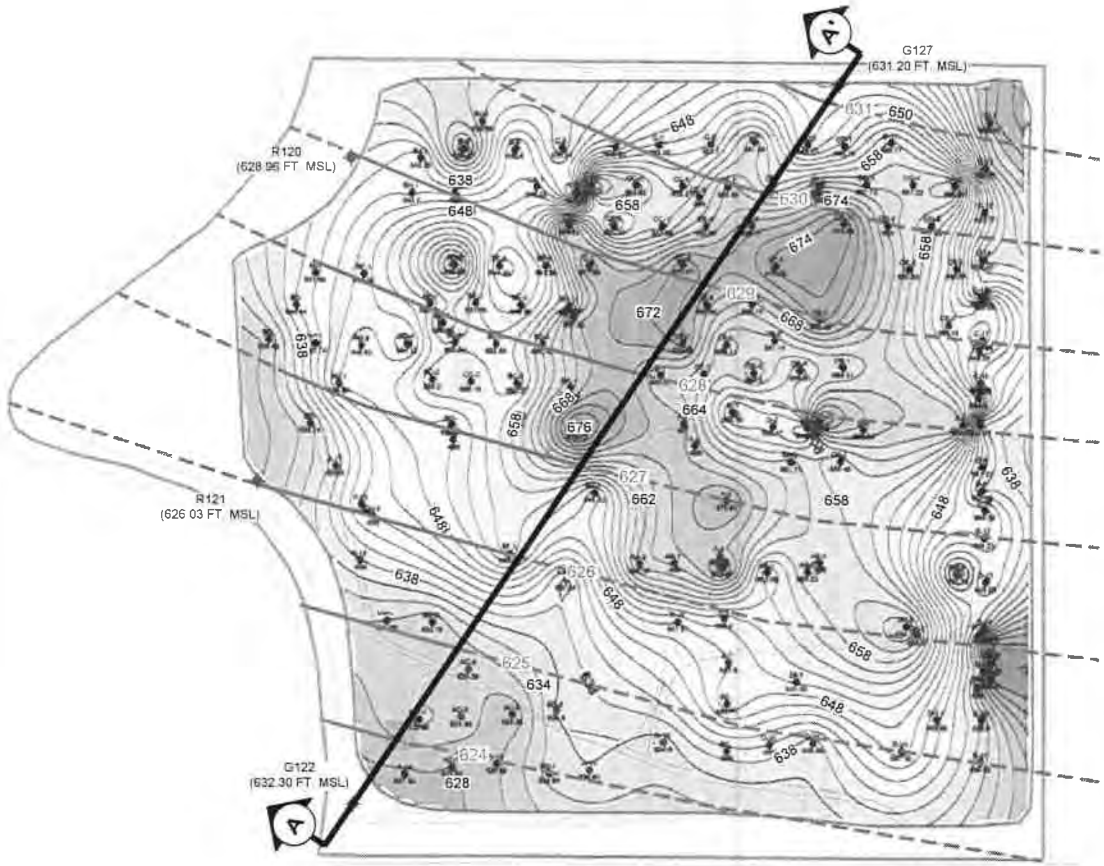
APTIM has obtained information regarding the measured leachate level elevations and measured shallow groundwater elevations from the IEPA via the Freedom of Information Act (FOIA) process. Measurements of the leachate levels within the Sexton Landfill were completed most-recently in September 2017. In order to accurately depict the conditions at the Sexton Landfill, measurements of the shallow groundwater unit from the third quarter of 2017 were utilized to evaluate the difference in elevation. As shown in the attached figures, leachate potentiometric levels are significantly above the groundwater table over the majority of the landfill's footprint.

Despite efforts to remove leachate from the landfill, leachate levels are approximately forty-three feet (43') higher than the groundwater table near its center. Near the approximate waste boundary, the leachate levels range between approximately five (5) and twenty (20) feet above the groundwater table. The most significant difference in elevation between the leachate levels and the shallow groundwater unit lies between G127 and the closest leachate extraction point (not readily identifiable). The high leachate levels indicate that storm water is likely penetrating the existing landfill cap. This mounding of leachate indicates radial flow away from the center of landfill. As the IEPA is aware, the Sexton Landfill is an Illinois Administrative Code 807 facility, and, as such, does not have a composite liner.

Based on the high leachate levels above the groundwater table within the landfill, APTIM continues to be concerned that the landfill final cover is not effective in minimizing storm water from infiltrating the cap. Due to the fact that proposed compost facility intends to use significant volumes of water to condition compost piles, locating a compost facility on top of this landfill will likely increase the leachate levels within the landfill. The mounding of leachate demonstrated in the attached figures, and resulting radial flow away from the facility, indicate that the potential for groundwater contamination from this unlined landfill is significant around the entirety of the landfill, and will likely be exacerbated by the addition of a compost facility.

Sincerely,

Devin Moose, P.E.
Director of Solid Waste
Aptim Environmental & Infrastructure, Inc.



LEGEND

G122 (632.30 FT MSL) ✦	APPROXIMATE SHALLOW GROUNDWATER WELL LOCATION
—— 631 ——	APPROXIMATE POTENTIOMETRIC CONTOUR
— — 630 — —	INTERPOLATED POTENTIOMETRIC CONTOUR
676	ADDITIONAL LEACHATE LEVEL ELEVATION CONTOUR LABELS

NOTES

1. LEACHATE LEVEL MEASUREMENT LOCATIONS AND ELEVATIONS OBTAINED FROM *PERMIT APPLICATION TO DEVELOP AND OPERATE A COMPOST FACILITY* (IEPA LOG # 2018-471) - LEACHATE LEVEL ELEVATION MAP PREPARED BY ENVIRONMENTAL INFORMATION LOGISTICS, LLC (SEPTEMBER 2017).
2. SHALLOW GROUNDWATER WELL LOCATION AND ELEVATIONS OBTAINED FROM *2017 ANNUAL ASSESSMENT OF GROUNDWATER FLOW AND HYDRAULIC GRADIENTS* PREPARED BY ENVIRONMENTAL INFORMATION LOGISTICS, LLC (JULY 2018)

REV. NO.	DATE	DESCRIPTION

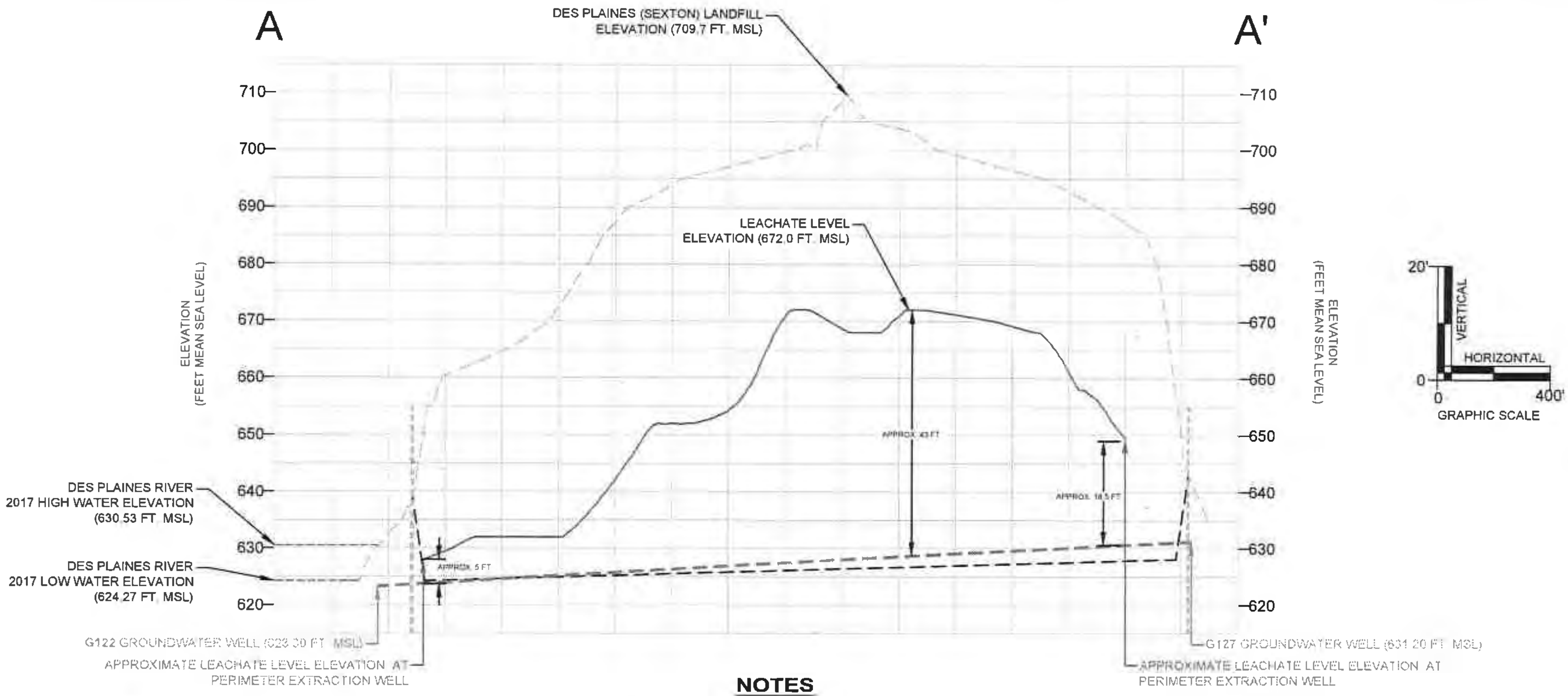
APTIM

APTIM Environmental & Infrastructure, LLC

DES PLAINES (SEXTON) LANDFILL

LEACHATE LEVEL AND SHALLOW GROUNDWATER ELEVATIONS SEPTEMBER 2017

DRAWN BY: SJL/BWM | APPROVED BY: DAM | PROJ. NO.: 631237181/631238471 | DATE: JANUARY 2019



LEGEND

- APPROXIMATE EXISTING TOPOGRAPHY
- APPROXIMATE WASTE BOUNDARY
- APPROXIMATE LEACHATE LEVEL ELEVATION (SEPT. 2017)
- APPROXIMATE SHALLOW GROUNDWATER ELEVATION (AUG. 2017)
- APPROXIMATE BOTTOM OF LANDFILL
- APPROXIMATE DES PLAINES RIVER WATER ELEVATION

NOTES

1. EXISTING TOPOGRAPHY AND APPROXIMATE WASTE BOUNDARY OBTAINED FROM *DES PLAINES LANDFILL 2018 GMZ MONITORING REPORT* (IEPA LOG # 2018-393) - SITE LOCATION AND PLAN PREPARED BY ENVIRONMENTAL INFORMATION LOGISTICS, LLC
2. LEACHATE LEVEL ELEVATIONS OBTAINED FROM *PERMIT APPLICATION TO DEVELOP AND OPERATE A COMPOST FACILITY* (IEPA LOG # 2018-471) - LEACHATE LEVEL ELEVATION MAP PREPARED BY ENVIRONMENTAL INFORMATION LOGISTICS, LLC. (SEPTEMBER 2017).
3. SHALLOW GROUNDWATER WELL LOCATION AND ELEVATIONS OBTAINED FROM *2017 ANNUAL ASSESSMENT OF GROUNDWATER FLOW AND HYDRAULIC GRADIENTS* PREPARED BY ENVIRONMENTAL INFORMATION LOGISTICS, LLC. (JULY 2018).
4. BOTTOM OF LANDFILL WAS APPROXIMATED TO BE 15 FT. BELOW GROUND SURFACE AT THE APPROXIMATE WASTE DISPOSAL BOUNDARY AT A 3H:1V SLOPE. BOTTOM OF LANDFILL LOCATION WAS APPROXIMATED BASED ON EXPERIENCE AND KNOWLEDGE OF LOCAL DEVELOPMENT DURING THE CONSTRUCTION OF THE LANDFILL (1974 TO 1991).
5. DES PLAINES RIVER ELEVATIONS WERE DETERMINED USING THE UNITED STATES GEOLOGICAL SURVEY (USGS) SURFACE-WATER MONTHLY ELEVATION STATISTICS AT WATER GAUGE 05529000 LOCATED APPROXIMATELY 1.5 MILES UPSTREAM OF THE LANDFILL.

REV. NO.	DATE	DESCRIPTION

APTIM Environmental & Infrastructure, LLC

DES PLAINES (SEXTON) LANDFILL

CROSS-SECTION

DRAWN BY: SJL/BWM | APPROVED BY: DAM | PROJ. NO.: 631237181/631236471 | DATE: JANUARY 2019

Rompot, Derek

From:	Don Owen <dowen@glenview.il.us>
Sent:	Tuesday, June 18, 2019 9:22 AM
To:	Rominger, Kyle; Smith, Kenn
Cc:	Cooperider, Jacki; Rompot, Derek; James Tigue; 'Raymond Rummel (rrummel@elkgrove.org)'; 'George Van Dusen'; Moose, Devin; Labelle, Spencer J; David Van Vooren; Timm, Jay
Subject:	[External] RE: Patriot Acres IEPA Log No. 2018-471 & IEPA Log No. 2018-090 Des Plaines landfill "leachate and gas load"
Attachments:	Village of Glenview - Patriot Acres Draft Denial Review No. 2.pdf

Mr. Smith & Mr. Rominger,

Please note that the Village of Glenview has coordinated with SWANCC to study the potential negative impacts of the Patriot Acres development and is aligned with the comments provided by SWANCC Executive Director Van Vooren below. Aptim, our joint consultant, provided the Village of Glenview with a similar letter (see attached).

Donald K. Owen | Deputy Village Manager
Village of Glenview
2500 East Lake Avenue | Glenview, IL 60026
PH: (847) 904-4478

From: David Van Vooren [mailto:dvv@swancc.org]
Sent: Tuesday, June 18, 2019 9:11 AM
To: Rominger, Kyle <Kyle.Rominger@Illinois.gov>; Timm, Jay <JAY.TIMM@Illinois.gov>; Kenn.Smith@Illinois.gov
Cc: Cooperider, Jacki <Jacki.Cooperider@Illinois.gov>; Rompot, Derek <Derek.Rompot@Illinois.gov>; Don Owen <dowen@glenview.il.us>; James Tigue <jtigue@glenview.il.us>; 'Raymond Rummel (rrummel@elkgrove.org)' <rrummel@elkgrove.org>; 'George Van Dusen' <george.vandusen@skokie.org>; Moose, Devin <Devin.Moose@aptim.com>; Labelle, Spencer J <spencer.labelle@aptim.com>
Subject: RE: Patriot Acres IEPA Log No. 2018-471 & IEPA Log No. 2018-090 Des Plaines landfill "leachate and gas load"

Mr. Smith & Mr. Rominger,

On behalf of the Solid Waste Agency of Northern Cook County, I am forwarding correspondence prepared by SWANCC's consulting engineers, Aptim, setting forth serious questions about Patriot Acres' application for a compost facility. SWANCC commissioned this review in reply to the Applicant's recent response to IEPA's denial letter and specifically concerns the issues of leachate and gas load on the underlying landfill. As we continue to work through the Applicant's response to IEPA, I will continue to share any additional concerns.

In addition, on May 28, 2019, I informed IEPA that the Cook County Board forwarded Patriot Acres' request for an extension of their "special use permit" to operate a compost facility (the permit expired on May 10, 2019) to the Cook County Zoning Committee for review. I am now informed that the request will be heard at the Committee's July 2019 meeting and not its June 26th meeting. Without a valid special use permit for Patriot Acres, it would be pre-mature for the IEPA to issue any findings on the permit request before it. Instead, a denial would be appropriate.

As always should you have any questions please do not hesitate to contact me.

Sincerely

David Van Vooren
Ex. Director SWANCC

EXHIBIT 2

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 · (217) 782-3397
JB PRITZKER, GOVERNOR **JOHN J. KIM**, DIRECTOR

217/524-3301

AUG 02 20[illegible]

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
7015 0640 0002 6944 7090
7015 0640 0002 6944 7106

Catholic Bishop of Chicago
c/o Catholic Cemeteries
Attn: Roman Szabelski
1400 South Wolf Road
Hillside, IL 60162-2197

Patriot Acres
Attn: Mathew Smarjesse
811 Milwaukee
Glenview, IL 60025

Re: 0310630001 – Cook County
Des Plaines Landfill
Log No. 2018-090
Permit Landfill 807 file
Permit Correspondence

0318125005 – Cook County
Patriot Acres
Log No. 2018-471
03T Permits, Compost
Permit Correspondence

Dear Mr. Szabelski and Mr. Smarjesse:

Catholic Bishop of Chicago as owner and operator of the Des Plaines Landfill and Catholic Bishop of Chicago. as owner and Patriot Acres as operator of the proposed Patriot Acres landscape waste composting facility, is hereby notified that the Illinois Environmental Protection Agency (the Illinois EPA) intends to consider information, that was provided by a third party, in its review of your permit applications, which we have designated as Log No. 2018-090 (Des Plaines Landfill) and Log No. 2018-471 (Patriot Acres). Log No. 2018-090 requests authorization to modify a portion of the existing final grade ground surface with the proposed end use of a compost facility for the Des Plaines Landfill. Log No. 2018-471 requests authorization to develop and operate the landscape waste composting facility.

Specifically, the Illinois EPA intends to consider information presented in the July 18, 2019 e-mail from David Van Vooren (attached). The July 18, 2019 e-mail expresses concern over potential environmental issues pertaining to the permit applications.

If the Catholic Bishop of Chicago, an Illinois Corporation Sole, and Patriot Acres wish to respond to this notice by providing the Illinois EPA with information addressing the issue described above, it should do so by sending such information, original and two (2) photocopies, directly to the attention of Jacki Cooperider regarding Log No. 2018-090, and original and two (2) photocopies, directly to the attention of Derek Rompot regarding Log No. 2018-471, at the address below:

Permit Section, Bureau of Land #33
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

Illinois EPA is requesting submittal of the information by 5:00 p.m. on August 23, 2019. Submission by this date and time is necessary to help insure that the Illinois EPA has time to fully consider the information before making a final decision regarding applications Log Nos. 2018-090 and 2018-471. If the information cannot be submitted to the Illinois EPA by 5:00 p.m. on August 23, 2019, the Illinois EPA's deadline for taking final action on the application, which is currently August 27, 2019, will need to be extended.

Should you have any questions regarding this application or about this letter, please contact either Jacki Cooperider at 217/785-0100 or Derek Rompot at 217/524-3262.

Sincerely,

Kenneth E. Smith

Kenneth E. Smith, P.E. Manager
Permit Section
Division of Land Pollution Control
Bureau of Land

KES:TWH:JMC:DCR:3010630001-807LF-018090-Wells3.docx
JMC DCR 0318125005-comp-2018-471-Wells3.docx

Attachment: E-mail from David Van Vooren

cc: John Lardner, JPL Environmental Engineering

Rompot, Derek

From:	David Van Vooren <dvv@swancc.org>
Sent:	Thursday, July 18, 2019 2:34 PM
To:	Rominger, Kyle; Timm, Jay; Smith, Kenn
Cc:	Cooperider, Jacki; Rompot, Derek; Don Owen; James Tigue; 'Raymond Rummel (rrummel@elkgrove.org)'; 'George Van Dusen'; Moose, Devin; Labelle, Spencer J
Subject:	[External] RE: Patriot Acres IEPA Log No. 2018-090 | Des Plaines Landfill
Attachments:	SWANCC - Patriot Acres Draft Denial Review No. 3.pdf

Mr. Smith & Mr. Rominger,

I have attached correspondence form SWANCC outlining our concerns in the recent response that the applicant has submitted regarding the above referenced permit. As we continue to work through the applicants response I will continue to share our concerns with the IEPA.

As always should you have any questions please do not hesitate to contact me.

Sincerely

David Van Vooren
Ex. Director SWANCC

APTIM

APTIM
1607 E. Main Street, Suite E
St. Charles, IL 60174
Tel: +1 630 762 1400
Fax: +1 630 762 1402

July 18, 2019

Mr. Dave Van Vooren
Executive Director
Solid Waste Agency of Northern Cook County
77 Hintz Road, Suite 200
Wheeling, IL 60090

Subject: Review of Second Draft Denial Response | IEPA Log # 2018-090 - Des Plaines Landfill

Mr. Van Voreen:

At the request of the Solid Waste Agency of Northern Cook County (SWANCC), Aptim Environmental & Infrastructure, LLC (APTIM) is submitting this review of the second draft denial response submitted by Patriot Acres, LLC (Applicant). The Applicant submitted the second draft denial response to the attention of Ms. Jacki Cooperider of the Illinois Environmental Protection Agency (IEPA) in March 2019.

The second draft denial response attempts to address seven (7) comments provided by the IEPA. This letter is focused on the Applicant's response to Comment 3 provided by the IEPA, which states the following:

> *"Please provide slope stability calculations for the proposed developed areas on the landfill final cover including the compost areas, retention ponds, staging building, and storage areas."* (Emphasis added by APTIM).

Upon our review of the draft denial response presented by the Applicant, it was determined that the response does not conform to the IEPA's request, nor does it consider the current conditions of the Des Plaines Landfill (Landfill) including the leachate mound approximately 43-ft. above surrounding groundwater levels.

Slope stability analysis does not evaluate entire compost facility

The IEPA is currently reviewing two (2) permit applications submitted by the Applicant. The first is to modify the final grade surface of the Landfill (IEPA Log # 2018-090). The second is to develop and operate a compost facility (IEPA Log #2018-471). In both permit applications, the Applicant is seeking a permit to construct and operate a compost facility with two phases, Phase I (4.66 acres) and Phase II (7.16 acres). The overall compost facility will include multiple composting areas, curing areas, finished compost storage areas, and two (2) stormwater detention basins while also modifying the Landfill final cover grades.

The slope stability analysis presented in the draft denial response does not consider the geometry or loading conditions of the Phase II of the proposed compost facility. The slope stability analysis omits loads and slope modifications from multiple composting areas, curing areas, finished compost storage areas, the stormwater detention basin, and modified landfill final cover grades. The slope stability analysis presented in the draft denial response is therefore incomplete and does not conform to the IEPA's request.

Geotechnical properties of waste do not reflect risks associated with the leachate mound

Although the Landfill has been certified closed for almost 30 years, a leachate mound approximately 43-ft. above surrounding groundwater levels was present within the Landfill as of September 2017. The presence of a leachate mound indicates that the waste is saturated, which increases the risk of slope failure. Ten (10) large landfill slope failures were evaluated in the technical paper entitled, "*Stability Assessment of Ten Large Landfill Failures*" by Robert M. Koerner and Te-Yang Soong published in 2000.

Koerner built upon this technical paper in 2014 to present an evaluation of twenty (20) solid waste landfill slope failures. According to the technical paper and presentation, it was determined in both evaluations that the triggering mechanisms were all liquid related, i.e., leachate buildup within the waste mass, wet clay beneath the geomembrane, or excessively wet foundation soils.

In the slope stability analysis prepared by the Applicant, geotechnical properties of the waste (unit weight, cohesion, and friction angle) were defined with generalized values from a technical paper that is based on typical, unsaturated municipal solid waste. A friction angle of 35 degrees was used in the analysis. However, Dr. Krishna Reddy of the University of Illinois at Chicago studied the consolidated undrained shear strength friction angle of saturated municipal solid waste at an Illinois landfill and found it to be 12 degrees (see attached).

Due to the high leachate levels within the Landfill and resulting saturated municipal solid waste conditions, the geotechnical properties utilized by the Applicant should be justified. Our concern is that the Applicant has assumed geotechnical properties of the waste that result in a significantly greater factor of safety value than may reflect current conditions of the Landfill. Prior to development of the proposed compost facility and Landfill modifications, an accurate slope stability analysis should be completed to ensure stability of the Landfill slopes and prevent unreasonable risk for the local environments and properties.

Geotechnical properties of in-situ soils are not substantiated

The Applicant utilized geotechnical properties for the in-situ soils beneath the Landfill that are not accurate. The Landfill was originally constructed within the floodplain of the Des Plaines River which indicates that in-situ soils are likely to be alluvial deposits with soft silts that have low strength properties. Despite this fact, the Applicant utilized geotechnical properties for compacted low plasticity clays reported in the "*Engineering and Design Manual, Coal Refuse Disposal Facilities*" report prepared by the United States Department of Labor, Mine Safety, and Health Administration.

The Applicant does not provide any laboratory data or other evidence to support their assumption that alluvial deposits would perform equally to a compacted low-plasticity clay liner installed in controlled lifts. The Landfill was not constructed with a Construction Quality Assurance (CQA) Plan, making it unlikely that the soils were compacted in controlled lifts. In fact, the Applicant provides no demonstration that the soils were compacted at all. As such, it is not appropriate to utilize geotechnical properties in the slope stability analysis that reflect compacted in-situ soils.

Seismic analysis was not completed for long-term conditions

The slope stability analysis was conducted using a circular search method for both short-term and long-term static conditions as well as short-term seismic conditions. Despite the slope stability analysis omitting Phase II of the compost facility and utilizing inaccurate geotechnical properties for the saturated waste, the slope stability analysis was not completed for long-term seismic conditions. Long-term seismic conditions will likely have the lowest factor of safety value.

The Applicant notes that the seismic analysis was not evaluated for long-term conditions because seismic events occur over a short duration lasting minutes, not weeks or months. However, this is inaccurate and demonstrates a lack of understanding by the Applicant. Short-term and long-term conditions are not describing the duration of the analysis or the seismic event. Rather, the short-term and long-term conditions describe the geotechnical properties of each individual layer as it relates to time in order to account for consolidation of the foundation soils and dissipation of the pore-water pressure from the waste. The seismic analysis should be completed for long-term conditions to ensure that the Landfill can withstand a seismic event after consolidation of the foundation soils and waste.

APTIM

Slope stability analysis does not consider localized berm stability

The slope stability analysis prepared by the Applicant evaluates the stability of the Landfill with proposed modifications for Phase I of the compost facility. This analysis does not consider the stability of the Phase I or Phase II stormwater detention basin berms on a localized level to ensure that the berms will not fail. Slope failure of the stormwater detention basin berm has the potential to result in an uncontrolled discharge of stormwater and compost leachate as well as catastrophic damage to the compost facility itself. Without analyzing the stability of both stormwater detention basin berms, unreasonable risks are being incurred by the Applicant and more so local environments and properties.

Conclusion

The draft denial response provided by the Applicant does not conform to the IEPA's request and does not consider the current conditions of the Landfill. The Applicant has not provided a slope stability analysis of the entire proposed compost facility including the stormwater detention basins and modified Landfill grades in Phase II. Furthermore, the slope stability analysis was not completed with accurate geotechnical values for the historically saturated waste nor the in-situ soils. In addition, the Applicant misunderstood the slope stability model conditions and therefore did not complete the appropriate seismic analysis. Critical stability analysis such as the stormwater detention basin berms in Phase I and Phase II were not completed. The draft denial response provided by the Applicant does not demonstrate that the proposed compost facility and Landfill modifications are designed to ensure the stability of critical compost facility slopes and Landfill slopes and is therefore incomplete.

Sincerely,

Devin Moose, P.E.
Director of Solid Waste
Aptim Environmental & Infrastructure, LLC

ATTACHMENT 1

Geotechnical properties of fresh municipal solid waste at Orchard Hills Landfill, USA (2008)

Written by Krishna R. Reddy, Hiroshan Hettiarachchi, Naveen Parakalla, Janardhanan Gangathulasi, Jean Bogner

APTIM

Waste Management 29 (2009) 952–959

Contents lists available at ScienceDirect

Waste Management

journal homepage: www.elsevier.com/locate/wasman

Geotechnical properties of fresh municipal solid waste at Orchard Hills Landfill, USA

Krishna R. Reddy [a,*], Hiroshan Hettiarachchi [b], Naveen S. Parakalla [a], Janardhanan Gangathulasi [a], Jean E. Bogner [c]

[a] Department of Civil and Materials Engineering, University of Illinois at Chicago, 842 West Taylor Street, Chicago, IL 60607, USA
[b] Department of Civil Engineering, Lawrence Technological University, 21000 West Ten Mile Road, Southfield, MI 48075, USA
[c] Landfills +, Inc., 1144 N. Wheaton, IL 60187, USA

ARTICLE INFO

Article history:
Accepted 21 May 2008
Available online 23 September 2008

ABSTRACT

This paper presents the results of a laboratory investigation to determine the geotechnical properties of fresh municipal solid waste (MSW) collected from the working phase of Orchard Hills Landfill located in Davis Junction (Illinois, USA). Laboratory testing was conducted on shredded MSW to determine the compaction, hydraulic conductivity, compressibility, and shear strength properties at in-situ gravimetric moisture content of 44%. In addition, the effect of increased moisture content during leachate recirculation on compressibility and shear strength of MSW was also investigated by testing samples with variable gravimetric moisture contents ranging from 44% to 100%. Based on Standard Proctor tests, a maximum dry density of 420 kg/m^3 was observed at 70% optimum moisture content. The hydraulic conductivity varied in a wide range of 10^{-8}–10^{-4} m/s and decreased with increase in dry density. Compression ratio values varied in a close range of 0.24–0.33 with no specific trend with the increase in moisture content. Based on direct shear tests, drained cohesion varied from 31 to 64 kPa and the drained friction angle ranged from 26 to 30°. Neither cohesion nor friction angle demonstrated any correlation with the moisture content, within the range of moisture contents tested. The consolidated undrained triaxial shear tests on saturated MSW showed the total strength parameters (c and φ) to be 32 kPa and 12°, and the effective strength parameters (c' and φ') to be 38 kPa and 16°. The angle of friction (φ) decreased and cohesion (c) value increased with the increase in strain. The effective cohesion (c') increased with increase in strain; however, the effective angle of friction (φ') decreased first and then increased with the increase in strain. Such strain-dependent shear strength properties should be properly accounted in the stability analysis of bioreactor landfills.

1. Introduction

For many countries, engineered landfilling continues to be an affordable and environmentally acceptable method of solid waste disposal. In the United States, approximately 54% of the waste is being landfilled (USEPA, 2007). In recent years, there has been a shift in philosophy of landfill design from the dry storage concept towards the bioreactor approach. In the bioreactor approach, the moisture content of the municipal solid waste (MSW) is increased by recirculation of leachate to enhance biodegradation of MSW. In addition to more rapid degradation, bioreactor landfills offer a significant reduction in post-closure management time (Reddy and Bogner, 2003).

The geotechnical properties of MSW are of prime importance for the design and maintenance of any type of landfill. However, bioreactor landfills have added new challenges for design engineers and operators. Recirculation of leachate in bioreactor landfills enhances the degradation of MSW, but at the same time the additional moisture raises stability concerns (Koerner and Soong, 2000; Reddy and Bogner, 2003). Stability may be impacted by increased unit weight of MSW and potential increase in pore water pressure build-up within the landfill. The decreased hydraulic conductivity of MSW resulting from heavy compaction may hinder the leachate recirculation process. Therefore, variation in hydraulic conductivity with compacted density of MSW is also an important consideration in the design of leachate recirculation system design. Landfill settlement is another important aspect of bioreactor landfills, which is typically estimated using the compressibility characteristics of the MSW. However, it is not well understood how the compressibility of MSW is affected by dynamic changes in moisture content within the landfill.

Settlement and stability are believed to be affected by the degradation of MSW. Stability of fresh MSW during the initial leachate recirculation operations is critical due to increased pore water pressures and rapid degradation rate. Rapidly settling MSW during the initial stages of operation of a bioreactor landfill may damage landfill infrastructure components such as leachate recirculation

* Corresponding author. Tel.: +1 312 996 4755; fax: +1 312 996 2426.
E-mail addresses: kreddy@uic.edu (K.R. Reddy), hiroshan@ltu.edu (H. Hettiarachchi), nparak2@uic.edu (N.S. Parakalla), jganga2@uic.edu (J. Gangathulasi), jbogner@landfillsplus.com (J.E. Bogner).

0956-053X/$ - see front matter © 2008 Elsevier Ltd. All rights reserved.
doi:10.1016/j.wasman.2008.05.011

piping and gas extraction wells. Within this context, it is important to understand the properties of fresh landfilled MSW as it is subjected to increased moisture content. Numerous studies have been previously conducted on the geotechnical properties of landfilled MSW, so that settlement and stability of landfills can be evaluated (Landva and Clark, 1990; Fassett et al., 1994; Gabr and Valero, 1995; Kavazanjian, 2001; Hossain, 2002; Sharma and Reddy, 2004; Dixon et al., 2005; Zekkos, 2005). However, limited research has been conducted to investigate the geotechnical properties of fresh MSW under the increased moisture content expected under bioreactor landfill conditions.

This paper describes a comprehensive laboratory study conducted on fresh MSW collected from a MSW landfill to investigate the variation of geotechnical properties with increased moisture content and density. Compaction characteristics, hydraulic conductivity, compressibility and shear strength properties of fresh MSW were determined. It should be noted that moisture content can be defined in the literature in three different ways: dry gravimetric moisture content, wet gravimetric moisture content, and volumetric moisture content (Sharma and Reddy, 2004); however, in this study moisture content is defined as dry gravimetric moisture content: $w_d = \frac{M_w}{M_s} \times 100$; where M_w is the mass of water and M_s is the mass of dry MSW. All the experiments were carried out as per the standard procedures established by the American Society of Testing and Materials (ASTM) for soils (ASTM, 2006).

2. MSW sample collection and characterization

Fresh MSW samples were collected from the working phase of Orchard Hills Landfill located in Davis Junction (Illinois, USA), which is owned and operated by Veolia Environmental Services. The landfill commenced its operation in 1988 and expects to complete by 2018. Composition of the MSW was determined according to a protocol developed by the French Environmental Protection Agency as referenced in Grellier et al. (2007). MSW components were grouped into different fractions (easily degradable, moderately degradable, hardly degradable, and inert) depending on their biodegradability. The typical composition of MSW is shown in Table 1. It can be seen that the MSW consists of approximately 29% inert (non-biodegradable) components. The residual fines (less than 20 mm in size) may contain some inert fraction, but it is difficult to quantify this by visual observations.

Based on testing of four representative bulk samples (greater than 5 kg each), the in-situ dry gravimetric moisture content of the MSW was found to be 44 ± 1%. During the moisture content determinations, the temperature was maintained at 60 °C to avoid combustion of volatile materials. Four dry samples were heated in large porcelain dishes to 440 °C to determine the organic content (loss-on-ignition) of the fresh MSW in accordance with ASTM D2974. The organic content of the MSW was found to be 76–84%.

The gradation of the moist MSW samples was determined in the field using a set of three large sieves with opening diameters of 100, 50 and 20 mm (Grellier et al., 2007). The size distribution of field MSW samples indicated that approximately 53%, 16% and 11% (wet weight basis) of the MSW was retained on 100, 50 and 20 mm sieves, respectively. The percent fines passing through the 20 mm sieve was 20%. Most of the traditional laboratory geotechnical testing equipment cannot accommodate field MSW samples with large particle sizes. Therefore, in order to facilitate standard laboratory testing, but with representative field composition, the bulk field MSW samples were shredded using a slow-speed, high torque shredder (Shred Pax Corp., AZ-7H, Wood Dale, IL, USA). The shredded MSW was dried and its gradation was determined using sieve analysis in accordance with ASTM D422. Fig. 1 shows

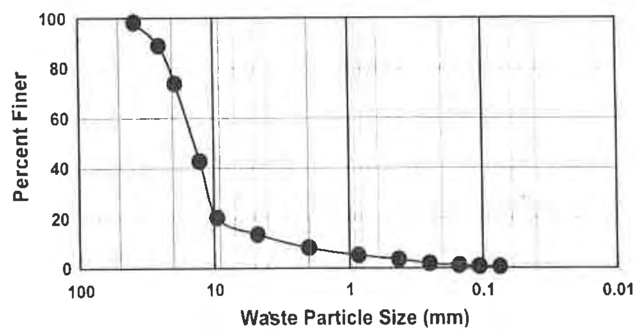


Fig. 1. Gradation of fresh MSW after shredding.

Table 1
Typical composition of fresh municipal solid waste at Orchard Hills Landfill

Category	Waste type	Waste composition (% by wet mass*)	
Easily biodegradable	Cooking waste	6.6	6.9
	Garden waste	0.3	
Medium biodegradable	Paper	8.2	24.6
	Cardboard	13.3	
	Food carton	0.0	
	Sanitary waste	3.1	
Hardly biodegradable	Textiles	5.8	19.2
	Nappies	1.7	
	Wood	11.7	
Inert waste	Metal	4.4	29.2
	Plastic bottles	5.7	
	Other plastics	5.3	
	Special waste	0.0	
	Medical waste	0.1	
	Other waste	3.5	
	Inert waste	5.8	
	Glass	4.4	
Residual fines**	Fines (<20 mm)	20.1	20.1

* Average gravimetric moisture content=44%.
** May include some inert fraction which is hard to visually identify and separate.

the typical gradation of shredded MSW, and it can be seen that the shredded samples consisted of particles with sizes ranging from 0.75 to 40 mm, but approximately 80% (by dry weight basis) of MSW consisted of particles with sizes less than 20 mm.

3. Testing methods

Although MSW samples were obtained from landfills, many previous studies have focused on testing of either individual MSW components or reconstituted MSW samples with predefined proportions (Landva and Clark, 1990; Grisolia et al., 1991; Gabr and Valero, 1995; Wall and Zeiss, 1995). In this study, the MSW samples collected from the field were shredded without any pre-sorting, and the geotechnical testing was conducted using these samples. Compaction, hydraulic conductivity, compressibility, and shear strength tests were conducted. During testing, every attempt was made to prevent biodegradation, so that the test results reflect the properties of the fresh MSW.

3.1. Compaction

Shredded oven-dried fresh MSW samples were used to evaluate compaction characteristics. Standard Proctor compaction tests were conducted in accordance with ASTM D698 using a 102 mm diameter mold. However, when it was needed to increase the moisture content during testing to simulate the field conditions, leachate (collected from Orchard Hill Landfill) was used instead of water. The testing was performed on samples with four different initial target moisture contents: 44%, 60%, 80%, and 100%.

3.2. Hydraulic conductivity

Constant head hydraulic conductivity tests were performed in accordance to ASTM D2434. For these tests, fresh MSW was compacted in the rigid-wall permeameter (with sample dimensions of 64 mm inside diameter and 160 mm height) using a tamping device. Flow rate under constant hydraulic gradient was measured. Darcy's law was used to calculate hydraulic conductivity. Hydraulic conductivity of MSW was also determined by flexi-wall triaxial testing which was performed in accordance with ASTM D5084. In this testing, cylindrical MSW samples (70 mm diameter and 140 mm height) were first subjected to a low initial confining pressure and then saturated by flushing deionized water from bottom up under a low hydraulic gradient. Once the sample was saturated, hydraulic conductivity was determined by measuring flow rate under constant gradient conditions. The sample was then consolidated under desired confining pressure, and the total volume change was measured by measuring the outflow from the sample based on which the increased density of the sample was calculated. The sample was checked for saturation and then hydraulic conductivity was determined under confined condition by measuring flow rate under constant gradient conditions and applying Darcy's law.

3.3. Compressibility

Confined compressibility testing was carried out in a floating ring oedometer to determine the compressibility characteristics of fresh MSW with varying moisture content. In this testing, the MSW sample was placed in the oedometer with one porous stone on the top and another on the bottom of the sample. Fresh MSW was compacted into 63 mm inside diameter and 27 mm thick circular oedometer rings with a tamping device. Leachate was added to MSW to prepare samples at 44%, 60%, 80%, and 100% moisture contents. For each load increment, strain vs. time readings were recorded until the primary compression process was complete. Long-term compressibility testing to assess secondary compression and biodegradation was beyond the scope of this study.

3.4. Drained shear strength

Direct shear tests were conducted to determine the drained shear strength parameters (cohesion and the angle of internal friction) of fresh MSW at different moisture contents. Tests were performed in accordance with ASTM D3080. Leachate was added to MSW to prepare samples at four different moisture contents (44%, 60%, 80%, and 100%). The samples were compacted in the circular shear box with 63 mm inside diameter and 49 mm height and then sheared at a constant strain rate under four different normal stress conditions: 176, 266, 538 and 630 kPa for 44% moisture content tests, and 176, 266, 538 and 774 kPa for other moisture content tests.

3.5. Consolidated undrained shear strength

In order to perform consolidated undrained (CU) triaxial testing, the fresh MSW at in-situ moisture content was compacted in a cell. Tests were performed according to ASTM D4767. Samples were compacted in a mold, extruded and then inserted into latex membranes. The samples were then set up in the triaxial shear setup. The average diameter and height of the samples were 70 mm and 140 mm, respectively. All samples were initially subjected to a confining pressure of 35 kPa and a back pressure of 21 kPa and were saturated. The samples were then consolidated under different confining pressures of 69, 138, and 276 kPa and volume change was measured. The MSW samples were finally subjected to shear under undrained condition. Shearing was done at low constant strain rate (approximately 1.0–1.2% per min) so that pore pressure generated was uniform throughout the specimen. The tests were repeated with samples with three different increased initial moisture contents.

4. Results and discussion

4.1. Compaction characteristics

Standard Proctor compaction tests conducted on shredded MSW resulted in a maximum dry density of 420 kg/m^3 at 70% optimum moisture content (see Fig. 2). However, under confined conditions (in triaxial hydraulic conductivity/shear tests), the dry density of MSW was found to increase to 600–620 kg/m^3. Hetti-

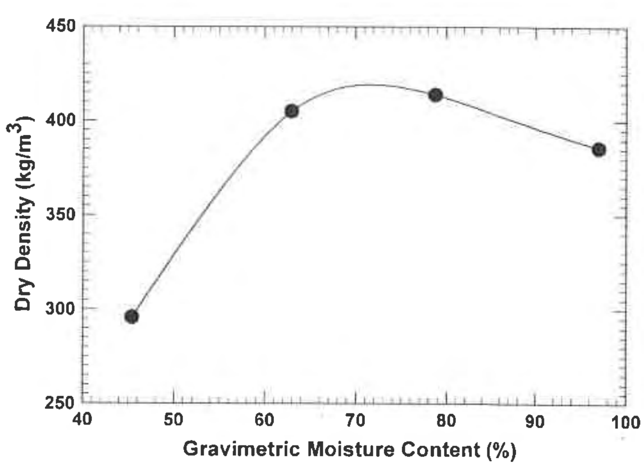


Fig. 2. Variation of dry density of fresh shredded MSW with gravimetric moisture content.

arachchi (2005) reported a maximum dry density of 525 kg/m^3 at 62% optimum moisture content for a MSW sample generated in the laboratory. The mix proportion for this lab-prepared MSW was selected to simulate the average MSW composition in the US and the average specific gravity was reported as 1.6, but the maximum particle size was limited to 12.5 mm as opposed to 40 mm in this study. The difference in the maximum particle sizes is believed to be one of the reasons responsible for the difference between the two maximum dry density values reported by these two studies. Another major reason could be the difference in the average specific gravity. Fresh MSW collected at Orchard Hills Landfill had an average specific gravity of 0.85, which is considerably lower than the specific gravity of the lab-prepared MSW reported by Hettiarachchi (2005). Therefore, the maximum size and size distribution should be taken into account when laboratory results are interpreted or compared.

4.2. Hydraulic conductivity

The hydraulic conductivity values obtained from flexi-wall triaxial equipment under different confinement pressures are presented in Fig. 3. Assuming a zero confinement, results obtained from the rigid-wall permeameter tests are also included in Fig. 3. Fig. 3 demonstrates how hydraulic conductivity varies with dry density of fresh MSW. The hydraulic conductivity values vary in a range of 10^{-8}–10^{-4} m/s when the dry densities vary in an approximate range of 300–650 kg/m^3. The general trend is that the hydraulic conductivity decreases with increase in dry density of fresh MSW. The results are in agreement with the data published by Blieker et al. (1993). For a similar dry density range, Blieker et al. (1993) obtained an average hydraulic conductivity value of 10^{-6} m/s for the laboratory tested MSW samples from Keele Valley Landfill in Ontario, Canada. Information on the age or the state of degradation of the MSW was not available; however, the depth of sampling as deep as 37 m indicates that it may be at least a few years old.

The higher confinement increases the density; therefore, hydraulic conductivity decreases with the increase in the confinement pressure. Zero confinement simulates fresh MSW located near the top surface of a landfill. To explain the practical meaning of confining pressure and the corresponding hydraulic conductivity of MSW, the confining pressures were converted to approximate equivalent MSW heights, assuming average dry densities and an average gravimetric moisture content of 70% (Table 2). This provided a relatively fair basis to compare results with a second set

Table 2
Variation of hydraulic conductivity of fresh MSW with confining pressure

Confining pressure (kPa)	Average dry density (kg/m^3)	Average bulk density* (kg/m^3)	Equivalent average depth (m)	Hydraulic conductivity (m/s)
0	350	595	0	10^{-5}–10^{-4}
67	500	850	8	10^{-7}–10^{-6}
137	550	935	15	10^{-7}
275	600	1020	27	10^{-8}–10^{-7}

* Based on 70% average dry gravimetric moisture content.

of data published by Blieker et al. (1993), who conducted constant head hydraulic conductivity tests on core samples obtained from Brock West Landfill in Ontario. The MSW samples varied in depth from 18–30 m from the surface and were estimated to be a minimum of 10 years old. The approximate hydraulic conductivity value of 10^{-8} m/s that they reported for 27.4 m compares well with the value predicted for the same depth in Table 2. It should be noted that the tests were conducted using saturated fresh MSW; therefore, the hydraulic conductivity values represent the saturated hydraulic conductivity of fresh MSW. If the MSW is unsaturated, then unsaturated hydraulic properties should be determined.

4.3. Compression ratio

An instantaneous compression, followed by gradual time differed compression (characterizing a process of mechanical compression), was observed during loading. The results of the compressibility tests are presented in Fig. 4. Compression ratios obtained from each graph in Fig. 4 are given in Table 3. Samples tested had varying moisture contents from 44% to 100%. However the results did not exhibit any specific increase or decrease in compressibility with the increase in moisture content. All four compression ratio values fall into a very close range of 0.24–0.33 (with an average of 0.27 and 0.04 standard deviation).

Table 3 also summarizes compression ratio values reported in the literature for fresh MSW. All but Hunte et al. (2007) are laboratory efforts. Hunte et al. (2007) back calculated compression ratio using stress strain data collected during the filling phase of Calgary Biocell Landfill in Canada. Their compression index is comparable to what Hettiarachchi (2005) reported for saturated synthetic MSW. The compression ratio values published by Hossain (2002) are distributed in a wide range of 0.16–0.25. However, the average value is also comparable to the values reported by Hunte et al.

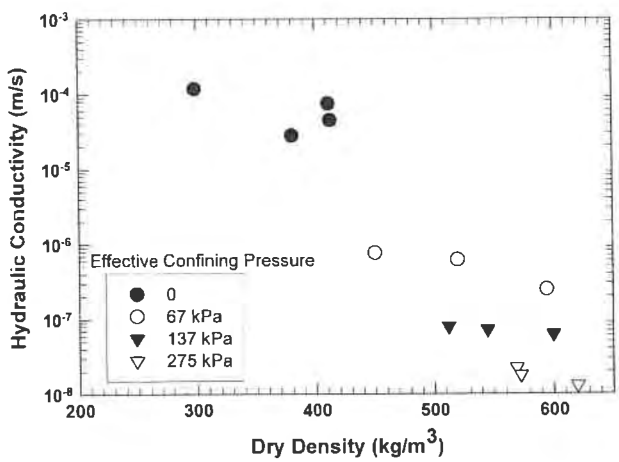


Fig. 3. Variation of hydraulic conductivity of fresh shredded MSW with dry density under different confinement pressures.

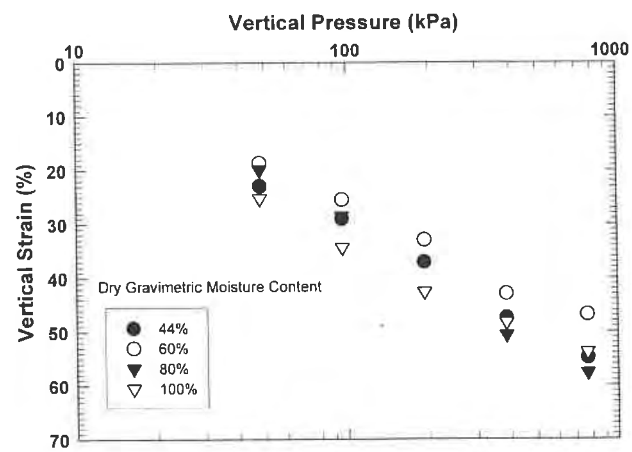


Fig. 4. Variation of compressibility of fresh shredded MSW with moisture content.

Table 3
Compressibility of fresh MSW at different moisture contents

Source	Compression ratio (%)	Gravimetric moisture content (%)
Current research (Oedometer test, fresh shredded MSW, maximum particle size approximately 40 mm)	0.28	44
	0.25	60
	0.33	80
	0.24	100
Hunte et al. (2007) (Calculated from field data, Calgary Biocell Landfill, Canada, relatively fresh MSW)	0.21	55 (Average)
Hettiarachchi (2005) (Special loading frame and a teflon cell, synthetic waste to simulate fresh MSW, maximum particle size approximately 12.5 mm)	0.18	60
	0.21	128 (Saturated)
Hossain (2002) (Oedometer tests, relatively fresh, shredded MSW from control samples, maximum particle size 10 mm × 40 mm, saturated with 6% acetic acid)	0.16–0.25	Saturated
Landva and Clark (1990) (470 mm diameter consolidometer, fresh shredded MSW samples from Edmonton, Canada)	0.35	Relatively dry

(2007) and Hettiarachchi (2005). Landva and Clark (1990) reported a 0.35 value for fresh MSW from Edmonton tested in a large consolidometer. The compressibility data summarized in Table 3 does not show any correlation to the moisture content. This supports the observations made by Vilar and Carvalho (2004) for aged MSW. Vilar and Carvalho (2004) studied the compressibility of 15 year old MSW recovered from Bandeirantes sanitary landfill in Brazil. The compressibility of this aged MSW was found to be 0.21, but it was not influenced by saturation.

4.4. Drained shear strength parameters

Fig. 5 shows the direct shear test results for MSW at an in-situ moisture content of 44%. Similar trends were observed in the results for samples tested at increased moisture contents. The fresh MSW samples exhibited continuous strength gain at horizontal deformation well in excess of 10% of the diameter of the sample. In the absence of samples reaching any peak strength, shear strength at 15% horizontal deformation was used to establish the Mohr-Coulomb shear strength envelopes (see Fig. 6). Shear strength parameters estimated from Fig. 6 for fresh MSW at 44%, 60%, 80% and 100% moisture contents are presented in Table 4. It is observed that the cohesion of fresh MSW varied around from 31–64 kPa and the drained friction angle ranged from 26–30°. Neither the cohesion nor the friction angle demonstrated any correlation with the moisture content. Landva and Clark (1990) conducted direct shear tests on large samples of shredded fresh MSW from Edmonton, Canada. They reported 23 kPa and 24° as the shear strength properties (see Table 4). Kavazanjian (1999) presented results of direct shear tests performed on samples collected from the OII landfill in California and found cohesion of 43 kPa and friction angle of 31°. Caicedo et al. (2002) also used large samples to conduct direct shear tests on relatively new (1 year aged) unshredded MSW from Don Juana landfill in Bogota, Colombia. Moisture contents of these samples were comparable to what was used in the current research and the shear strength properties were found to be 78 kPa and 23° (Table 4). It is evident from Table 4 that the drained angle of friction varies in a narrow range of 23–30°. However the range for cohesion, 23–78 kPa, is much wider. The wide variation in cohesion may be attributed to the composition of MSW.

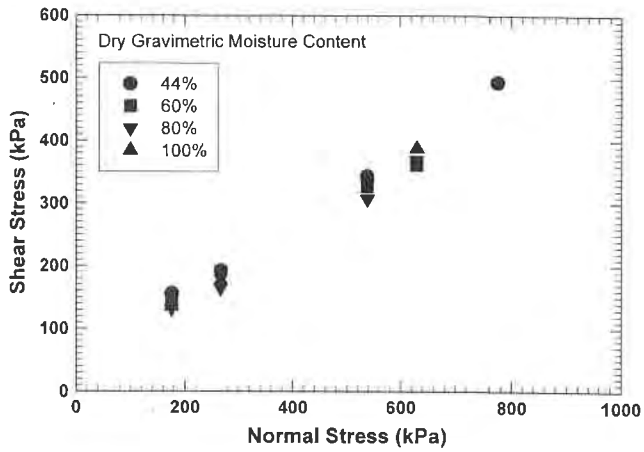


Fig. 6. Mohr-Coulomb failure criteria for fresh shredded MSW at different moisture contents

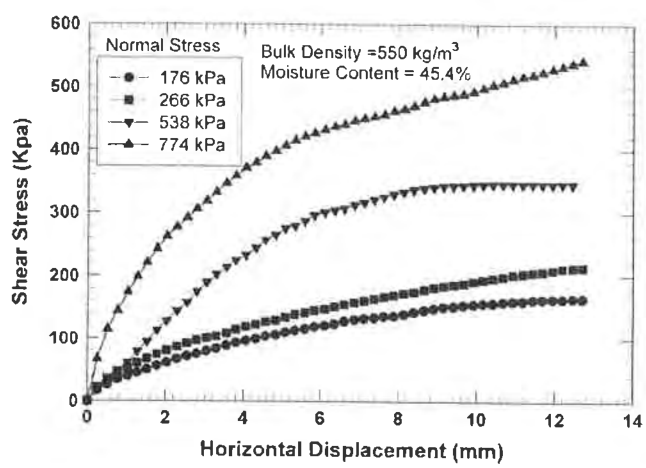


Fig. 5. Direct shear test results for shredded fresh MSW under in-situ moisture content of 44%

4.5. Consolidated undrained shear strength properties

In geotechnical engineering, CU strengths are typically used for stability problems where the soils are at equilibrium after being fully consolidated and then fail with insufficient drainage occurring when additional stresses are applied quickly (Holtz and Kovacs, 1981). With the addition of more moisture, one might also expect similar situations in a bioreactor landfill. Hence CU strength results may be considered suitable to analyze stability of a bioreactor landfill.

Fig. 7 shows the triaxial CU test results for an in-situ moisture content of 44%. Similar trends were observed for the tests conducted with samples at different initial moisture contents. During the tests, the deviatoric stress increased continuously, without reaching any peak or ultimate value. The same behavior was ob-

Table 4
Drained shear strength properties of fresh MSW based on direct shear testing

Source	Cohesion (kPa)	Friction angle (degrees)	Gravimetric moisture content (%)
Current study (Fresh shredded MSW, sample diameter 63 mm, shear strength defined at 15% strain)	46	30	44
	64	26	60
	32	28	80
	31	30	100
Landva and Clark (1990) (Fresh sredded MSW from Edmonton, Canada, sample dimensions 434 mm × 287 mm)	23	24	–
Kavazanjian (1999) (Waste from OII landfill in California, USA, sample diameter 460 mm, shear strength defined at 10% strain)	43	31	–
Caicedo et al. (2002) (1 year aged unshredded MSW, sample diameter 900 mm, shear strength defined at 6.7% strain)	78	23	67

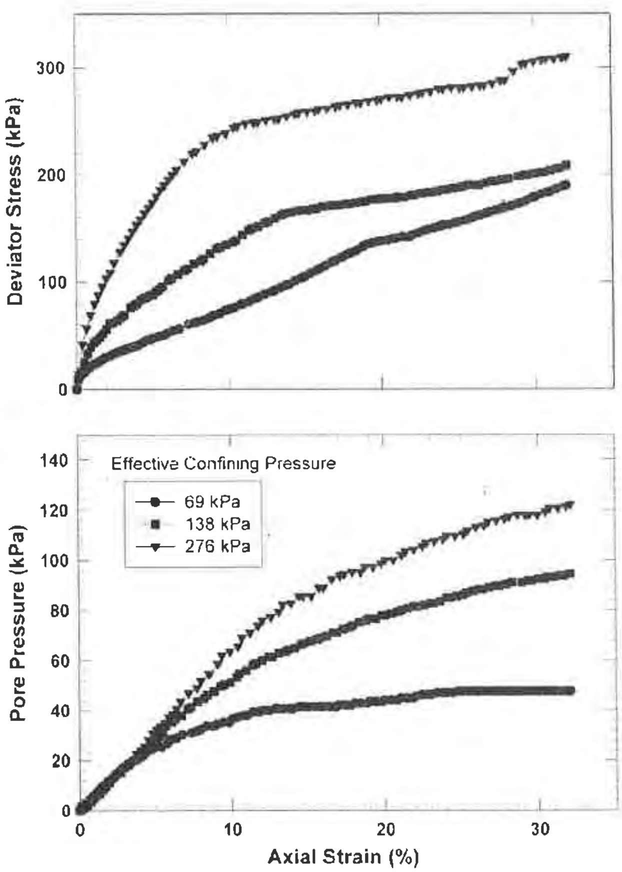


Fig. 7. Triaxial consolidated undrained test results for shredded fresh MSW.

served in all the samples tested. To be in agreement with the procedure followed in the direct shear testing, shear strength parameters were defined at 15% strain. Table 5 summarizes the total and effective shear strength properties obtained from the CU tests. The average total strength parameters (c and φ) were found to be 32 kPa and 12°, while effective stress parameters (c' and φ') were found to be 38 kPa and 16°. The effective consolidated undrained angle of friction (14°) reported by Caicedo et al. (2002) for relatively fresh MSW from Dona Juana landfill is in agreement with the results from the current research (see Table 4). The effective consolidated undrained cohesion (45 kPa) reported by Caicedo et al. (2002) is slightly higher than what was found for fresh MSW from Orchard Hills Landfill. As explained before, this discrepancy may be attributed to the presence of a higher percentage of organic matter in the MSW from Don Juana Landfill. The results from CU tests are also included in Fig. 8 to compare with the results from the direct shear tests. In general, the angle of friction results by CU tests on fresh MSW are approximately 50% of what was produced by the direct shear tests. Cohesion values yielded by the CU tests remain within the same range as produced by the direct shear tests. However they are approximately 50% of the maximum cohesion reported for the fresh MSW, particularly finer components such as food MSW.

Many researchers have observed strain hardening behavior in MSW irrespective of the age of MSW or the testing technique (Jessberger and Kockel, 1993; Gabr and Valero, 1995; Grisolia et al., 1995; Kavazanjian, 2001; Caicedo et al., 2002; Vilar and Carvalho, 2004). Therefore, it is generally believed that the shear strength properties of MSW are strain-dependent. In geotechnical testing of clay, it is common to assume the stress at 15% or 20% strain if the sample begins to bulge without failing. However strength testing on MSW has not evolved to a standardized criteria and a wide range of strains 5–30% has been adopted as the failure strain (Grisolia et al., 1995; Vilar and Carvalho, 2004). Currently, there is no standard strain to define the strength of MSW. High strains and hardening behavior at strains greater than 30% demonstrate the ability of MSW to undergo high plastic deformation prior to failure. However, from a geotechnical stability viewpoint, it may not be desirable to define strength at such a high strain.

In this study, the CU testing was continued beyond 20% strain. Consolidated undrained shear strength was determined at 5%, 10%, 15%, and 20% strains. The average values obtained are plotted in Fig. 9. The φ decreased, while c increased with increase in strain. The c' increased with increased strains, while φ' decreases first and

Table 5
Consolidated undrained (CU) shear strength properties of fresh MSW based on triaxial CU testing

Source	Cohesion (kPa)	Friction angle (degrees)	Stress calculation method
Current research (Fresh shredded MSW, sample diameter 70 mm, shear strength defined at 15% strain)	32	12	TSP
	38	16	ESP
Caicedo et al. (2002) (1 year aged unshredded MSW, sample dimensions: diameter 300 mm, height 600 mm, shear strength defined at 15% strain)	45	14	ESP

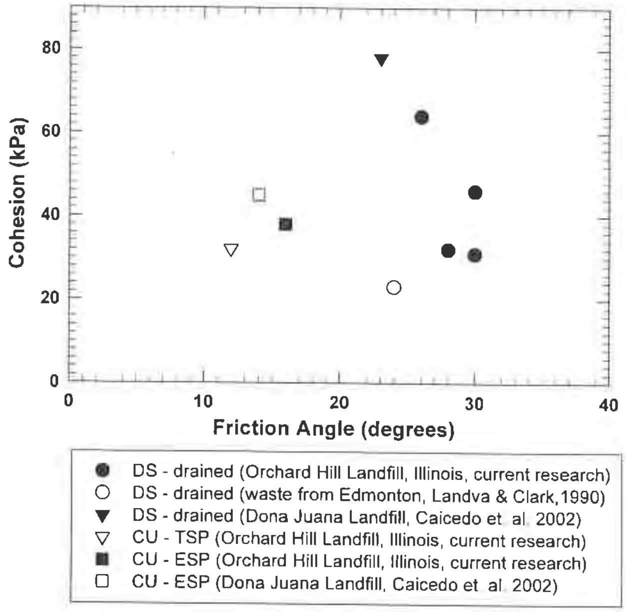


Fig. 8. Distribution of shear strength parameters for fresh shredded MSW (DS- direct shear test, CU- consolidated undrained triaxial test, TSP- total stress parameters, and ESP- effective stress parameters).

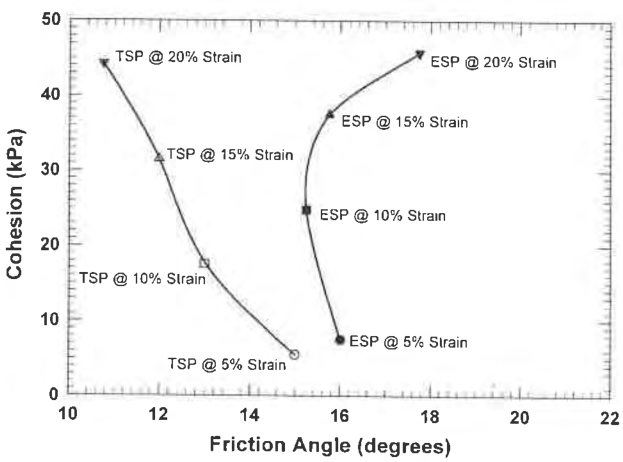


Fig. 9. Strain dependency of shear strength parameters for fresh shredded MSW (TSP- total stress parameters, and ESP- effective stress parameters).

then increases with the increase in strain. The minimum φ' was observed approximately at 10% strain. Therefore, the strain to define shear strength based on consolidated undrained shear test results should be critically examined.

Small-scale laboratory testing performed in this research provided a general understanding of the geotechnical properties of shredded fresh MSW. Generally, the specimen size was approximately 1.6–2.6 times the maximum size of the particle in the shredded MSW samples used for testing; therefore, a systematic evaluation of the gradation of MSW as well as the specimen size in relation to the maximum particle size in the MSW on geotechnical properties of MSW, based on large-scale testing using representative field MSW samples, should be performed. The validity of laboratory test results should be examined based on in-situ test results and back-analysis of field performance data. The effects of degradation on geotechnical properties of MSW should also be investigated.

5. Summary and conclusions

Fresh MSW collected from the working phase of Orchard Hills Landfill in Illinois (USA) was tested for compaction characteristics, hydraulic conductivity, compressibility, and shear strength properties. The following conclusions can be drawn from the results of this study:

A maximum dry density of 420 kg/m^3 was observed at 70% optimum moisture content; however, a maximum dry density of 620 kg/m^3 was measured under higher confined stress conditions. The composition of MSW should be taken into account when the compaction characteristics are interpreted.

The hydraulic conductivity of fresh MSW varied in a wide range of 10^{-8}– 10^{-4} m/s and decreased with increase in dry density. Assuming confinement as a measure of overburden stress, it may be concluded that the fresh MSW near the surface had 10^{-5}–10^{-4} m/s and at deep depths it may be as low as 10^{-8}–10^{-7} m/s.

Compression ratio values varied in a close range of 0.24–0.33 (with 0.27 average and 0.04 standard deviation). The results did not indicate any specific increase or decrease in compressibility with the increase in moisture content.

Drained cohesion of fresh MSW varied from 31–64 kPa and the drained friction angle ranged from 26–30°. Neither cohesion nor friction angle demonstrated any correlation with the moisture content. It was also concluded that cohesive behavior of MSW may be due to the presence of biodegradable organic matter such as food.

The average total strength parameters (c and φ) were found to be 32 kPa and 12° while effective stress parameters (c' and φ') were 38 kPa and 16°. The φ was lower and c was higher with the increase in strain. The effective cohesion parameter, c', increased with increased strains; but the effective friction parameter, φ', decreased first and then increased with the increase in strain. The minimum φ' was observed approximately at 10% strain and therefore attention should be paid on the selected strain to define shear strength properties of fresh MSW.

Acknowledgements

The authors are thankful to Veolia Environmental Services, particularly Chris Peters, for supporting field activities, including MSW sampling. The assistance of Solenne Grellier in MSW sampling and characterization is appreciated. Funding for this research is received from the National Science Foundation (Grant#0600441) and is gratefully acknowledged.

References

ASTM (American Society of Testing and Materials), 2006. Annual Book of Standards. West Conshohocken, PA.

Blieker, D.E., McBean, E., Farquhar, G., 1993. Refuse sampling and permeability testing at the Brock West and Keele Valley Landfills. In: Proceedings of the Sixteenth International Madison Waste Conference. University of Wisconsin, Madison.

Caicedo, B., Yamin, L., Giraldo, E., Coronado, O., 2002. Geomechanical Properties of Municipal Solid Waste in Dona Juana Sanitary Landfill. Environmental Geotechnics (4th ICEG), De Mell & Almeida (des). Swets & Zeitlinger, Lisse, ISBN 90 5809 501 0.

Dixon, N., Russell, D., Jones, V., 2005. Engineering properties of municipal solid waste. Geotextiles and Geomembranes 23, 205–233.

Fassett, J.B., Leonards, G.A., Repetto, P.C., 1994. Geotechnical properties of municipal solid waste and their use in landfill design. In: Proceedings of the Waste Tech '94 Solid Waste Association of North America. Silver Springs, Maryland, pp. 1–31.

Gabr, M.A., Valero, S.N., 1995. Geotechnical properties of municipal solid waste. Geotechnical Testing Journal, ASTM 18 (2), 241–251.

Grellier S., Reddy, K.R., Gangathulasi, J., Adib, R., Peters, C., 2007. US MSW and its biodegradation in a bioreactor landfill. In: Proceedings of the Sardinia '2007, Eleventh International Landfill Symposium, Cagliari, Italy.

Grisolia, M., Napoleoni, Q., Tangredi, G., 1991. Geotechnical behavior of sanitary landfills based on laboratory and in-situ test. In: Proceedings of the Seventh

International Conference on Solid Waste Management and Technology, Philadelphia, PA.

Grisolia, M., Napoleoni, Q., Tangredi, G., 1995. The use of triaxial tests for the mechanical characterization of municipal solid waste. In: Proceedings of the Sardinia '95, Fifth International Landfill Symposium, vol. 2, Cagliari, Italy, pp. 761-767.

Hettiarachchi, C.H., 2005. Mechanics of Biocell Landfill Settlements, PhD Dissertation, Department of Civil & Environmental Engineering. New Jersey Institute of Technology, Newark NJ.

Holtz, R.D., Kovacs, W.D., 1981. An Introduction to Geotechnical Engineering. Prentice Hall, NJ.

Hossain, M.S., 2002. Mechanics of Compressibility and Strength of Solid Waste in Bioreactor Landfills, PhD Dissertation, Department of Civil Engineering. North Carolina State University at Raleigh, NC.

Hunte, H., Hettiaratchi, J.P.A., Meegoda, J.N., Hettiarachchi, C.H., 2007. Settlement of Bioreactor Landfills During Filling Operations. ASCE Geotechnical Special Publications #152, GeoDenver2007. ISBN: # 0784408971.

Jessberger, H.L., Kockel, R., 1993. Determination and assessment of the mechanical properties of waste materials. In: Proceedings of the Sardinia '93, Fourth International Landfill Symposium. S. Margherita di Pula, Cagliari, Italy, pp. 1383-1392.

Kavàzanjian, E., 2001. Mechanical properties of municipal solid waste. In: Proceedings of the Sardinia 2001, Eighth International Landfill Symposium, vol. 3. S. Margherita di Pula, Cagliari, Italy, pp. 415-424.

Kavazanjian, E., 1999. Seismic design of solid waste containment facilities In: Proceddings of Eighth Canadian Conference on Earthquake Engineering. Vancouver, BC.

Koerner, R.M., Soong, T-Y., 2000. Leachate in landfills: the stability issues. Geotextiles and Geomembranes 18, 293–309.

Landva, A.O., Clark, J.I., 1990. Geotechnics of Waste Fill, Geotechnics of Waste Fills—Theory And Practice. ASTM STP 1070, Philadelphia (pp. 86-113).

Reddy, K.R., Bogner, J.E., 2003. Bioreactor Landfill Engineering for Accelerated Stabilization of Municipal Solid Waste. Invited Theme Paper on Solid Waste Disposal, International e-Conference on Modern Trends in Foundation Engineering: Geotechnical Challenges and Solutions. Indian Institute of Technology, Madras. p. 22.

Sharma, H.D., Reddy, K.R., 2004. Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies. John Wiley & Sons, NJ.

USEPA, 2007. Municipal solid waste in the United States: 2005 Facts and Figures.http://www.epa.gov.

Vilar, O., Carvalho, M., 2004. Mechanical properties of municipal solid waste. ASTM Journal of Testubg abd Evaluation 32 (6), 1–12.

Wall, D.K., Zeiss, C., 1995. Municipal landfill biodegradation and settlement. J. Env.Engg., ASCE 121 (3), 214–224.

Zekkos, D.P., 2005. Evaluation of Static and Dynamic Properties of Municipal Solid Waste. PhD Dissertation, Department of Civil and Environmental Engineering, Univ. of California, Berkeley, California, USA.