# PART I FORM UPDATES

# (includes Applicant's Certification Statement)

The pages that follow are updates to the Part I Form which include the applicant's certification statement for this submittal.

# Texas Commission on Environmental Quality

## Part I Form

### New Permit/Registration and Amendment Applications for an MSW Facility

**1. Reason for Submittal**

☐ Initial Submittal ☒ Notice of Deficiency (NOD) Response

**2. Authorization Type**

☒ Permit ☐ Registration

**3. Application Type**

☐ New ☒ Major Amendment
☐ Major Amendment (Limited Scope)

**4. Application Fees**

☐ Pay by Check ☒ Online Payment

If paid online, e-Pay Confirmation Number: 582EA000148778

**5. Application URL**

Is the application submitted for Type I Arid Exempt (AE) and/or Type IV AE facility?

☐ Yes ☒ No

If the answer is "No", provide the URL address of a publicly accessible internet web site where the application and all revisions to that application will be posted.
http://www.wm.com/wm/texas/permits.asp

**6. Application Publishing**

Party Responsible for Publishing Notice:

☐ Applicant ☐ Agent in Service ☒ Consultant

## Signature Page

I, Steve Jacobs, Director of Disposal Operations
(Site Operator (Permittee/Registrant)'s Authorized Signatory) (Title)

certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature: [signature] Date: 5-9-14

---

TO BE COMPLETED BY THE OPERATOR IF THE APPLICATION IS SIGNED BY AN AUTHORIZED REPRESENTATIVE FOR THE OPERATOR

I, ______________________, hereby designate ______________________
(Print or Type Operator Name) (Print or Type Representative Name)

as my representative and hereby authorize said representative to sign any application, submit additional information as may be requested by the Commission; and/or appear for me at any hearing or before the Texas Commission on Environmental Quality in conjunction with this request for a Texas Water Code or Texas Solid Waste Disposal Act permit. I further understand that I am responsible for the contents of this application, for oral statements given by my authorized representative in support of the application, and for compliance with the terms and conditions of any permit which might be issued based upon this application.

______________________
Printed or Typed Name of Operator or Principal Executive Officer

______________________
Signature

---

SUBSCRIBED AND SWORN to before me by the said Steve Jacobs
On this 9th day of May, 2014
My commission expires on the 27th day of July, 2016
[signature: Jill Beardsley]
Notary Public in and for
Travis County, Texas
(Note: Application Must Bear Signature & Seal of Notary Public)

NOTARY PUBLIC STATE OF TEXAS
JILL BEARDSLEY
My Commission Expires
July 27, 2016

# REPLACEMENT PAGES

The items that follow are to completely replace the previous versions of those pages. For convenience, divider tabs are provided to indicate which portion of the application the revisions pertain to.

*Prepared for:*
**USA Waste of Texas Landfills, Inc.**

# PERMIT AMENDMENT APPLICATION

# PART I – SITE AND APPLICANT INFORMATION

# SUPPLEMENTAL TECHNICAL REPORT

## FAIRBANKS LANDFILL
## MSW PERMIT NO. 1565B
## HOUSTON, HARRIS COUNTY, TEXAS

*Prepared by:*


Geosyntec consultants

Texas Board of Professional Engineers Firm Registration No. F-1182
3600 Bee Caves Road, Suite 101
Austin, Texas 78746
(512) 451-4003


5/9/2014

STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED
PROFESSIONAL ENGINEER

SEALED FOR THIS PART I SUPPLEMENTAL TECHNICAL REPORT, AND FOR PERMITTING PURPOSES ONLY.

WITHIN EACH APPENDIX, ITEMS THAT REQUIRE A SIGNATURE AND SEAL BY A LICENSED PROFESSIONAL (E.G., ENGINEER, SURVEYOR, OR GEOSCIENTIST) ARE SIGNED, SEALED, AND DATED, AS APPROPRIATE, BY THE RESPONSIBLE PROFESSIONAL.


Submitted August 2013
Revised March 2014
Revised May 2014

# TABLE OF CONTENTS
# PART I, SUPPLEMENTAL TECHNICAL REPORT



5/9/2014
STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED PROFESSIONAL ENGINEER
FOR PERMIT PURPOSES ONLY

**TABLES**



STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED
PROFESSIONAL ENGINEER
5/9/2014
FOR PERMIT PURPOSES ONLY

**APPENDICES**

WITHIN EACH APPENDIX, ITEMS THAT REQUIRE A SIGNATURE AND SEAL BY A LICENSED PROFESSIONAL (E.G., ENGINEER, SURVEYOR, OR GEOSCIENTIST) ARE SIGNED, SEALED, AND DATED, AS APPROPRIATE, BY THE RESPONSIBLE PROFESSIONAL.

### 3.2.3 Site Layout and Proposed Changes

As mentioned, a Site Plan presenting the extent of the current facility and proposed expansion is presented in Appendix IA as Drawing IA-6. Inspection of Drawing IA-6 shows that the permit boundary and landfill footprint is proposed to increase towards the east and south. The northern and western limits of the landfill have been constructed, and no changes these existing waste limits are proposed. A minor reduction in the permit boundary is proposed on the west side of the site, to eliminate a small area where facility operations have not occurred and will not occur. No changes are proposed to the existing site entrance/exit location. Table I-1, presented below, summarizes the current permit conditions and the proposed changes.

**TABLE I-1**

**SUMMARY OF CURRENT PERMIT AND PROPOSED EXPANSION - FAIRBANKS LANDFILL**

| Item | Units | Current Condition (Permit 1565A) | Increase due to Expansion | New Condition (Permit 1565B) |
|---|---|---|---|---|
| Permit Boundary Area | (acres) | 118.1 | 70.9 | 188.95 |
| Waste Disposal Footprint Area | (acres) | 80.0 | 57.3 | 137.3 |
| Buffer/Other Area | (acres) | 38.1 | 13.6 | 51.7 |
| Buffer/Other Area as a Percentage of Permit Boundary | (percent) | 32.3% | 19.1% | 27.3% |
| Total Waste Disposal Capacity | (cubic yards) | 8,326,000 | 17,886,000 | 26,212,000 |
| Remaining Capacity as of 26 March 2012 Aerial Flyover | (cubic yards) | 98,000 | 17,886,000 | 17,984,000 |
| Projected Remaining Site Life | (years) | 0.3 | 26.7 | 27.0 |
| Maximum Elevation of Final Cover | (ft, msl) | 154.0 | 96.5 | 250.5 |
| Elevation of Deepest Excavation | (ft, msl) | 51.0 | No Change | 51.0 |

Drawing IA-6 shows that for this proposed expansion, the two existing waste disposal units will be joined together to form one combined landfill footprint. The entire combined landfill footprint will have a contiguous, tied-in liner meeting the regulatory-prescribed design criteria for a Type IV landfill facility. Details of the liner system design are presented in Part III of the Permit Amendment Application.

Table I-1 indicates that of the 188.95-acre permit boundary, the waste footprint of the landfill will occupy approximately 137.3 acres, and the remaining area of about 52 acres will be used as buffers and other site features (e.g., perimeter access road, surface water ponds, main access road

*Prepared for:*

**USA Waste of Texas Landfills, Inc.**

# PERMIT AMENDMENT APPLICATION

# PART II – EXISTING CONDITIONS SUMMARY AND CHARACTER OF THE FACILITY AND SURROUNDING LAND

# SUPPLEMENTAL TECHNICAL REPORT

## FAIRBANKS LANDFILL
## MSW PERMIT NO. 1565B
## HOUSTON, HARRIS COUNTY, TEXAS

5/9/2014

STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED
PROFESSIONAL ENGINEER

SEALED FOR THIS PART II SUPPLEMENTAL TECHNICAL REPORT, AND FOR PERMITTING PURPOSES ONLY.

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*Prepared by:*

Geosyntec consultants
Texas Board of Professional Engineers Firm Registration No. F-1182
3600 Bee Caves Road, Suite 101
Austin, Texas 78746
(512) 451-4003

Submitted August 2013
Revised March 2014
Revised May 2014

# TABLE OF CONTENTS
# PART II – EXISTING CONDITIONS SUMMARY AND CHARACTER OF THE FACILITY AND SURROUNDING LAND

## SUPPLEMENTAL TECHNICAL REPORT



STATE OF TEXAS
SCOTT M. GRAVES
86557
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PROFESSIONAL ENGINEER
5/9/2014

SEALED FOR THIS PART II SUPPLEMENTAL TECHNICAL REPORT, AND FOR PERMITTING PURPOSES ONLY.

5/9/2014
STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED
PROFESSIONAL ENGINEER

SEALED FOR THIS PART II SUPPLEMENTAL TECHNICAL REPORT, AND FOR PERMITTING PURPOSES ONLY.

**TABLE**



5/9/2014

STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED
PROFESSIONAL ENGINEER

SEALED FOR THIS PART II SUPPLEMENTAL TECHNICAL REPORT, AND FOR PERMITTING PURPOSES ONLY.

**APPENDICES**

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will not occur. No changes are proposed to the existing site entrance/exit location. Table II-1, presented below, summarizes the current permit conditions and the proposed changes.

**TABLE II-1**

**SUMMARY OF CURRENT PERMIT AND PROPOSED EXPANSION - FAIRBANKS LANDFILL**

| Item | Units | Current Condition (Permit 1565A) | Increase due to Expansion | New Condition (Permit 1565B) |
|---|---|---|---|---|
| Permit Boundary Area | (acres) | 118.1 | 70.9 | 188.95 |
| Waste Disposal Footprint Area | (acres) | 80.0 | 57.3 | 137.3 |
| Buffer/Other Area | (acres) | 38.1 | 13.6 | 51.7 |
| Buffer/Other Area as a Percentage of Permit Boundary | (percent) | 32.3% | 19.1% | 27.3% |
| Total Waste Disposal Capacity | (cubic yards) | 8,326,000 | 17,886,000 | 26,212,000 |
| Remaining Capacity as of 26 March 2012 Aerial Flyover | (cubic yards) | 98,000 | 17,886,000 | 17,984,000 |
| Projected Remaining Site Life | (years) | 0.3 | 26.7 | 27.0 |
| Maximum Elevation of Final Cover | (ft, msl) | 154.0 | 96.5 | 250.5 |
| Elevation of Deepest Excavation | (ft, msl) | 51.0 | No Change | 51.0 |

As Drawing IIA-10 indicates, the two existing waste disposal units will be joined together to form one combined landfill footprint for this proposed expansion. The entire combined landfill footprint will have a contiguous, tied-in liner meeting the regulatory-prescribed design criteria for a Type IV landfill facility. Details of the liner system design are presented in Part III of the Permit Amendment Application.

Table II-1 indicates that of the 188.95-acre permit boundary, the waste footprint of the landfill will occupy approximately 137.3 acres, and the remaining area of about 52 acres will be used as buffers and other site features (e.g., perimeter access road, surface water ponds, main access road with scales and scale-house/office, etc.). The distance from the permit boundary to all solid waste unloading, storage, disposal, or processing operations will exceed a minimum buffer distance of 50 feet (see Drawing IIA-10).

As shown on Drawing IIA-10, the existing pipeline easement that crosses the site in a southwest-northeast orientation will be relocated to be adjacent to the southern and eastern permit boundaries, and the existing easement and associated pipelines will be abandoned. Easements and right-of-ways are discussed further in Section 14.1.1 of this report.

# APPENDIX IID

# AIRPORTS AND AVIATION INFORMATION

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76193

Aeronautical Study No.
2014-ASW-1565-OE

Issued Date: 04/21/2014

Director, Planning and Project Development
Chuck A. Rivette, P.E.
9821 Katy Freeway
Suite 700
Houston, TX 77024

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

| | |
|---|---|
| Structure: | Landfill Fairbanks Landfill |
| Location: | Houston, TX |
| Latitude: | 29-54-06.30N NAD 83 |
| Longitude: | 95-31-55.10W |
| Heights: | 110 feet site elevation (SE) |
| | 140 feet above ground level (AGL) |
| | 250 feet above mean sea level (AMSL) |

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be e-filed any time the project is abandoned or:

_____ At least 10 days prior to start of construction (7460-2, Part 1)
__X__ Within 5 days after the construction reaches its greatest height (7460-2, Part 2)

Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/ lighting are accomplished on a voluntary basis, we recommend it be installed and maintained in accordance with FAA Advisory circular 70/7460-1 K Change 2.

This determination expires on 10/21/2015 unless:

(a) the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual Construction or Alteration, is received by this office.
(b) extended, revised, or terminated by the issuing office.
(c) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is based, in part, on the foregoing description which includes specific coordinates , heights, frequency(ies) and power . Any changes in coordinates , heights, and frequencies or use of greater power will void this determination. Any future construction or alteration , including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

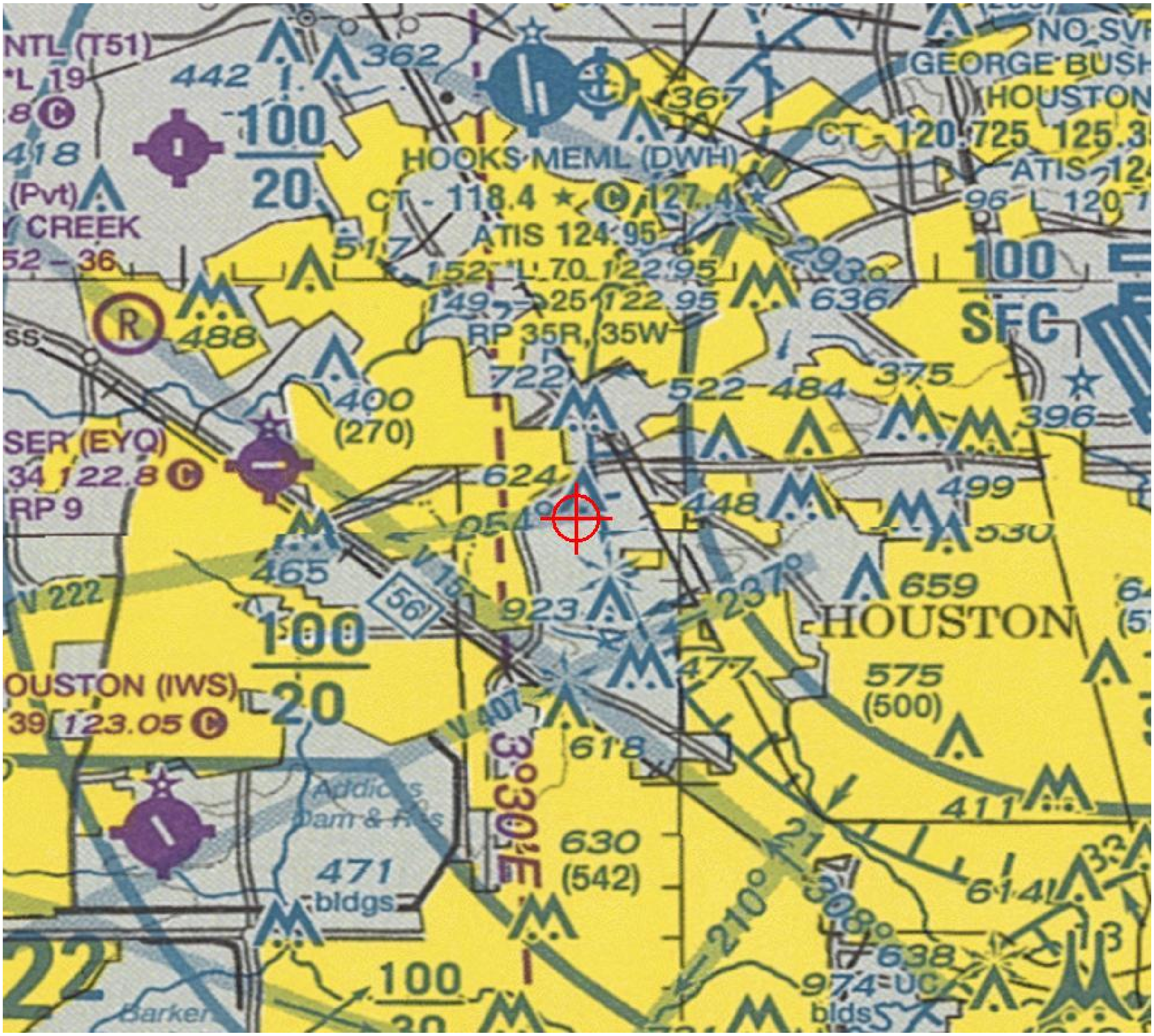
Any failure or malfunction that lasts more than thirty (30) minutes and affects a top light or flashing obstruction light, regardless of its position, should be reported immediately to (877) 487-6867 so a Notice to Airmen (NOTAM) can be issued. As soon as the normal operation is restored, notify the same number.

If we can be of further assistance, please contact our office at (817) 321-7751. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2014-ASW-1565-OE.

**Signature Control No: 209160743-214555073** ( DNE )
Chris Shoulders
Specialist

Attachment(s)
Map(s)

**Sectional Map for ASN 2014-ASW-1565-OE**



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Fort Worth, TX 76193

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Houston, TX 77024

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| | |
|---|---|
| Structure: | Landfill Fairbanks Landfill |
| Location: | Houston, TX |
| Latitude: | 29-54-06.55N NAD 83 |
| Longitude: | 95-32-06.38W |
| Heights: | 110 feet site elevation (SE) |
| | 140 feet above ground level (AGL) |
| | 250 feet above mean sea level (AMSL) |

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

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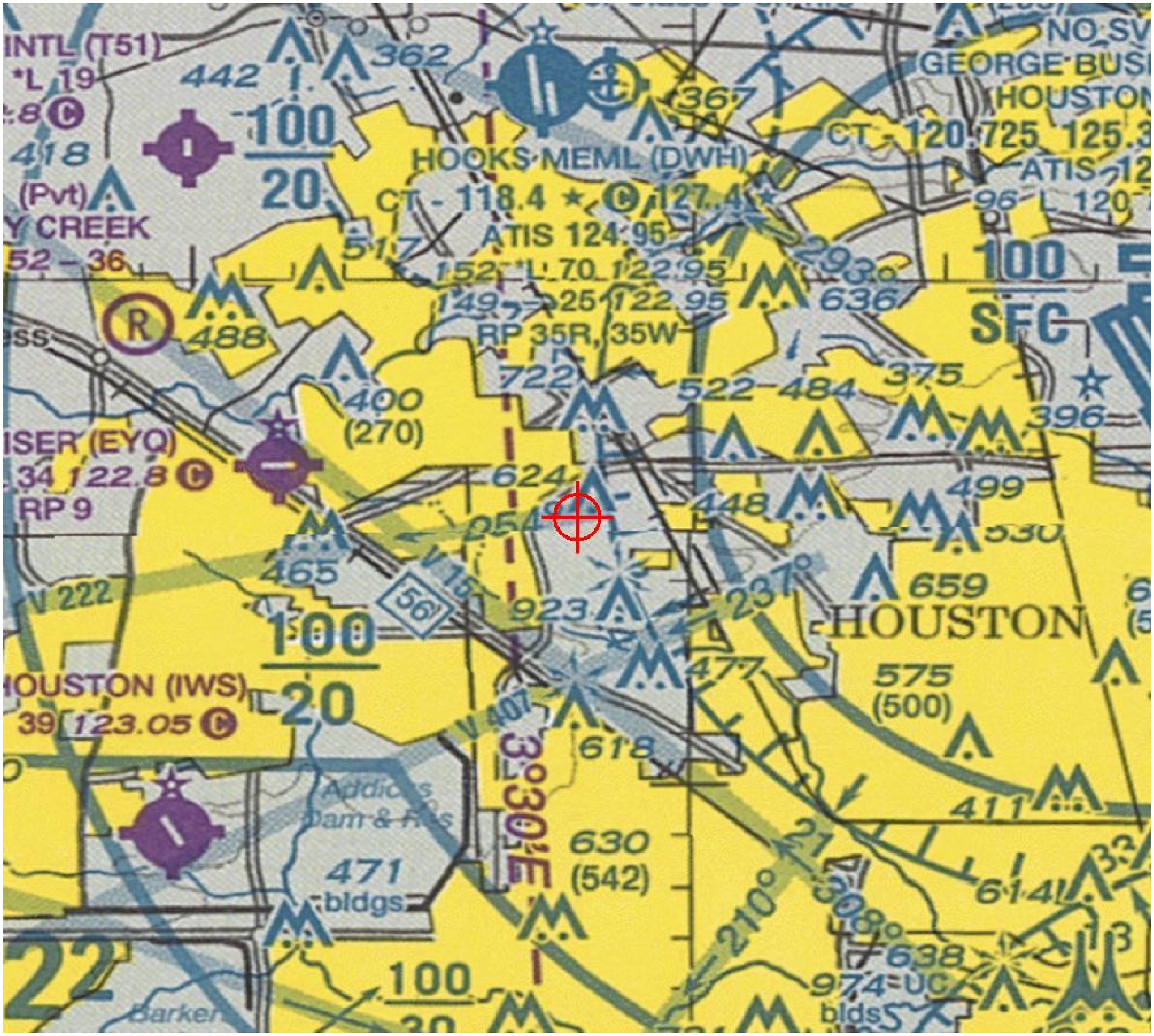
If we can be of further assistance, please contact our office at (817) 321-7751. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2014-ASW-1566-OE.

**Signature Control No: 209160744-214555078** ( DNE )
Chris Shoulders
Specialist

Attachment(s)
Map(s)

## Sectional Map for ASN 2014-ASW-1566-OE



Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76193

Aeronautical Study No.
2014-ASW-1567-OE

Issued Date: 04/21/2014

Director, Planning and Project Development
Chuck A. Rivette, P.E.
9821 Katy Freeway
Suite 700
Houston, TX 77024

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

| | |
|---|---|
| Structure: | Landfill Fairbanks Landfill |
| Location: | Houston, TX |
| Latitude: | 29-54-06.08N NAD 83 |
| Longitude: | 95-31-43.32W |
| Heights: | 110 feet site elevation (SE) |
| | 140 feet above ground level (AGL) |
| | 250 feet above mean sea level (AMSL) |

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

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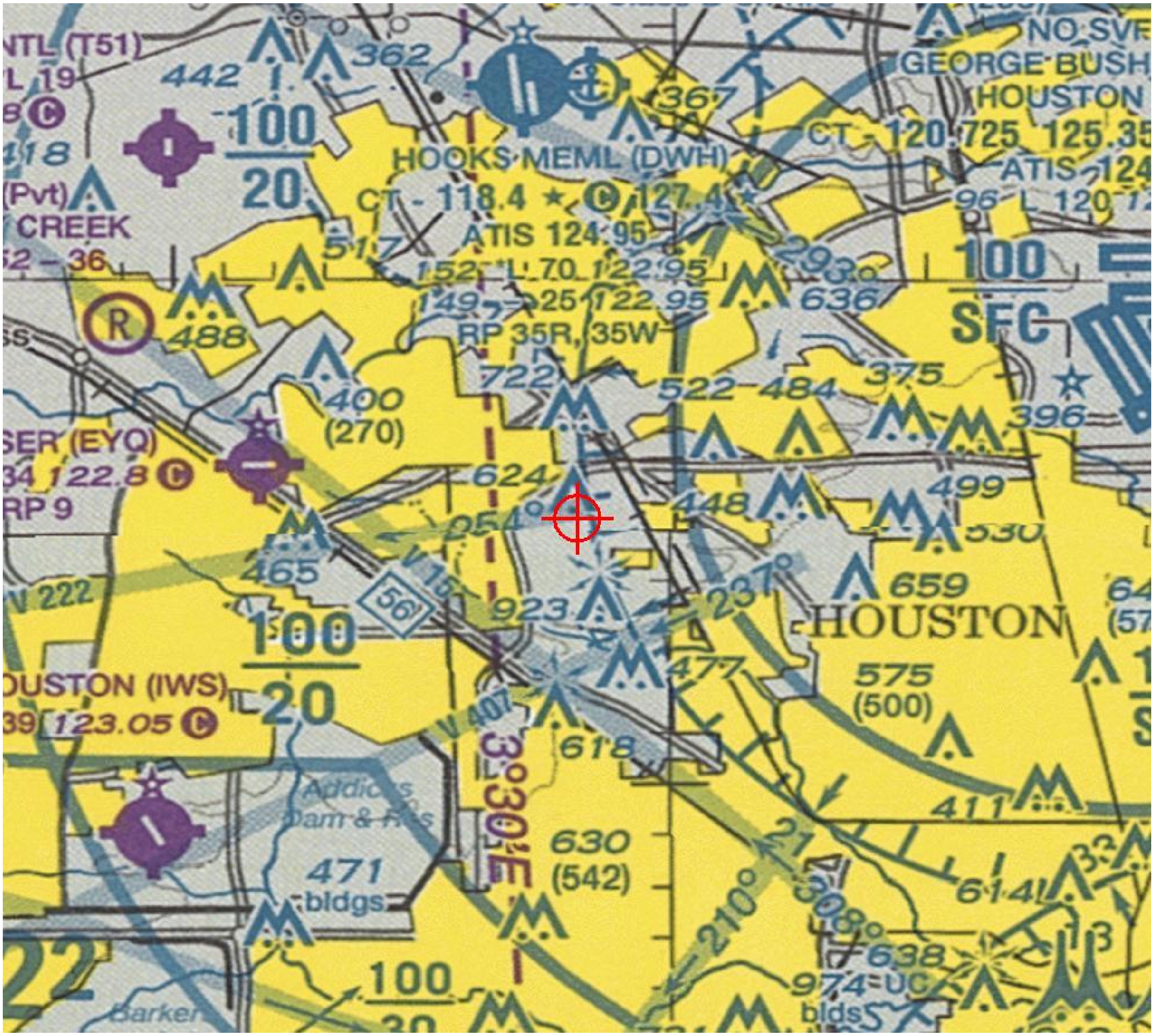
**Signature Control No: 209160745-214555079** ( DNE )
Chris Shoulders
Specialist

Attachment(s)
Map(s)


GEORGE BUSH
HOUSTON
HOOKS MEML (DWH)
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923
237°
659
HOUSTON
575
(500)
477
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3°30'E
630
(542)
471
bldgs
411
210°
638

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76193

Aeronautical Study No.
2014-ASW-1568-OE

Issued Date: 04/21/2014

Director, Planning and Project Development
Chuck A. Rivette, P.E.
9821 Katy Freeway
Suite 700
Houston, TX 77024

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

| | |
|---|---|
| Structure: | Landfill Fairbanks Landfill |
| Location: | Houston, TX |
| Latitude: | 29-54-04.07N NAD 83 |
| Longitude: | 95-32-06.57W |
| Heights: | 110 feet site elevation (SE)<br>133 feet above ground level (AGL)<br>243 feet above mean sea level (AMSL) |

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

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Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/ lighting are accomplished on a voluntary basis, we recommend it be installed and maintained in accordance with FAA Advisory circular 70/7460-1 K Change 2.

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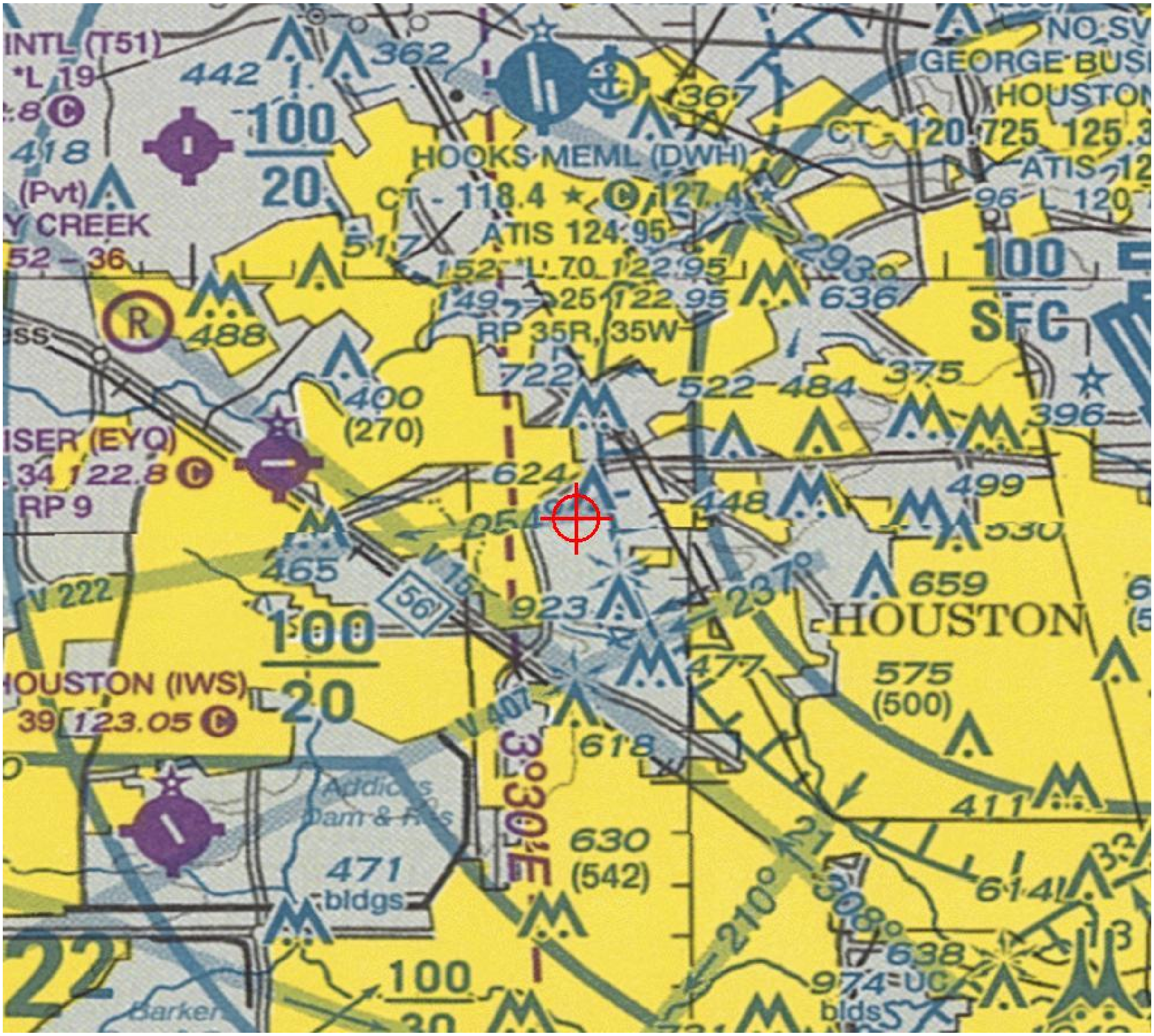
Any failure or malfunction that lasts more than thirty (30) minutes and affects a top light or flashing obstruction light, regardless of its position, should be reported immediately to (877) 487-6867 so a Notice to Airmen (NOTAM) can be issued. As soon as the normal operation is restored, notify the same number.

If we can be of further assistance, please contact our office at (817) 321-7751. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2014-ASW-1568-OE.

**Signature Control No: 209160746-214555074** ( DNE )
Chris Shoulders
Specialist

Attachment(s)
Map(s)

**Sectional Map for ASN 2014-ASW-1568-OE**



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2601 Meacham Boulevard
Fort Worth, TX 76193

Aeronautical Study No.
2014-ASW-1569-OE

Issued Date: 04/21/2014

Director, Planning and Project Development
Chuck A. Rivette, P.E.
9821 Katy Freeway
Suite 700
Houston, TX 77024

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

| | |
|---|---|
| Structure: | Landfill Fairbanks Landfill |
| Location: | Houston, TX |
| Latitude: | 29-53-59.64N NAD 83 |
| Longitude: | 95-31-42.35W |
| Heights: | 110 feet site elevation (SE) |
| | 121 feet above ground level (AGL) |
| | 231 feet above mean sea level (AMSL) |

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be e-filed any time the project is abandoned or:

_____ At least 10 days prior to start of construction (7460-2, Part 1)
__X__ Within 5 days after the construction reaches its greatest height (7460-2, Part 2)

Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/ lighting are accomplished on a voluntary basis, we recommend it be installed and maintained in accordance with FAA Advisory circular 70/7460-1 K Change 2.

This determination expires on 10/21/2015 unless:

(a) the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual Construction or Alteration, is received by this office.
(b) extended, revised, or terminated by the issuing office.
(c) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is based, in part, on the foregoing description which includes specific coordinates , heights, frequency(ies) and power . Any changes in coordinates , heights, and frequencies or use of greater power will void this determination. Any future construction or alteration , including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

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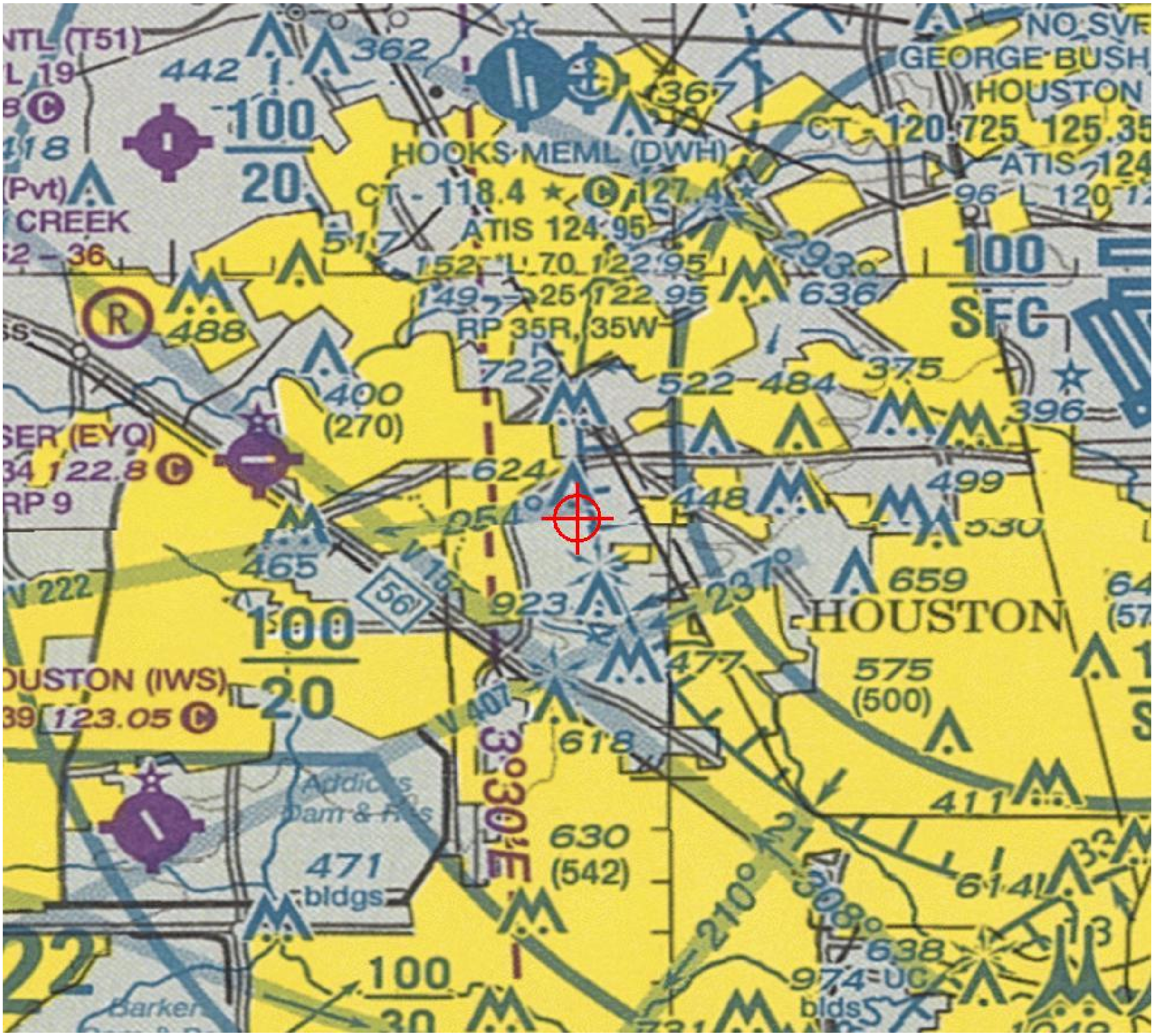
If we can be of further assistance, please contact our office at (817) 321-7751. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2014-ASW-1569-OE.

**Signature Control No: 209160747-214555076** ( DNE )
Chris Shoulders
Specialist

Attachment(s)
Map(s)


GEORGE BUSH
HOUSTON
HOOKS MEML (DWH)
CT - 118.4
ATIS 124.95
RP 35R, 35W
CREEK
(EYQ)
122.8
HOUSTON
(IWS)
123.05
Addicks Dam & Res
Barker
V 222
V 15
V 407
95°30'E

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Aeronautical Study No.
2014-ASW-1570-OE

Issued Date: 04/21/2014

Director, Planning and Project Development
Chuck A. Rivette, P.E.
9821 Katy Freeway
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Houston, TX 77024

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

| | |
|---|---|
| Structure: | Landfill Fairbanks Landfill |
| Location: | Houston, TX |
| Latitude: | 29-54-10.91N NAD 83 |
| Longitude: | 95-31-42.72W |
| Heights: | 110 feet site elevation (SE) |
| | 126 feet above ground level (AGL) |
| | 236 feet above mean sea level (AMSL) |

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be e-filed any time the project is abandoned or:

_____ At least 10 days prior to start of construction (7460-2, Part 1)
__X__ Within 5 days after the construction reaches its greatest height (7460-2, Part 2)

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This determination expires on 10/21/2015 unless:

(a) the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual Construction or Alteration, is received by this office.
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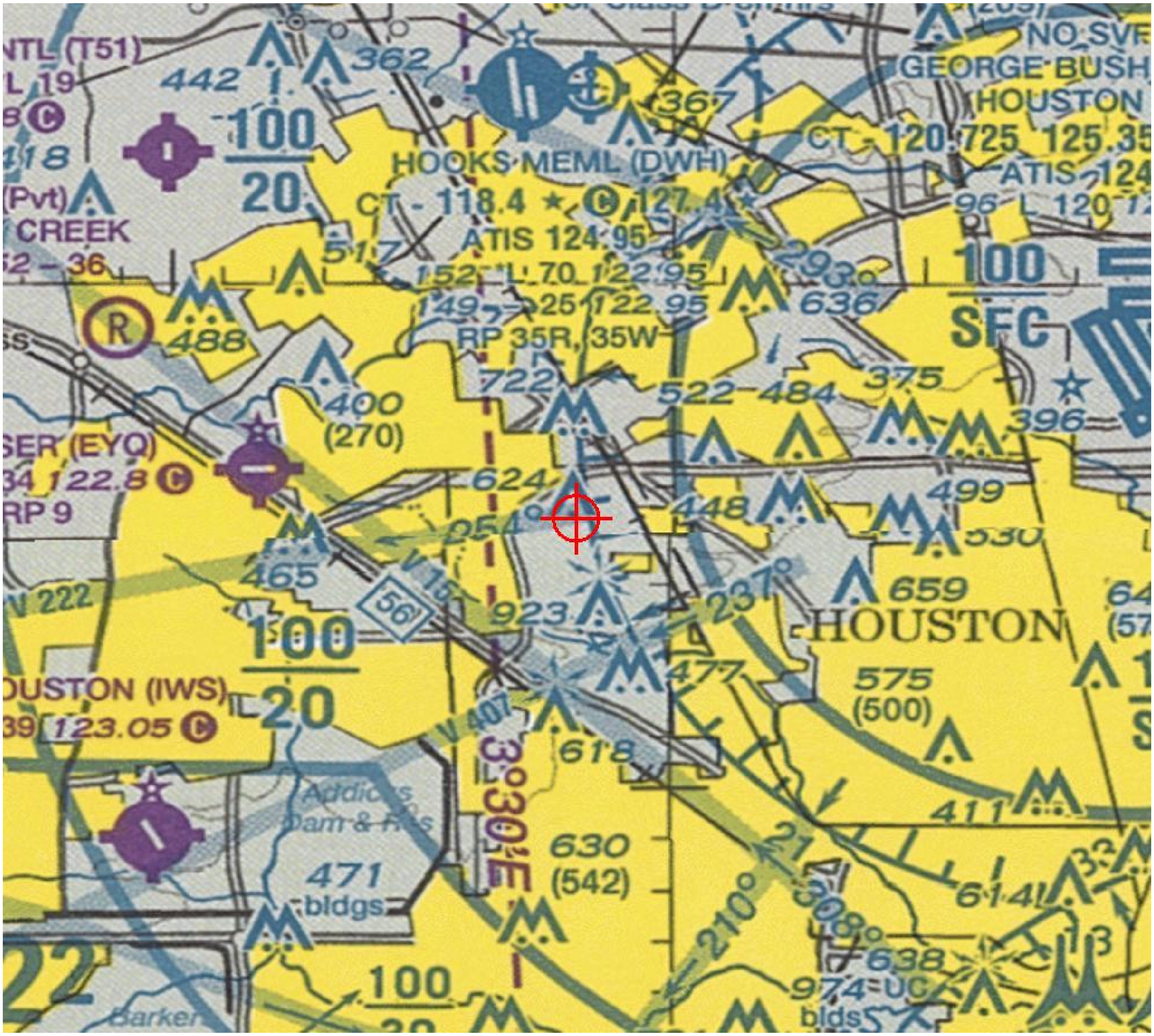
If we can be of further assistance, please contact our office at (817) 321-7751. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2014-ASW-1570-OE.

**Signature Control No: 209160749-214555075** ( DNE )
Chris Shoulders
Specialist

Attachment(s)
Map(s)

**Sectional Map for ASN 2014-ASW-1570-OE**



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Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76193

Aeronautical Study No.
2014-ASW-1571-OE

Issued Date: 04/21/2014

Director, Planning and Project Development
Chuck A. Rivette, P.E.
9821 Katy Freeway
Suite 700
Houston, TX 77024

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

| | |
|---|---|
| Structure: | Landfill Fairbanks Landfill |
| Location: | Houston, TX |
| Latitude: | 29-54-11.07N NAD 83 |
| Longitude: | 95-32-07.28W |
| Heights: | 110 feet site elevation (SE) |
| | 127 feet above ground level (AGL) |
| | 237 feet above mean sea level (AMSL) |

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be e-filed any time the project is abandoned or:

_____ At least 10 days prior to start of construction (7460-2, Part 1)
__X__ Within 5 days after the construction reaches its greatest height (7460-2, Part 2)

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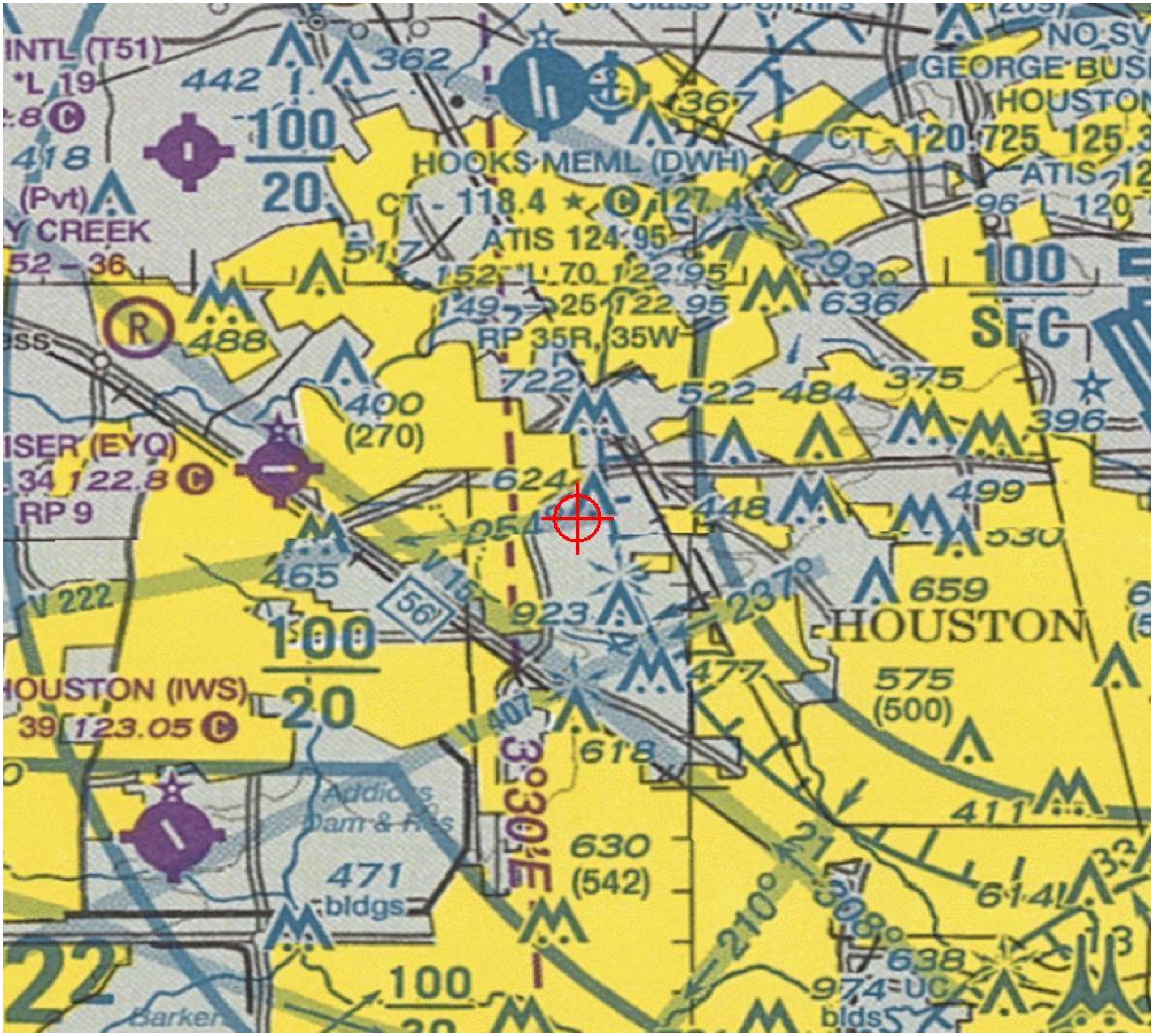
If we can be of further assistance, please contact our office at (817) 321-7751. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2014-ASW-1571-OE.

**Signature Control No: 209160751-214555077** ( DNE )
Chris Shoulders
Specialist

Attachment(s)
Map(s)

# Sectional Map for ASN 2014-ASW-1571-OE



*Prepared for:*

**USA Waste of Texas Landfills, Inc.**

# PERMIT AMENDMENT APPLICATION

# PART III – SITE DEVELOPMENT PLAN

# NARRATIVE REPORT

# FAIRBANKS LANDFILL
# MSW PERMIT NO. 1565B
# HOUSTON, HARRIS COUNTY, TEXAS

*Prepared by:*


Geosyntec consultants

Texas Board of Professional Engineers Firm Registration No. F-1182

3600 Bee Caves Road, Suite 101

Austin, Texas 78746

(512) 451-4003


5/9/2014

STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED
PROFESSIONAL ENGINEER

SEALED FOR THIS PART III NARRATIVE REPORT, AND FOR PERMITTING PURPOSES ONLY.

WITHIN EACH ATTACHMENT, ITEMS THAT REQUIRE A SIGNATURE AND SEAL BY A LICENSED PROFESSIONAL (E.G., ENGINEER, SURVEYOR, OR GEOSCIENTIST) ARE SIGNED, SEALED, AND DATED, AS APPROPRIATE, BY THE RESPONSIBLE PROFESSIONAL.

Submitted August 2013
Revised March 2014
Revised May 2014

# TABLE OF CONTENTS
# PART III – SITE DEVELOPMENT PLAN

## NARRATIVE REPORT

5/9/2014

STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED
PROFESSIONAL ENGINEER

SEALED FOR THIS PART III NARRATIVE REPORT, AND FOR PERMITTING PURPOSES ONLY

**TABLE**



STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED
PROFESSIONAL ENGINEER
5/9/2014

SEALED FOR THIS PART III NARRATIVE REPORT, AND FOR PERMITTING PURPOSES ONLY.

**ATTACHMENTS**

WITHIN EACH ATTACHMENT, ITEMS THAT REQUIRE A SIGNATURE AND SEAL BY A LICENSED PROFESSIONAL (E.G., ENGINEER, SURVEYOR, OR GEOSCIENTIST) ARE SIGNED, SEALED, AND DATED, AS APPROPRIATE, BY THE RESPONSIBLE PROFESSIONAL.

**TABLE III-1**

**SUMMARY OF CURRENT PERMIT AND PROPOSED EXPANSION - FAIRBANKS LANDFILL**

| Item | Units | Current Condition (Permit 1565A) | Increase due to Expansion | New Condition (Permit 1565B) |
|---|---|---|---|---|
| Permit Boundary Area | (acres) | 118.1 | 70.9 | 188.95 |
| Waste Disposal Footprint Area | (acres) | 80.0 | 57.3 | 137.3 |
| Buffer/Other Area | (acres) | 38.1 | 13.6 | 51.7 |
| Buffer/Other Area as a Percentage of Permit Boundary | (percent) | 32.3% | 19.1% | 27.3% |
| Total Waste Disposal Capacity | (cubic yards) | 8,326,000 | 17,886,000 | 26,212,000 |
| Remaining Capacity as of 26 March 2012 Aerial Flyover | (cubic yards) | 98,000 | 17,886,000 | 17,984,000 |
| Projected Remaining Site Life | (years) | 0.3 | 26.7 | 27.0 |
| Maximum Elevation of Final Cover | (ft, msl) | 154.0 | 96.5 | 250.5 |
| Elevation of Deepest Excavation | (ft, msl) | 51.0 | No Change | 51.0 |

As indicated on Attachment 3, Drawing 3-1, the two existing waste disposal units will be joined together to form one combined landfill footprint as part of the expansion. The entire combined landfill footprint will have a contiguous tied-in liner (see Attachment 3, Drawing 3-3) meeting the regulatory-prescribed design criteria for a Type IV landfill facility. Details of the liner system design are discussed subsequently in Section 4 of this report.

Table III-1 indicates that of the proposed 188.95-acre permit boundary, the waste footprint of the landfill will occupy approximately 137.3 acres, and the remaining area of about 52 acres will be used as buffers and other site features (e.g., perimeter access road, surface water ponds, main access road with scales and scale-house/office, etc.).

For Permit MSW-1565B, the filling pattern for waste disposal will start by continuing to fill the existing northern landfill area to higher elevations as the geometry allows for this expansion. Construction of new landfill sectors and subsequent waste filling in those sectors will then progress in the numerical sequence of sectors identified on Attachment 3, Drawing 3-1. More detailed phasing plans showing the excavation and filling sequences was previously presented in a series of drawings in Part II, Appendix IIA of this Permit Amendment Application.

As previously discussed in Part II of the Permit Amendment Application (Section 14.1.1 of the Part II narrative report), there is an existing pipeline easement that crosses the site in a sequence of excavation and filling at various points in time during upcoming landfill development.

The excavation side slopes will be configured at 3 horizontal:1 vertical (3H:1V) down to the cell floor, which is generally flat. The final aerial fill side slopes (i.e., above-grade final slopes) will be configured at 4H:1V slopes (i.e., a 25% grade) up to a landfill top deck area sloped upward at three (3) percent to a ridgeline, as shown on Drawing 3-3. The final cover system will be installed incrementally with the landfill development progression as fill areas reach their maximum final waste grade elevations.

## 4.5 Landfill Depth and Height Statistics

The elevation of deepest excavation is 51 feet above mean sea level (ft, MSL). The maximum elevation of waste is 248 ft, MSL. The maximum elevation of the final cover is 250.5 ft, MSL.

## 4.6 Estimated Rate of Solid Waste Deposition and Site Life

The landfill volume, estimated rate of solid waste deposition, and the resulting site life estimate is presented in Attachment 3B. For reference, a description of the waste characteristics, anticipated facility service area, and a five-year projection of the estimated maximum annual waste acceptance rate is presented in the "waste acceptance plan" in Part II of the Permit Amendment Application as required by 30 TAC §330.61(b).

## 4.7 Landfill Cross Sections

A series of landfill cross sections is provided in Attachment 3A (see Drawings 3-6 through 3-10). These cross sections have been selected to pass through key site features so as to accurately depict the existing and proposed depths of all fill areas within the site. The sections show the top of the perimeter berm; top of the proposed fill (top of the final cover); maximum elevation of proposed waste fill; top of the wastes; existing ground; bottom of the excavations; side slopes of trenches and fill areas; gas monitoring probes; groundwater monitoring wells, plus the initial and static levels of any water encountered. The cross-sections also show the logs of soil borings that pass near the profile. The 100-year flood elevation in Rolling Fork Creek is identified on the sections that pass through the west side of the site next to the creek.

## 4.8 Landfill Construction Design Details

Landfill construction design details are also presented in Attachment 3A (see Drawings 3-11 and 3-12), to accompany the previously mentioned cross section. The cross sections call-out the

# ATTACHMENT 2

# FACILITY SURFACE WATER DRAINAGE REPORT

*Prepared for:*

**USA Waste of Texas Landfills, Inc.**

# PERMIT AMENDMENT APPLICATION

# PART III – SITE DEVELOPMENT PLAN
# ATTACHMENT 2

# FACILITY SURFACE WATER DRAINAGE REPORT

## FAIRBANKS LANDFILL
## PERMIT NO. MSW-1565B
## HOUSTON, HARRIS COUNTY, TEXAS

*Prepared by:*


Geosyntec consultants

Texas Board of Professional Engineers Firm Registration No. F-1182

3600 Bee Caves Road, Suite 101

Austin, Texas 78746

(512) 451-4003


STATE OF TEXAS
SCOTT M. GRAVES
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LICENSED PROFESSIONAL ENGINEER

5/9/2014

FOR PERMIT PURPOSES ONLY

Submitted August 2013

Revised March 2014

Revised May 2014

# TABLE OF CONTENTS



5/9/2014
STATE OF TEXAS
SCOTT M. GRAVES
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**ATTACHMENTS**

to the landfill slopes (i.e., down-slope) will collect the runoff from the top deck and sideslopes and convey this runoff to the landfill perimeter at the toe of the cover system sideslopes. These downchute channels will be lined with an articulated concrete block (ACB) material, or equal, to resist hydraulic forces from the water flowing in these channels.

Perimeter Channel. The western and northern sides of the landfill are existing, and include perimeter channels to convey runoff from drainage terraces and downchutes, and any contributing sheet flow, around the landfill and into surface water ponds. The proposed expansion will continue to route runoff from the western and northern sides of the landfill in this manner, using the same alignment and slopes as the existing perimeter channels. Due to the additional drainage areas contributing to these perimeter channels, they will need to convey larger peak flows than the existing perimeter channels and therefore in some cases will be widened to provide the additional capacity requirements. The perimeter drainage channels around the west and north sides of the site have a single high-point (see Drawing 2-4), approximately mid-way along the northern side of the site. One side of the channel high-point will convey flow eastward, into the Northeast Surface Water Pond. The other side of the channel high-point will convey flow westward and then southward around the landfill perimeter and into a culvert that flows into the South Surface Water Pond.

Culverts. There are three culverts proposed (see Drawing 2-1). Culvert C1 is a box culvert that will receive flow from the perimeter channel on the west side of the landfill, and will convey water into the South Pond. Culvert C2 is a pipe culvert located on the eastern portion of the site beneath the main facility access road that will hydraulically connect the South Pond and the Northeast Pond. Culvert C3 (labeled as "SW-Culv" in the HEC-HMS Model in Attachment 2B) is a pipe culvert that serves as the outfall discharge point from the South Pond into Rolling Fork Creek, on the southwestern side of the site.

Surface Water Ponds. Two surface water ponds are proposed (see Drawing 2-1): a Northeast Surface Water Pond; and a South Surface Water Pond. It is noted that the term "surface water pond" is used because the ponds are intended to provide a detention function (controlling the rate of surface water release from the site), as well as provide a sediment control/water quality function.

The two surface water ponds will be hydraulically connected by the aforementioned Culvert C1, a 24-inch corrugated metal pipe situated beneath the site access road. As mentioned, the perimeter channel along the western and northern sides of the site will convey runoff into these ponds. Additionally, runoff collected by the drainage terraces and downchutes on the eastern and southern portions of the landfill will convey flow into these ponds. At the eastern end of the perimeter channel where it enters the Northeast Surface Water Pond, a grouted riprap apron will be used for erosion protection. At the southwestern end of the perimeter channel, a culvert (C1) will be used to connect the perimeter channel to the South Surface Water Pond (and will also have erosion protection). Where the downchutes flow directly into the ponds, the ACB-lined (or

# ATTACHMENT 2A

# SURFACE WATER MANAGEMENT SYSTEM DRAWINGS

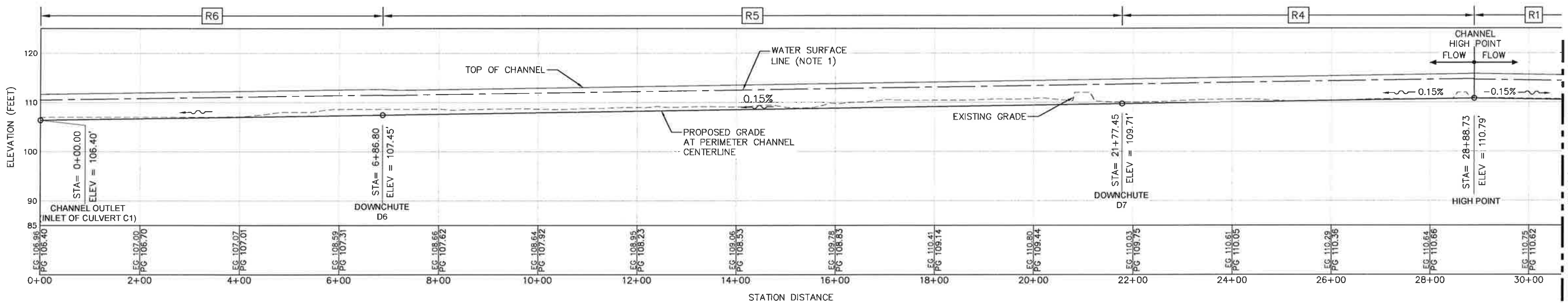
| LIST OF DRAWINGS | | |
|---|---|---|
| Drawing No. | Title | Date |
| 2-1 | Facility Surface Water Management Plan | March 2014 |
| 2-2 | Pre-Development Plan With Drainage Patterns | March 2014 |
| 2-3 | Post-Development Plan With Drainage Patterns | August 2013 |
| 2-4 | Perimeter Drainage Channel Plan With Stationing | August 2013 |
| 2-5 | Perimeter Drainage Channel Profile | May 2014 |
| 2-6 | Surface Water Ponds – Plan View | March 2014 |
| 2-7 | Surface Water Management System Details I | May 2014 |
| 2-8 | Surface Water Management System Details II | August 2013 |
| 2-9 | Surface Water Management System Details III | August 2013 |
| 2-10 | Surface Water Management System Details IV | March 2014 |
| 2-11 | Culvert Sections | March 2014 |
| 2-12 | Rolling Fork Creek and Landfill Perimeter Berm Section | March 2014 |

## LEGEND

| | |
|---|---|
| – – – – – – | EXISTING GRADE ALONG CHANNEL CENTERLINE |
| ——— | PROPOSED GRADE ALONG CHANNEL CENTERLINE |
| — — – | WATER SURFACE LINE (NOTE 1) |
| R5 | CHANNEL REACH DESIGNATION |
| PG 110.36 | PROPOSED GRADE ELEVATION |
| EG 110.36 | EXISTING GRADE ELEVATION |
| PVI | POINT OF VERTICAL INTERSECTION |

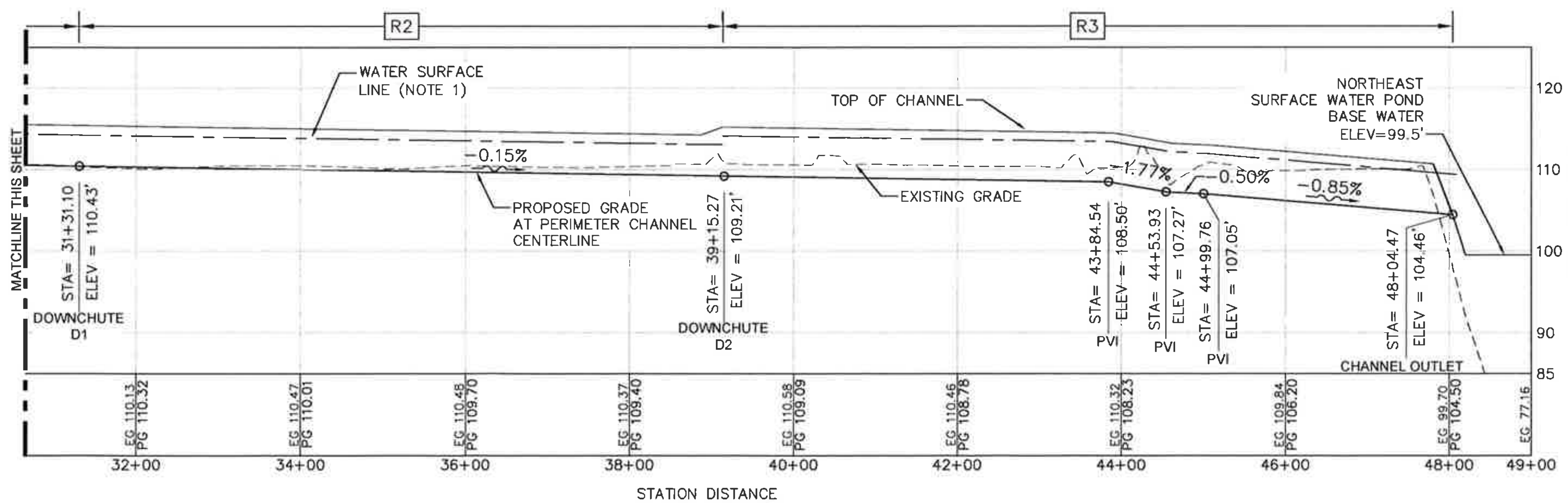
0 100' 200'
HORIZONTAL SCALE IN FEET

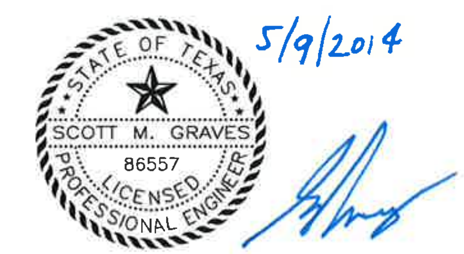
0 10' 20'
VERTICAL SCALE IN FEET




NOTES:

1. WATER SURFACE LINE REPRESENTS THE 25-YEAR, 24-HOUR NORMAL DEPTH OF FLOW.
2. SEE DRAWING 2-10 FOR TABLE OF PERIMETER DRAINAGE CHANNEL DESIGNATIONS, DIMENSIONS (WIDTH, DEPTH), AND CHANNEL LINING TYPE. SEE ATTACHMENT 2E FOR PERIMETER CHANNEL SIZING DESIGN.
3. PERIMETER DRAINAGE CHANNEL REACHES SHALL BE CONSTRUCTED/UPGRADED IN ACCORDANCE WITH THE INSTALLATION SCHEDULE DESCRIBED IN IN ATTACHMENT 2 (DRAINAGE REPORT, SECTION 8). THIS INCLUDES MITIGATING AREAS WHERE DISCREPANCIES EXIST BETWEEN THE EXISTING GRADE OF THE CHANNEL AND THE DESIGN GRADE. ADDITIONALLY, PERIMETER CHANNELS WILL BE INSPECTED AND MAINTAINED DURING OPERATIONS AND AFTER CLOSURE (CONSISTENT WITH SECTION 5 OF THE INTERMEDIATE COVER EROSION AND SEDIMENT CONTROL PLAN AND SECTION 3.3 OF THE POST-CLOSURE PLAN, RESPECTIVELY) WHICH WILL INCLUDE MITIGATING AREAS WHERE DISCREPANCIES OCCUR BETWEEN THE EXISTING GROUND ELEVATION AND THE DESIGN ELEVATION/GRADE OF THE PERIMETER CHANNELS.




FOR PERMIT PURPOSES ONLY

| REV | DATE | DESCRIPTION | DRN | APP |
|---|---|---|---|---|
| 1 | MAY 2014 | REVISED, RESPONSE TO NOD 2 | JJV/KH | SMG |
| – | AUG. 2013 | INITIAL SUBMITTAL TO TCEQ | JJV | SMG |

USA WASTE OF TEXAS LANDFILLS, INC.

LANDFILL SITE ADDRESS:
8205 FAIRBANKS N HOUSTON RD
HOUSTON, TEXAS 77064
PHONE: 713.824.6867

Geosyntec consultants
GEOSYNTEC CONSULTANTS, INC.
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PHONE: 512.451.4003

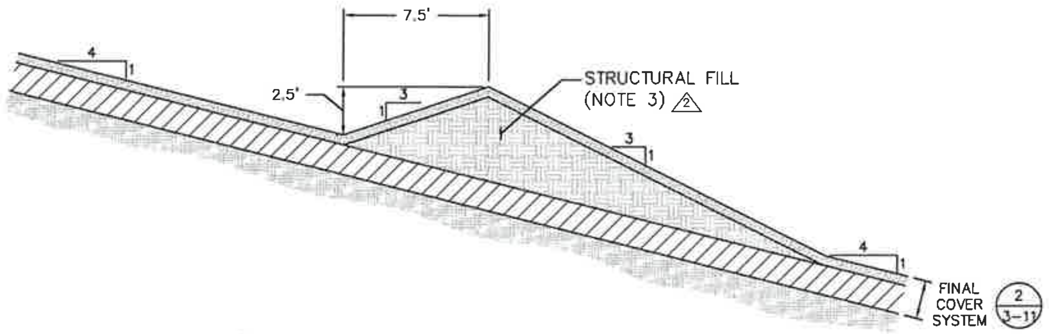
TITLE: PERIMETER DRAINAGE CHANNEL PROFILE

PROJECT: FAIRBANKS LANDFILL
PERMIT AMENDMENT APPLICATION – PERMIT NO. MSW-1565B

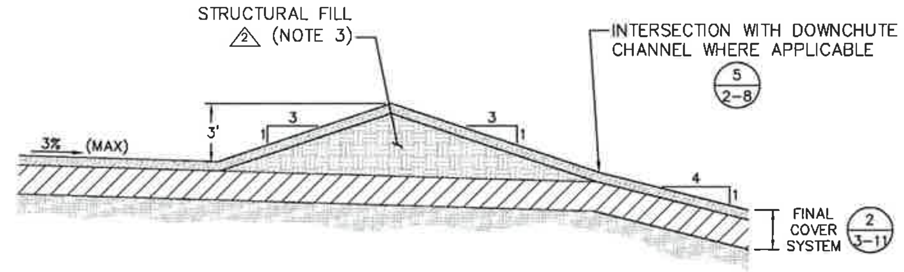
| PROJECT NO.: TXL0263 | DESIGN BY: BK | REVIEWED BY: SMG | PART NO.: III | DRAWING: 2-5 |
|---|---|---|---|---|
| FILE: 0263P2-5 | DRAWN BY: JJV/KH | APPROVED BY: BG | | |

PERMIT DRAWING

DRAWING: Austin P:\CADD\Projects\F\Fairbanks Landfill\Permit\Expansion (TXL0263)\Drawings\Dwgs-Rev0\0263P2-5.dwg PLOTTED: Apr 23, 2014 - 5:22pm




1 / 2-1 DETAIL
SIDESLOPE DRAINAGE TERRACE
SCALE: 1" = 10'
0 5' 10'
SCALE IN FEET




2 / 2-1 DETAIL
TOP DECK DRAINAGE TERRACE
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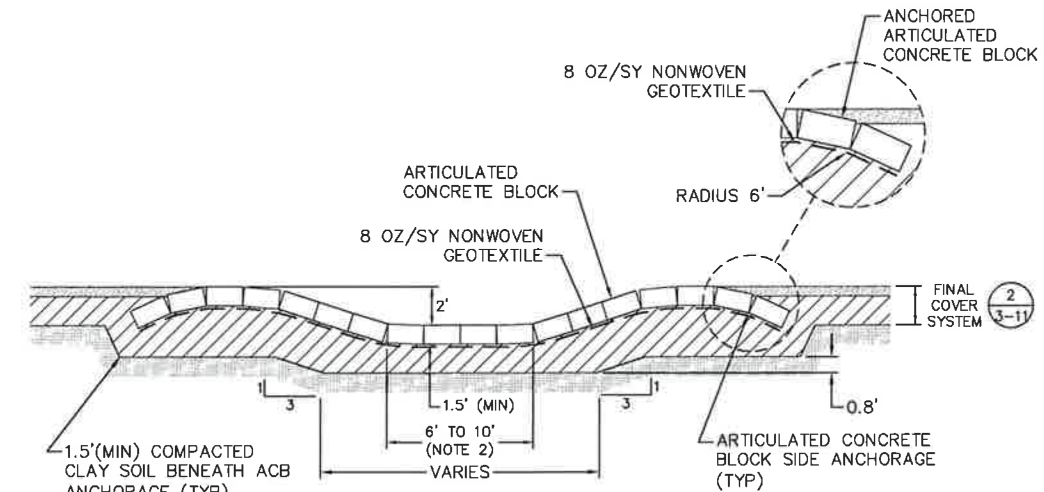
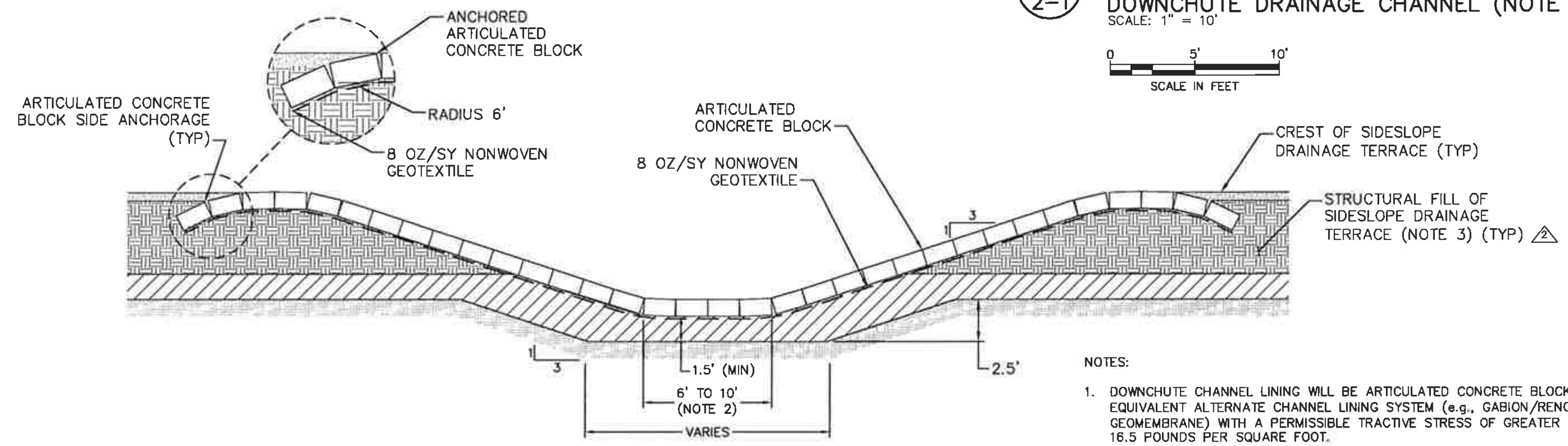
SCALE IN FEET



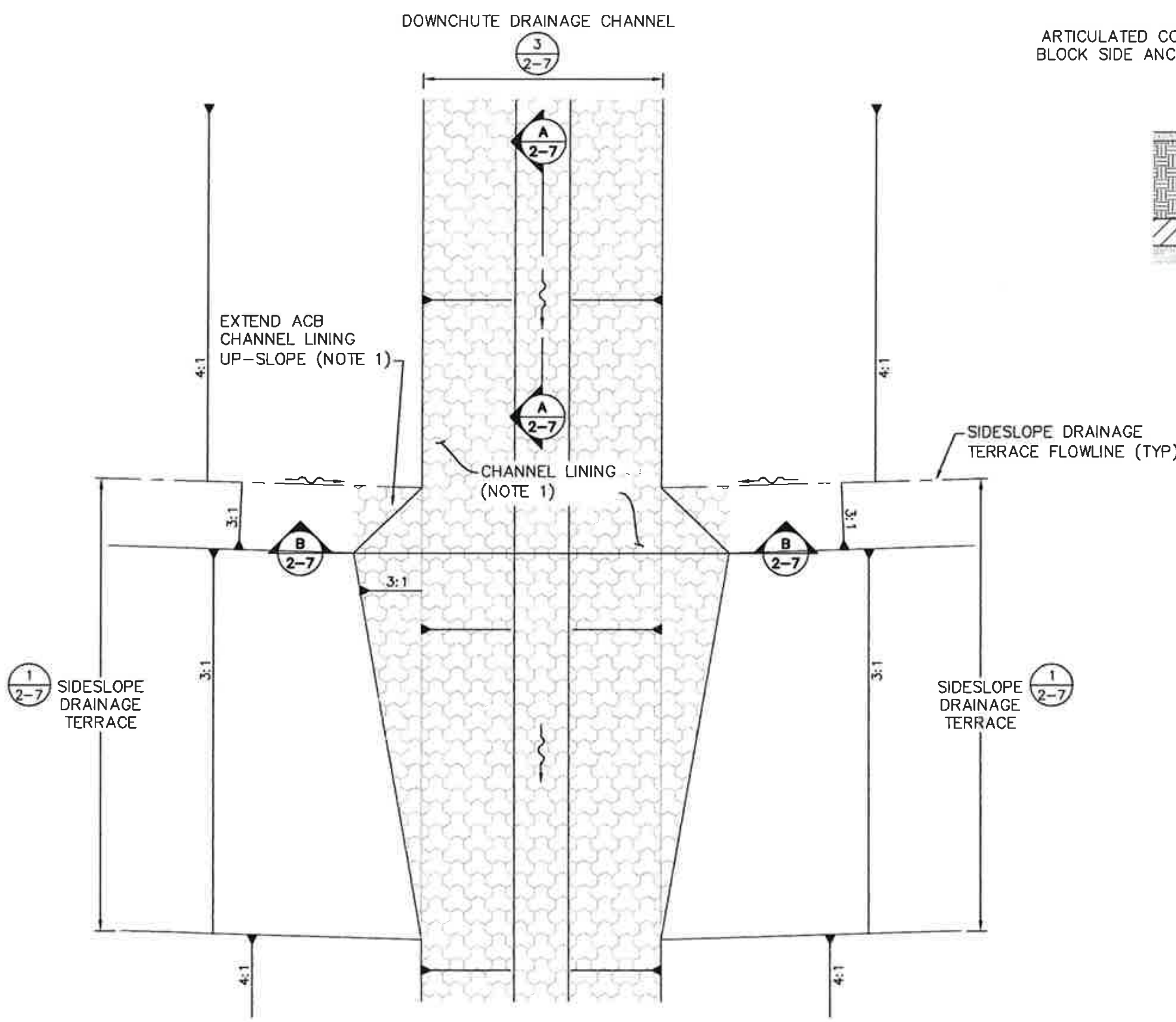

3 / 2-1 DETAIL
DOWNCHUTE DRAINAGE CHANNEL (NOTE 1)
SCALE: 1" = 10'
0 5' 10'
SCALE IN FEET



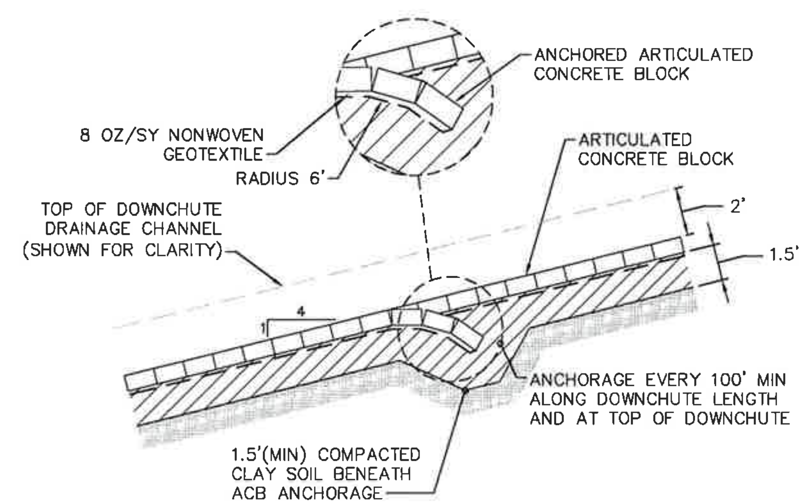

B / 2-7 SECTION
DOWNCHUTE DRAINAGE CHANNEL SECTION (NOTE 1)
SCALE: N.T.S.

NOTES:

1. DOWNCHUTE CHANNEL LINING WILL BE ARTICULATED CONCRETE BLOCK (ACB) OR APPROVED EQUIVALENT ALTERNATE CHANNEL LINING SYSTEM (e.g., GABION/RENO-MATTRESS, RIPRAP, GEOMEMBRANE) WITH A PERMISSIBLE TRACTIVE STRESS OF GREATER THAN OR EQUAL TO 16.5 POUNDS PER SQUARE FOOT.
2. REFER TO PART III, ATTACHMENT 2D FOR DOWNCHUTE CHANNEL WIDTHS, AND DRAWING 2-3 FOR DOWNCHUTE DESIGNATIONS.
3. (2) STRUCTURAL FILL SOIL ASSOCIATED WITH THE DRAINAGE FEATURES SHOWN ON THIS DRAWING SHALL BE CLASSIFIED AS CL, CH, SC, SM, SP, OR SW IN ACCORDANCE WITH THE UNIFIED SOILS CLASSIFICATION SYSTEM (USCS). ADDITIONALLY, THIS STRUCTURAL FILL SHALL BE NATURAL SOIL, FREE OF ORGANIC MATTER (I.E., ROOTS, VEGETATION), DEBRIS, FROZEN MATERIAL, OR EXCESSIVE MOISTURE. STRUCTURAL FILL SOIL SHALL HAVE 98 PERCENT BY WEIGHT SMALLER THAN 3 INCHES IN SIZE, AND SHALL BE PLACED IN 12-INCH THICK (MAXIMUM) LIFTS. EACH LIFT SHALL BE COMPACTED TO A DENSITY OF AT LEAST 92% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY (ASTM D 698).




4 / 2-1 DETAIL
TYPICAL SIDESLOPE DRAINAGE TERRACE AND DOWNCHUTE DRAINAGE CHANNEL INTERSECTION
SCALE: 1" = 20'
0 10' 20'
SCALE IN FEET




A / 2-7 SECTION
DOWNCHUTE DRAINAGE CHANNEL SECTION (NOTE 1)
SCALE: 1" = 8'
0 4' 8'
SCALE IN FEET

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5/9/2014

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|---|---|---|---|---|
| 2 | MAY 2014 | REVISED, RESPONSE TO NOD 2 | JJV/KH | SMG |
| 1 | MAR. 2014 | REVISED, RESPONSE TO NOD 1 | JJV/KH | SMG |
| - | AUG. 2013 | INITIAL SUBMITTAL TO TCEQ | JJV | SMG |

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TITLE:
SURFACE WATER MANAGEMENT DETAILS I

PROJECT:
FAIRBANKS LANDFILL
PERMIT AMENDMENT APPLICATION – PERMIT NO. MSW-1565B

PERMIT DRAWING

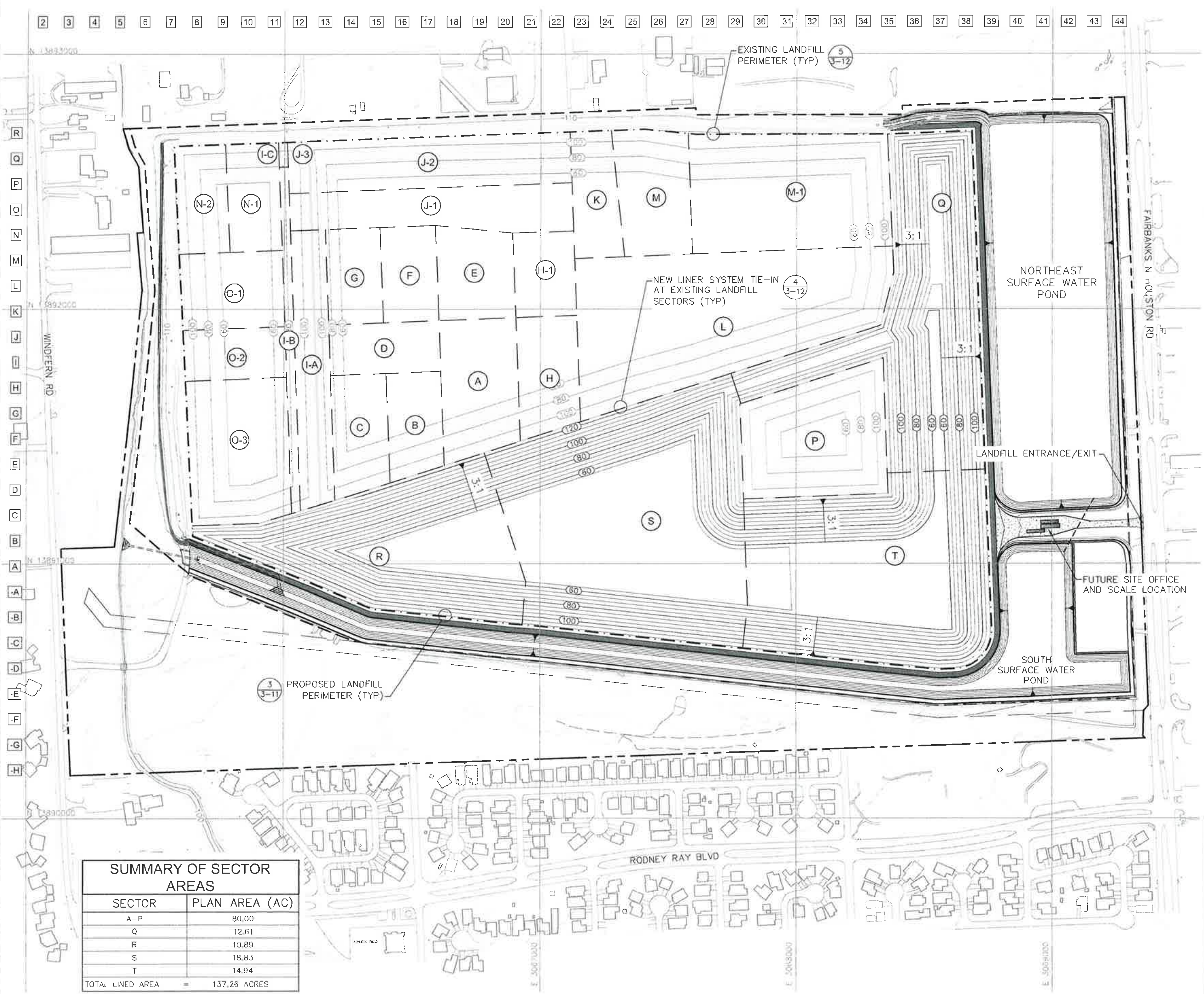
| PROJECT NO.: TXL0263 | DESIGN BY: BK | REVIEWED BY: SMG | PART NO.: III | DRAWING: 2-7 |
|---|---|---|---|---|
| FILE: 0263P2-8 | DRAWN BY: JJV | APPROVED BY: SMG | | |

DRAWING: Austin P:\CADD\Projects\F\Fairbanks Landfill\Permit\Expansion (TXL0263)\Drawings\Dwgs-Rev0\0263P2-8.dwg PLOTTED: Apr 24, 2014 - 12:47pm

# ATTACHMENT 3A

# LANDFILL DESIGN DRAWINGS

| LIST OF DRAWINGS | | |
|---|---|---|
| Drawing No. | Title | Drawing Date (latest revision) |
| 3-1 | Facility Layout Plan | August 2013 |
| 3-2 | Overall Base Grading Plan | May 2014 |
| 3-3 | Overall Final Cover Grading Plan | March 2014 |
| 3-4 | Landfill Entrance Plan | August 2013 |
| 3-5 | Landfill Cross-Section Location Map | August 2013 |
| 3-6 | Landfill Cross-Section A-A’ | March 2014 |
| 3-7 | Landfill Cross-Section B-B’ | March 2014 |
| 3-8 | Landfill Cross-Section C-C’ | March 2014 |
| 3-9 | Landfill Cross-Section D-D’ | March 2014 |
| 3-10 | Landfill Cross-Section E-E’ | March 2014 |
| 3-11 | General Landfill Construction Design Details I | March 2014 |
| 3-12 | General Landfill Construction Design Details II | May 2014 |




## LEGEND

- EXISTING GROUND ELEVATION (FT, MSL) (NOTE 1)
- EXISTING ROAD
- EXISTING WATER LINE
- STATE PLANE COORDINATES (NOTE 2)
- SITE GRID
- PROPERTY BOUNDARY
- PERMIT BOUNDARY
- PROPOSED LANDFILL FOOTPRINT
- SECTOR BOUNDARY
- SECTOR DESIGNATION
- FUTURE (RELOCATED) ENTERPRISE CRUDE PIPELINE EASEMENT
- LANDFILL ACCESS ROAD (PAVED PORTION)
- EXISTING TOP OF PROTECTIVE COVER BASE GRADES (FT, MSL)(NOTES 3, 5)
- PROPOSED TOP OF PROTECTIVE COVER BASE GRADES (FT, MSL)(NOTE 3)
- LANDFILL PERIMETER ROAD (ALL-WEATHER)

OVERVIEW:

SECTORS A–P ARE ALREADY CONSTRUCTED AND FILLING IS IN PROGRESS. SECTORS Q–T ARE PROPOSED SECTORS FOR THE LATERAL EXPANSION. ALL SECTORS WILL HAVE THE SAME LINER SYSTEM. LANDFILL DEVELOPMENT (EXCAVATION, LINING, AND FILLING) SEQUENCE WILL BE IN ALPHABETICAL ORDER OF THE SECTORS SHOWN. REFER TO DRAWINGS IIA–13 THROUGH IIA–16 FOR PHASE DEVELOPMENT LAYOUT PLANS. SECTORS MAY BE FURTHER SUBDIVIDED AT THE FACILITY'S DISCRETION. ALL SECTORS WILL HAVE THE SAME TYPES OF WASTE DISPOSED IN THEM, OF THE TYPES ALLOWED FOR A TYPE IV MSW LANDFILL FACILITY AND AS INDICATED IN THE PERMIT 1565B.

NOTES:

1. THE EXISTING TOPOGRAPHIC BASE MAP SHOWN ON THIS DRAWING WAS COMPILED USING PHOTOGRAMMETRIC METHODS BASED ON AERIAL PHOTOGRAPHY PERFORMED ON 26 MARCH 2012 AND PREPARED BY DALLAS AERIAL SURVEYS (DAS), INC.
2. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL (FT, MSL), AS DEFINED BY THE USGS NATIONAL GEODETIC VERTICAL DATUM (NAVD) OF 1988. STATE PLANE COORDINATE GRID CORRESPONDS TO TEXAS STATE PLANE COORDINATE SYSTEM, TEXAS SOUTH CENTRAL ZONE (4204), NORTH AMERICAN DATUM OF 1983 (NAD–83).
3. LINER GRADES SHOWN ARE THE TOP OF THE PROTECTIVE COVER COMPONENT OF THE LINER SYSTEM. THE BOTTOM OF EXCAVATION GRADES ARE 4–FT BELOW THOSE GRADES SHOWN HERE. THE ELEVATION OF DEEPEST EXCAVATION (EDE) FOR THE FACILITY IS 51 FT, MSL.
4. OUTSIDE OF THE LIMIT OF WASTE, THE PROPOSED CONTOURS REFER TO FINISHED GRADE OF PERIMETER FEATURES.
5. EXISTING TOP OF PROTECTIVE COVER GRADES WERE TAKEN FROM PERMIT MSW–1565A DRAWING E–4, PREPARED BY METROPLEX INDUSTRIES, INC., DATED JANUARY 2002.

### SUMMARY OF SECTOR AREAS

| SECTOR | PLAN AREA (AC) |
|---|---|
| A–P | 80.00 |
| Q | 12.61 |
| R | 10.89 |
| S | 18.83 |
| T | 14.94 |
| TOTAL LINED AREA = | 137.26 ACRES |

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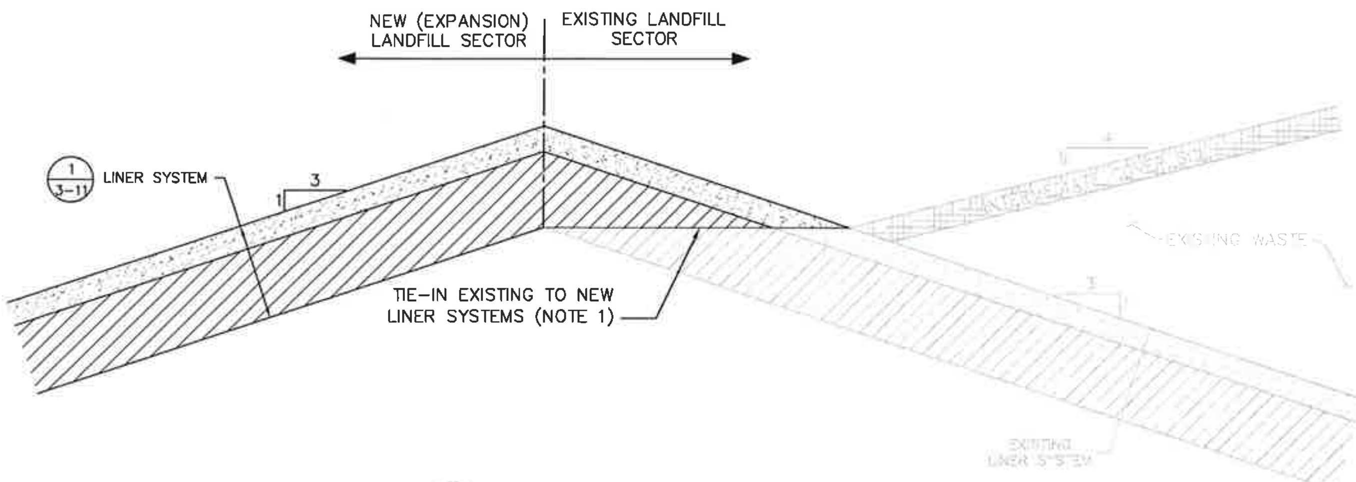
TITLE: OVERALL BASE GRADING PLAN

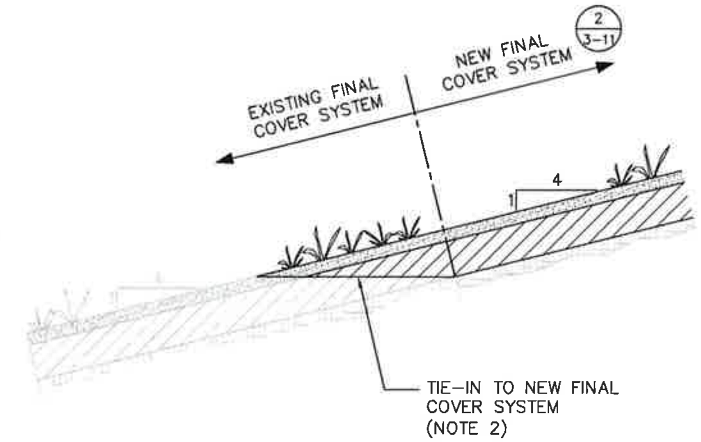
PROJECT: FAIRBANKS LANDFILL
PERMIT AMENDMENT APPLICATION – PERMIT NO. MSW–1565B

PERMIT DRAWING

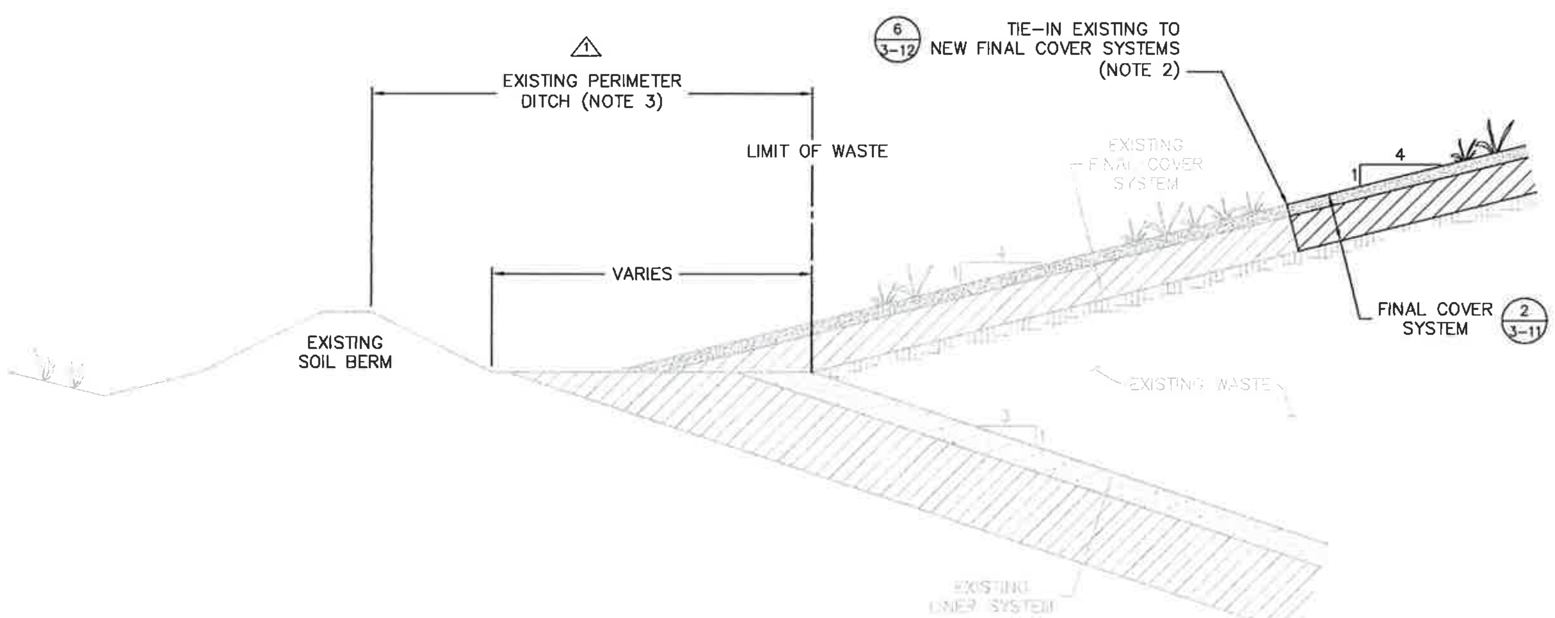
| | | | | | |
|---|---|---|---|---|---|
| PROJECT NO.: TXL0263 | DESIGN BY: SMG | REVIEWED BY: SMG | PART NO.: III | DRAWING: 3–2 |
| FILE: 0263P3–2 | DRAWN BY: JJV | APPROVED BY: SMG | | |




4 3-2 DETAIL
NEW LINER SYSTEM TIE-IN AT EXISTING LANDFILL SECTORS
SCALE: N.T.S.




⚠1 6 3-3 DETAIL
TIE-IN OF NEW FINAL COVER SYSTEM TO EXISTING FINAL COVER SYSTEM
SCALE: N.T.S.




5 3-2 DETAIL
EXISTING LANDFILL PERIMETER (TYP)
SCALE: N.T.S.

NOTES:

1. REFER TO THE LINER QUALITY CONTROL PLAN (LQCP) FOR LINER TIE-IN REQUIREMENTS.
2. REFER TO THE FINAL COVER QUALITY CONTROL PLAN (FCQCP) FOR FINAL COVER TIE-IN REQUIREMENTS.
3. ⚠2 SEE DRAWINGS 2-4 AND 2-5 FOR DITCH DESIGNATIONS AND THEIR LOCATION AND PROFILE SLOPE. SEE DRAWING 2-10 FOR A TABLE OF DITCH DIMENSIONS (WIDTH, DEPTH) AND CHANNEL LINING TYPE. SEE ATTACHMENT 2E FOR THE PERIMETER DITCH SIZING DESIGN CALCULATIONS.

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| 1 | MAR. 2014 | REVISED, RESPONSE TO NOD 1 | JJV/KH | SMG |
| – | AUG. 2013 | INITIAL SUBMITTAL TO TCEQ | JJV | SMG |

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TITLE: GENERAL LANDFILL CONSTRUCTION DESIGN DETAILS II

PROJECT: FAIRBANKS LANDFILL
PERMIT AMENDMENT APPLICATION – PERMIT NO. MSW-1565B

| | | | | |
|---|---|---|---|---|
| PROJECT NO.: TXL0263 | DESIGN BY: SMG | REVIEWED BY: SMG | PART NO.: III | DRAWING: 3-12 |
| FILE: 0263P3-12 | DRAWN BY: JJV | APPROVED BY: SMG | | |

PERMIT DRAWING

DRAWING: Austin P:\CADD\Projects\F\Fairbanks Landfill\Permit\Expansion (TXL0263)\Drawings\Dwgs-Rev0\0263P3-12.dwg PLOTTED: Apr 24, 2014 - 10:48am

*Prepared for:*
**USA Waste of Texas Landfills, Inc.**

# PERMIT AMENDMENT APPLICATION

# PART III – SITE DEVELOPMENT PLAN
# SUB-ATTACHMENT 3C

# LINER QUALITY CONTROL PLAN

# FAIRBANKS LANDFILL
# PERMIT NO. MSW-1565B
# HOUSTON, HARRIS COUNTY, TEXAS


*Prepared by:*
Geosyntec consultants
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Submitted August 2013
Revised March 2014
Revised May 2014

# TABLE OF CONTENTS
# LINER QUALITY CONTROL PLAN



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# TABLE OF CONTENTS (CONTINUED)



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## TABLE OF CONTENTS (CONTINUED)

# TABLE OF CONTENTS (CONTINUED)

**TABLES**



**FIGURE**



**APPENDICES**



STATE OF TEXAS
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86557
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5/9/2014
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# TABLE 3C-1
# MATERIAL SPECIFICATIONS FOR RECOMPACTED CLAY LINER

| PROPERTY | QUALIFIER | UNITS | SPECIFIED VALUES | TEST METHOD[(1)] |
|---|---|---|---|---|
| Maximum Particle Size[(2)] | Maximum | Inch | 1 | ASTM D 422 |
| Percent Passing #200 Sieve | Minimum | Percent | 30 | ASTM D 422 |
| Liquid Limit | Minimum | Percent | 30 | ASTM D 4318 |
| Plasticity Index | Minimum | Percent | 15 | ASTM D 4318 |
| Hydraulic Conductivity | Maximum | cm/s | $1 \times 10^{-7}$ | ASTM D 5084[(3)] |
| Triaxial Compressive Strength (cohesion) | Minimum | psf | 650 | ASTM D 2850 |

Notes:

(1) CQA testing frequencies are provided in Tables 3C-2 and 3C-3 of this LQCP.
(2) Recompacted clay liner material must also not contain rocks or stones that total more than 10% by weight.
(3) Refer to Table 3C-2 for additional hydraulic conductivity testing requirements.

# TABLE 3C-2
# PRE-CONSTRUCTION TESTING REQUIREMENTS FOR RECOMPACTED CLAY LINER

| TEST | METHOD | MINIMUM FREQUENCY OF TESTING(1) | PASSING CRITERIA |
|---|---|---|---|
| Particle Size (Sieve) Analysis | ASTM D 422 | 1 per source | See Table 3C-1 |
| Atterberg Limits | ASTM D 4318 | 1 per source | See Table 3C-1 |
| Natural (as-received) Moisture Content | ASTM D 2216 | 1 per source | None |
| Standard Compaction | ASTM D 698, if “light” weight compactor to be used(2) | 1 per source (select either Standard or Modified Compaction Test based on weight of compactor to be used) | None |
| Modified Compaction | ASTM D 1557, if “heavy” weight compactor to be used(2) | | None |
| Remolded Hydraulic Conductivity | ASTM D 5084(3) | 1 per moisture/density relationship | $\leq 1 \times 10^{-7}$ cm/s |
| Remolded Triaxial Compression Strength (UU, single point) | ASTM D 2850 | 1 per source | ≥ 650 psf |

Notes:

(1) The testing frequency of one per source refers to a relatively consistent and distinguishable soil type at a borrow source location based on visual observations and field classification procedures. If the same borrow source is utilized for the soil supply of more than one liner area project, results from previous pre-construction tests may continue to be used.

(2) Compaction test method shall be selected to be representative of the type of compaction equipment planned for use by the Contractor. For reference, CAT 815 series compactors or equivalent are considered “light” weight equipment, representative of Standard Compaction Tests, and CAT 825 series compactors or equivalent are considered “heavy” weight equipment, representative of Modified Compaction Tests.

(3) Hydraulic conductivity testing shall be performed using tap water or a 0.05N solution of $CaSO_4$. Use effective stress of 20 psi. Distilled or deionized water shall not be used. The permeant should be deaired. All hydraulic conductivity test data shall be submitted with the SLER.

(4) Perform remolded hydraulic conductivity and triaxial compression tests as appropriate for the type of compaction equipment planned for use, on either: (i) a remolded sample that is compacted greater than or equal to 95% of the maximum dry density and at the optimum moisture content as determined from the Standard Proctor test; or (ii) a remolded sample that is compacted greater than or equal to 90% of the maximum dry density and at one percentage point dry of optimum as determined from the Modified Proctor test. Alternatively, a higher relative compaction or moisture content can be used in pre-construction testing; however, these higher values will then be the minimum required values for the recompacted clay liner.

(5) Additional hydraulic conductivity tests may be performed during the preconstruction testing program if authorized by the Owner, in order to develop a more detailed, alternative APZ that may broaden the range of allowable moisture-density target compaction criteria or define allowable conditions for use of soil blends. See Section 2.3.2.2 of this LQCP for a discussion of this approach.

*Prepared for:*

**USA Waste of Texas Landfills, Inc.**

# PERMIT AMENDMENT APPLICATION
# PART III – SITE DEVELOPMENT PLAN
# ATTACHMENT 3D.1

# GEOTECHNICAL REPORT

## FAIRBANKS LANDFILL
## MSW PERMIT NO. 1565B
## HOUSTON, HARRIS COUNTY, TEXAS

*Prepared by:*


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Texas Board of Professional Engineers Firm Registration No. F-1182

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5/9/2014
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Submitted August 2013

Revised March 2014

Revised May 2014

# TABLE OF CONTENTS
# GEOTECHNICAL REPORT



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5/9/2014
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## TABLES



## APPENDICES

# 4. CONCLUSIONS

## 4.1 Overview of Geotechnical Findings

The findings of the 2012 geotechnical investigation of the landfill expansion area are generally consistent with previous investigations, resulting in a site-wide characterization of the geotechnical site characteristics. The resulting findings are summarized below.

- Stratum I soils (generally Clay) are suitable for use as low-permeability liner and final cover layers, vegetative layer, operational (i.e. weekly, intermediate) cover, and general (i.e., compacted) fill. However, it is noted that Stratum I soils have been largely removed from the site.

- Fill Soils (generally Clay) encountered during the investigation are suitable for use as low-permeability liner and final cover layers, vegetative layer, operational (i.e. weekly, intermediate) cover, and general (i.e., compacted) fill.

- Stratum II soils (Sand) are suitable for use as protective cover and operational (i.e. weekly, intermediate) cover. However, it is noted that Stratum II soils have been largely removed from the site through previous sand-pit operations.

- Stratum III soils (Clay) are suitable for use as low-permeability liner and final cover layers, operational (i.e. weekly, intermediate) cover, and general (i.e., compacted) fill.

- Stratum IV soils (Sand) are interpreted to be below the elevation of deepest excavation (EDE) planned for the facility. Therefore, they are not expected to be encountered during landfill development. However, in terms of their geotechnical properties, they are suitable for use as protective cover and operational (i.e. weekly, intermediate) cover.

- Stratum V soils (Clay) are much deeper beneath the site, well below the EDE. Therefore, they are not expected to be encountered during landfill development. However, in terms of their geotechnical properties, they would be suitable for the same uses as Stratum III.

- With respect to the in-situ characteristics of the soils as they relate to constructability, permeability, slope stability, and settlement, all of the strata and soils encountered appear to provide suitable characteristics for adequate performance (as supported by the geotechnical design calculations presented elsewhere in Attachment 3D).

Additional discussion is presented below in the remainder of this report to further describe the rationale for the above findings.

# ATTACHMENT 3D.2

# SLOPE STABILITY ANALYSIS

Geosyntec consultants



| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Written by: | Y. Bholat | Date: | 1/22/2014 | Reviewed & Revised by: | S. Graves | Date: | 5/2/14 |
| Client: | WM TX | Project: | Fairbanks Landfill Expansion | Project No.: | TXL0263 | Phase No.: | 06 |

**SLOPE STABILITY ANALYSIS**
**FAIRBANKS LANDFILL**

5/9/2014

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FOR PERMIT PURPOSES ONLY; CALCULATION PAGES 1 THROUGH 135

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TX ENG FIRM REGISTRATION NO. 1182

# 1 INTRODUCTION

## 1.1 Purpose

The purpose of this calculation package is to present the slope stability analysis for the proposed expansion of the Fairbanks Landfill. Analyses were performed along critical interim and final slopes where slopes would be the steepest and/or the tallest, combined with critical combinations of subsurface conditions/strengths.

The slope stability factors of safety (FS) are evaluated herein for cross sections that represent critical combinations of geometry and shear strength, and for a variety of potential sliding scenarios. Duncan (1992) and EPA (2004) recommend considering the uncertainty of strength measurements and the consequences of failure in the selection of the target factor of safety. Therefore, minimum acceptable target factors of safety for landfill slope stability depend on project-specific conditions and uncertainties. Values used in the analysis were selected based on recommendations by Duncan (1992) and EPA (2004). The target calculated factor of safety for short-term conditions (i.e., foundation slopes prior to liner system construction, liner system veneer, and interim landfill slopes during operation) is 1.25. The target calculated factor of safety for long-term conditions (i.e., final cover veneer and final landfill slopes at the end of operation) is 1.5.

## 1.2 Method

The slope stability analyses were performed using a method of slices coded in the computer program SLIDE, Version 6.019 [Rocscience, 2012]. The computer program was

SLIDE computer output and figures illustrating each of the shear surface scenarios are presented in Appendix 2.

## 6.5 Back-calculated Strengths for Compacted Clay Liner and Final Cover

It is noted that with respect to clay liner and cover strengths, the slope stability analyses previously discussed use assumed strength properties that are expected to be reasonable for the liner and final cover using conservatively selected strengths based on values reported in technical literature for the types of soil expected to be used. However, to provide a recommendation for a minimum strength, the minimum strength of the liner or final cover can be back-calculated until the desired target minimum calculated factor of safety is achieved.

These back-analyses were performed use the same cross sections as discussed previously in this report. The shear strength of the compacted clay liner and/or the compacted clay final cover was varied iteratively for each scenario until the lowest allowable strength is identified that produces a calculated factor of safety greater than or equal to the target minimum calculated factor of safety. Table 6 presents the results of these back-analyses.

**Table 6**
**SUMMARY OF SLIDE RESULTS FOR BACK-CALCULATED LINER/COVER STRENGTHS**

| Back-Calculated Liner and Final Cover System Strength Properties Shear Surface Scenario | Back-Calculated Minimum Strength Required |
|---|---|
| **Veneer Stability** | |
| South slope. Veneer stability of liner system using undrained strengths. Undrained strength, Su, of liner was reduced until FS = 1.25. | 174 psf |
| South slope. Veneer stability of final cover using drained strengths. Drained friction angle assumed to be 0 degrees. Drained cohesion of final cover reduced until FS = 1.5. | 82 psf |
| East slope. Veneer stability of liner system using undrained strengths. Undrained strength, Su, of liner was reduced until FS = 1.25. | 170 psf |
| East slope. Veneer stability of final cover using drained strengths. Drained friction angle assumed to be 0 degrees. Drained cohesion of final cover reduced until FS = 1.5. | 82 psf |
| **Interim Slope** | |
| Block-type shear surface - Seated in the liner system and through Waste. Undrained strength, Su, of liner was reduced until FS = 1.25. | 375 psf |
| **South Slope** | |
| Block-type shear surface – Seated in the liner system and through Waste. Drained friction angle assumed to be 0 degrees. Drained cohesion of liner reduced until FS = 1.5. | 650 psf |
| **East Slope** | |
| Block-type shear surface – Seated in the liner system and through Waste. Drained friction angle assumed to be 0 degrees. Drained cohesion of liner reduced until FS = 1.5. | 490 psf |

Inspection of the above table reveals the minimum strength of the liner and/or cover system needed to attain adequate calculated factors of safety for the various scenarios analyzed. The above table further reveals that the highest required shear strength is for a long-term scenario of sliding through the liner system, which requires a cohesion of 650 psf.

## 7 SUMMARY AND CONCLUSIONS

Based on the analyses presented herein, the following conclusions are drawn.

- Critical cross sections were selected for analysis, and various sliding modes were considered.
- Soil and waste properties were selected based on conservative interpretations of site specific lab results or correlations from published technical literature.
- The calculated factors of safety are all greater than or equal to the target minimum calculated factors of safety.

## A1.1 Estimating the Drained Friction Angle of Stratum II

Stratum II is a sand layer. A drained friction angle, ϕ’, of 33° for Stratum II was used for slope stability analyses. Standard penetration test (SPT) blow counts from the most recent as well as the previous subsurface investigation were used in estimating ϕ’. The following table applies blow count and overburden corrections to obtain $(N_1)_{60}$ values. Terzaghi et al.’s (1996) SPT correlation was then used to approximate the drained friction angle (Figure 8). This method results in an average friction angle of about 35°. Geosyntec slightly reduced the assumed Stratum II friction angle to ϕ’=33°, to add further conservatism to the analysis.

**Table 7**
**STRATUM II FRICTION ANGLE CALCULATION**

| Borehole | Elevation | Blow Counts, N | $N_{60}$ | Effective Stress, $\sigma'_v$ | Overburden Correction, $C_N$ | $(N_1)_{60}$ | Consistency | Friction Angle |
|---|---|---|---|---|---|---|---|---|
| (-) | ft amsl | (-) | Use $C_E$=0.75 | psf | $C_N = (p_a/\sigma'_v)^m \leq 2$, m=0.5 Liao and Whitman (1986) | (-) | (-) | Terzahgi (1996) ϕ' (deg) |
| BME-1 | 83.8 | 25 | 19 | 2336 | 0.95 | 18 | Med. Dense | 34 |
| BME-1 | 81.8 | 25 | 19 | 2588 | 0.90 | 17 | Med. Dense | 34 |
| BME-1 | 79.8 | 33 | 25 | 2840 | 0.86 | 21 | Med. Dense | 35 |
| BME-1 | 77.8 | 49 | 37 | 3092 | 0.83 | 30 | Dense | 38 |
| BME-1 | 75.8 | 24 | 18 | 3344 | 0.80 | 14 | Med. Dense | 33 |
| BME-1 | 73.8 | 22 | 17 | 3596 | 0.77 | 13 | Med. Dense | 32 |
| BME-1 | 71.8 | 25 | 19 | 3848 | 0.74 | 14 | Med. Dense | 33 |
| BME-1 | 69.8 | 47 | 35 | 4100 | 0.72 | 25 | Med. Dense | 36 |
| BME-1 | 67.8 | 18 | 14 | 4352 | 0.70 | 9 | Loose | 31 |
| BME-1 | 65.8 | 29 | 22 | 4604 | 0.68 | 15 | Med. Dense | 33 |
| BME-1 | 63.8 | 67 | 50 | 4856 | 0.66 | 33 | Dense | 39 |
| BME-1 | 61.8 | 41 | 31 | 5108 | 0.64 | 20 | Med. Dense | 35 |
| BME-2 | 91.4 | 39 | 29 | 1820 | 1.08 | 32 | Dense | 38 |
| BME-2 | 90.4 | 35 | 26 | 2072 | 1.01 | 27 | Med. Dense | 37 |
| BME-2 | 89.4 | 34 | 26 | 2324 | 0.95 | 24 | Med. Dense | 36 |
| BME-2 | 88.4 | 44 | 33 | 2576 | 0.91 | 30 | Med. Dense | 38 |
| BME-2 | 87.4 | 32 | 24 | 2828 | 0.87 | 21 | Med. Dense | 35 |
| BME-2 | 86.4 | 26 | 20 | 3080 | 0.83 | 16 | Med. Dense | 33 |
| BME-2 | 85.4 | 28 | 21 | 3332 | 0.80 | 17 | Med. Dense | 33 |
| BME-2 | 84.4 | 25 | 19 | 3584 | 0.77 | 14 | Med. Dense | 33 |
| BME-2 | 83.4 | 41 | 31 | 3836 | 0.74 | 23 | Med. Dense | 36 |
| BME-2 | 82.4 | 41 | 31 | 4088 | 0.72 | 22 | Med. Dense | 35 |

## A1.2 Estimating the Drained Friction Angle of Stratum IV

Stratum IV is a sand layer. Blow counts from the most recent subsurface investigation were used to approximate the drained friction angle of Stratum IV. The following table applies blow count and overburden corrections to obtain $(N_1)_{60}$ values. Terzaghi et al.'s (1996) SPT correlation was then used to approximate the drained friction angle (Figure 8). The average drained friction angle, ϕ' = 35° derived from the correlation presented below was used for stability analyses.

**Table 8**
**STRATUM IV FRICTION ANGLE CALCULATION**

| Borehole | Elevation | Blow Counts, N | $N_{60}$ | Effective Stress, $\sigma'_v$ | Overburden Correction, $C_N$ | $(N_1)_{60}$ | Consistency | Friction Angle |
|---|---|---|---|---|---|---|---|---|
| (-) | ft amsl | (-) | Use $C_E$=0.75 | psf | $C_N = (p_a/\sigma'_v)^m \leq$ 2, m=0.5 Liao and Whitman (1986) | (-) | (-) | Terzahgi (1996) ϕ' (deg) |
| BME-1 | 28.8 | 62 | 47 | 9390 | 0.47 | 22 | Med. Dense | 36 |
| BME-1 | 23.8 | 62 | 47 | 10070 | 0.46 | 21 | Med. Dense | 35 |
| BME-1 | 18.8 | 100 | 75 | 10750 | 0.44 | 33 | Dense | 39 |
| BME-1 | 13.8 | 100 | 75 | 11430 | 0.43 | 32 | Dense | 38 |
| BME-3 | 37.4 | 26 | 20 | 6902 | 0.55 | 11 | Med. Dense | 31 |
| BME-3 | 32.4 | 33 | 25 | 7582 | 0.53 | 13 | Med. Dense | 32 |
| BME-3 | 27.4 | 47 | 35 | 8262 | 0.51 | 18 | Med. Dense | 34 |
| BME-3 | 22.4 | 54 | 41 | 8942 | 0.49 | 20 | Med. Dense | 35 |
| BME-4 | 39.2 | 9 | 7 | 6240 | 0.58 | 4 | Very Loose | 28 |
| BME-4 | 34.2 | 13 | 10 | 6920 | 0.55 | 5 | Loose | 29 |
| BME-4 | 29.2 | 38 | 29 | 7600 | 0.53 | 15 | Med. Dense | 33 |
| BME-4 | 24.2 | 45 | 34 | 8280 | 0.51 | 17 | Med. Dense | 33 |
| BME-4 | 19.2 | 45 | 34 | 8960 | 0.49 | 16 | Med. Dense | 33 |
| BME-4 | 14.2 | 21 | 16 | 9640 | 0.47 | 7 | Loose | 30 |
| BME-4 | 9.2 | 26 | 20 | 10320 | 0.45 | 9 | Loose | 30 |
| BME-4 | 4.2 | 48 | 36 | 11000 | 0.44 | 16 | Med. Dense | 33 |
| BME-5 | 29.1 | 34 | 26 | 6902 | 0.55 | 14 | Med. Dense | 33 |
| BME-5 | 24.1 | 41 | 31 | 7582 | 0.53 | 16 | Med. Dense | 33 |
| BME-5 | 19.1 | 78 | 59 | 8262 | 0.51 | 30 | Med. Dense | 38 |
| BME-5 | 14.1 | 77 | 58 | 8942 | 0.49 | 28 | Med. Dense | 37 |
| BME-5 | 9.1 | 78 | 59 | 9622 | 0.47 | 27 | Med. Dense | 37 |
| BME-5 | 4.1 | 78 | 59 | 10302 | 0.45 | 27 | Med. Dense | 37 |
| BME-5 | -0.9 | 77 | 58 | 10982 | 0.44 | 25 | Med. Dense | 37 |
| BME-5 | -5.9 | 100 | 75 | 11662 | 0.43 | 32 | Dense | 38 |
| BME-5 | -10.9 | 100 | 75 | 12342 | 0.41 | 31 | Dense | 38 |
| BME-6 | 39.2 | 36 | 27 | 5970 | 0.60 | 16 | Med. Dense | 33 |
| BME-6 | 37.2 | 56 | 42 | 6242 | 0.58 | 24 | Med. Dense | 36 |
| BME-6 | 32.2 | 100 | 75 | 6922 | 0.55 | 41 | Dense | 40 |
| BME-6 | 27.2 | 100 | 75 | 7602 | 0.53 | 40 | Dense | 40 |
| BME-6 | 22.2 | 47 | 35 | 8282 | 0.51 | 18 | Med. Dense | 34 |
| BME-6 | 17.2 | 100 | 75 | 8962 | 0.49 | 36 | Dense | 39 |
| BME-6 | 7.2 | 98 | 74 | 10277 | 0.45 | 33 | Dense | 39 |

## A1.4 Estimating the Strength of Compacted Clay for the Cover/Liner and Constructed Fill

The following table is derived from Duncan et al. (1989) for drained and undrained strengths of compacted clay. In the slope stability analyses, drained strengths used for the cover, liner, and constructed fill were c’ = 250 psf and ϕ’ = 25°. The undrained shear strength assumed was 1600 psf (i.e., the cohesion (c), and with a friction angle (ϕ) of zero).

**Table 9**
**SHEAR STRENGTH PROPERTIES OF COMPACTED SOILS**
**(DUNCAN ET AL. 1989)**

| USCS Symbol | Soil Type | Typical Strength Characteristics | | | |
|---|---|---|---|---|---|
| | | Drained | | Undrained | |
| | | c’ (psf) | ϕ’ (deg) | c (psf) | ϕ (deg) |
| CL | Inorganic clays of low to medium plasticity | 285 | 28 ± 2 | 2100 ± 320 | 1-3 |
| CH | Inorganic clay of high plasticity | 245 ± 120 | 19 ± 5 | 1800 ± 980 | 0-2 |

# Analysis #7a

## *Project Summary*

---

- File Name: SouthSlope 2014-04-10 Undrained Block Liner System Veneer Backcalculated Su.slim
- Slide Modeler Version: 6.027
- Project Title: SLIDE - An Interactive Slope Stability Program
- Date Created: 11/12/2012, 11:59:43 AM

## *General Settings*

---

- Units of Measurement: Imperial Units
- Time Units: days
- Permeability Units: feet/second
- Failure Direction: Left to Right
- Data Output: Standard
- Maximum Material Properties: 20
- Maximum Support Properties: 20

## *Analysis Options*

---

**Analysis Methods Used**

- Spencer

- Number of slices: 30
- Tolerance: 0.005
- Maximum number of iterations: 50
- Check malpha < 0.2: Yes
- Initial trial value of FS: 1
- Steffensen Iteration: Yes

## *Groundwater Analysis*

---

- Groundwater Method: Water Surfaces
- Pore Fluid Unit Weight: 62.4 lbs/ft3
- Advanced Groundwater Method: None

## Surface Options

- Surface Type: Non-Circular Block Search
- Number of Surfaces: 5000
- Pseudo-Random Surfaces: Enabled
- Convex Surfaces Only: Disabled
- Left Projection Angle (Start Angle): 135
- Left Projection Angle (End Angle): 135
- Right Projection Angle (Start Angle): 45
- Right Projection Angle (End Angle): 45
- Minimum Elevation: Not Defined
- Minimum Depth: Not Defined

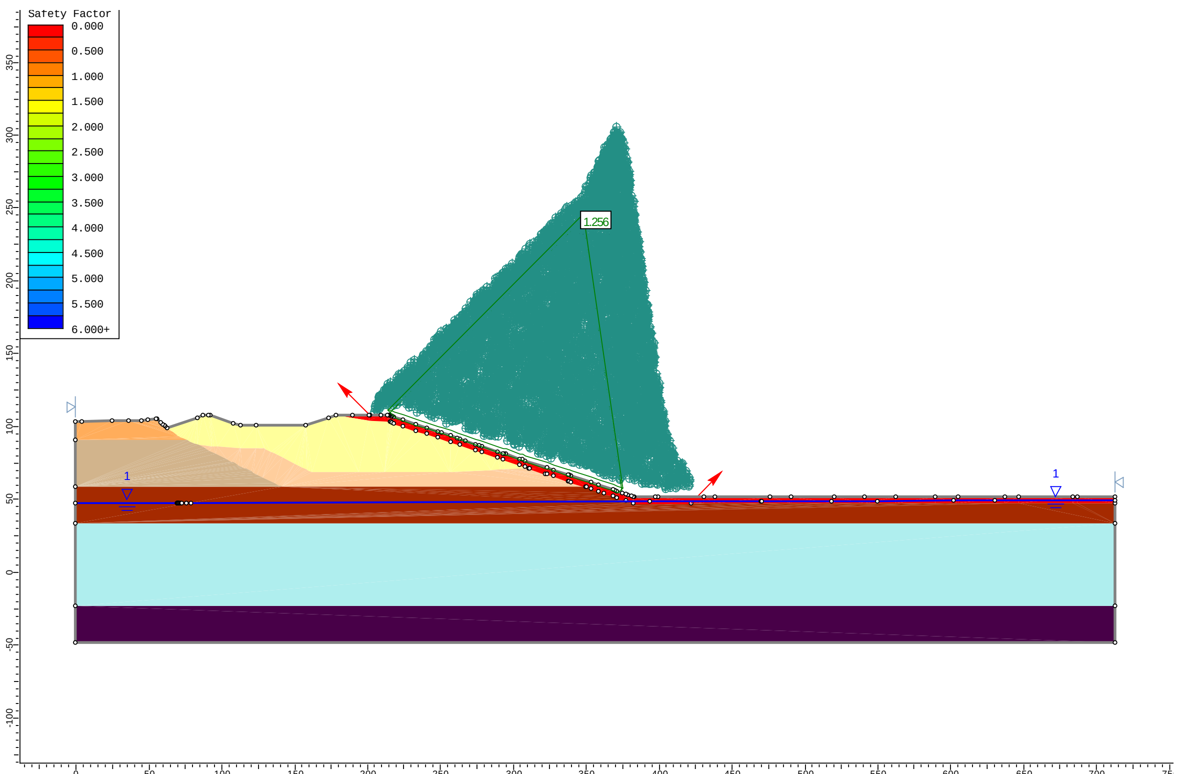
## Material Properties

| Property | Cover/Liner | Fill Layer | Layer I: Clay | Layer II: Sand | Layer III: Clay | Layer IV: Sand/Silt | Layer V: Clay | Constructed Fill |
|---|---|---|---|---|---|---|---|---|
| Color | | | | | | | | |
| Strength Type | Undrained | Undrained | Undrained | Mohr-Coulomb | Undrained | Mohr-Coulomb | Undrained | Undrained |
| Unit Weight [lbs/ft3] | 120 | 130 | 134 | 126 | 130 | 136 | 123 | 120 |
| Cohesion [psf] | | | | 0 | | 0 | | |
| Friction Angle [deg] | | | | 33 | | 35 | | |
| Cohesion Type | 174 | 2074 | 2304 | | 1490 | | 1500 | 1600 |
| Water Surface | None | None | None | None | None | Piezometric Line 1 | None | None |
| Hu Value | | | | | | 1 | | |
| Ru Value | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |

## Global Minimums

## Method: spencer

- FS: 1.255880
- Axis Location: 347.615, 245.674
- Left Slip Surface Endpoint: 213.680, 111.261
- Right Slip Surface Endpoint: 374.785, 57.878
- Resisting Moment=5.21411e+006 lb-ft
- Driving Moment=4.15177e+006 lb-ft
- Resisting Horizontal Force=28032.2 lb
- Driving Horizontal Force=22320.8 lb
- Total Slice Area=660.091 ft2



# Analysis #8a

## *Project Summary*

---

- File Name: EastSlope 2014-04-10 Undrained Block Liner System Veneer Backcalculated Su.slim
- Slide Modeler Version: 6.027
- Project Title: SLIDE - An Interactive Slope Stability Program
- Date Created: 11/12/2012, 3:14:56 PM

## *General Settings*

---

- Units of Measurement: Imperial Units
- Time Units: days
- Permeability Units: feet/second
- Failure Direction: Right to Left
- Data Output: Standard
- Maximum Material Properties: 20
- Maximum Support Properties: 20

## *Analysis Options*

---

**Analysis Methods Used**

- Spencer

- Number of slices: 30
- Tolerance: 0.005
- Maximum number of iterations: 50
- Check malpha < 0.2: Yes
- Initial trial value of FS: 1
- Steffensen Iteration: Yes

## *Groundwater Analysis*

---

- Groundwater Method: Water Surfaces
- Pore Fluid Unit Weight: 62.4 lbs/ft3
- Advanced Groundwater Method: None

## *Surface Options*

- Surface Type: Non-Circular Block Search
- Number of Surfaces: 5000
- Pseudo-Random Surfaces: Enabled
- Convex Surfaces Only: Disabled
- Left Projection Angle (Start Angle): 135
- Left Projection Angle (End Angle): 135
- Right Projection Angle (Start Angle): 45
- Right Projection Angle (End Angle): 45
- Minimum Elevation: Not Defined
- Minimum Depth: Not Defined

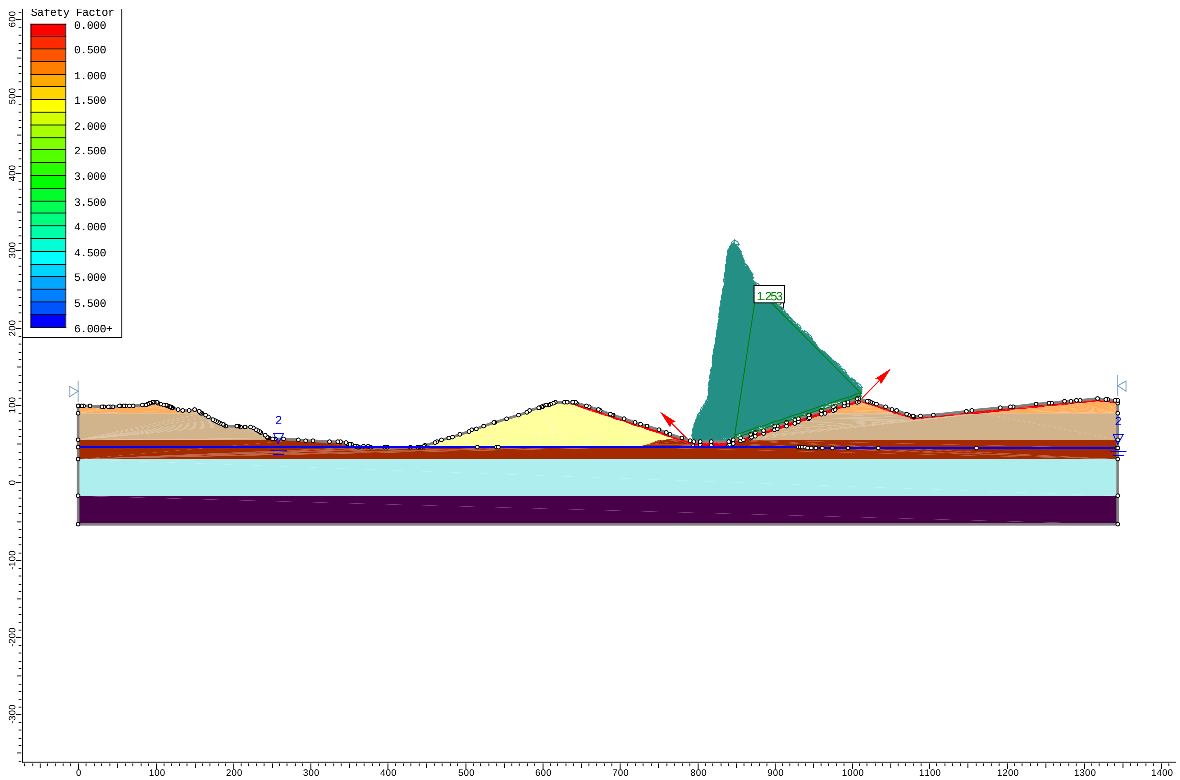
## *Material Properties*

| **Property** | **Cover/Liner** | **Layer I: Clay** | **Layer II: Sand** | **Layer III: Clay** | **Layer IV: Sand/Silt** | **Layer V: Clay** | **Constructed Fill** |
|---|---|---|---|---|---|---|---|
| Color | | | | | | | |
| Strength Type | Undrained | Undrained | Mohr-Coulomb | Undrained | Mohr-Coulomb | Undrained | Undrained |
| Unit Weight [lbs/ft3] | 120 | 134 | 126 | 130 | 136 | 123 | 120 |
| Cohesion [psf] | | | 0 | | 0 | | |
| Friction Angle [deg] | | | 33 | | 35 | | |
| Cohesion Type | 170 | 2304 | | 1490 | | 1500 | 1600 |
| Water Surface | None | None | None | None | Piezometric Line 2 | None | None |
| Hu Value | | | | | 1 | | |
| Ru Value | 0 | 0 | 0 | 0 | | 0 | 0 |

## *Global Minimums*

### Method: spencer

- FS: 1.252530
- Axis Location: 876.543, 252.243
- Left Slip Surface Endpoint: 847.860, 61.969
- Right Slip Surface Endpoint: 1011.552, 115.132
- Resisting Moment=5.20477e+006 lb-ft
- Driving Moment=4.15541e+006 lb-ft
- Resisting Horizontal Force=27827.6 lb
- Driving Horizontal Force=22217.1 lb
- Total Slice Area=660.378 ft2



# Analysis #9a

## *Project Summary*

---

- File Name: SouthSlope 2014-04-10 Drained Block Final Cover System Veneer Backcalculated c, phi=0.slim
- Slide Modeler Version: 6.027
- Project Title: SLIDE - An Interactive Slope Stability Program
- Date Created: 11/12/2012, 11:59:43 AM

## *General Settings*

---

- Units of Measurement: Imperial Units
- Time Units: days
- Permeability Units: feet/second
- Failure Direction: Right to Left
- Data Output: Standard
- Maximum Material Properties: 20
- Maximum Support Properties: 20

## *Analysis Options*

---

**Analysis Methods Used**

- Spencer

- Number of slices: 30
- Tolerance: 0.005
- Maximum number of iterations: 50
- Check malpha < 0.2: Yes
- Initial trial value of FS: 1
- Steffensen Iteration: Yes

## *Groundwater Analysis*

---

- Groundwater Method: Water Surfaces
- Pore Fluid Unit Weight: 62.4 lbs/ft3
- Advanced Groundwater Method: None

## *Surface Options*

- Surface Type: Non-Circular Block Search
- Number of Surfaces: 5000
- Pseudo-Random Surfaces: Enabled
- Convex Surfaces Only: Disabled
- Left Projection Angle (Start Angle): 135
- Left Projection Angle (End Angle): 135
- Right Projection Angle (Start Angle): 45
- Right Projection Angle (End Angle): 45
- Minimum Elevation: Not Defined
- Minimum Depth: Not Defined

## *Material Properties*

| Property | Waste | Cover/Liner | Fill Layer | Layer I: Clay | Layer II: Sand | Layer III: Clay | Layer IV: Sand/Silt | Layer V: Clay |
|---|---|---|---|---|---|---|---|---|
| Color | | | | | | | | |
| Strength Type | Shear Normal function | Mohr-Coulomb | Shear Normal function | Mohr-Coulomb | Mohr-Coulomb | Shear Normal function | Mohr-Coulomb | Mohr-Coulomb |
| Unit Weight [lbs/ft3] | 90 | 120 | 130 | 134 | 126 | 130 | 136 | 123 |
| Cohesion [psf] | | 82 | | 40 | 0 | | 0 | 0 |
| Friction Angle [deg] | | 0 | | 35 | 33 | | 35 | 18 |
| Water Surface | None | None | None | None | None | None | Piezometric Line 1 | None |
| Hu Value | | | | | | | 1 | |
| Ru Value | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |

### Shear Normal Functions

- Name: Waste Conservative

| Normal (psf) | Shear (psf) |
|---|---|
| 0 | 501 |

| | |
|---|---:|
| 772 | 501 |
| 62656 | 40690 |

- Name: Layer III Conservative Drained

| Normal (psf) | Shear (psf) |
|---|---:|
| 0 | 0 |
| 1619 | 1052 |
| 43200 | 16598 |

- Name: Fill Layer Conservative Drained

| Normal (psf) | Shear (psf) |
|---|---:|
| 0 | 0 |
| 12525 | 4150 |
| 43200 | 11458 |

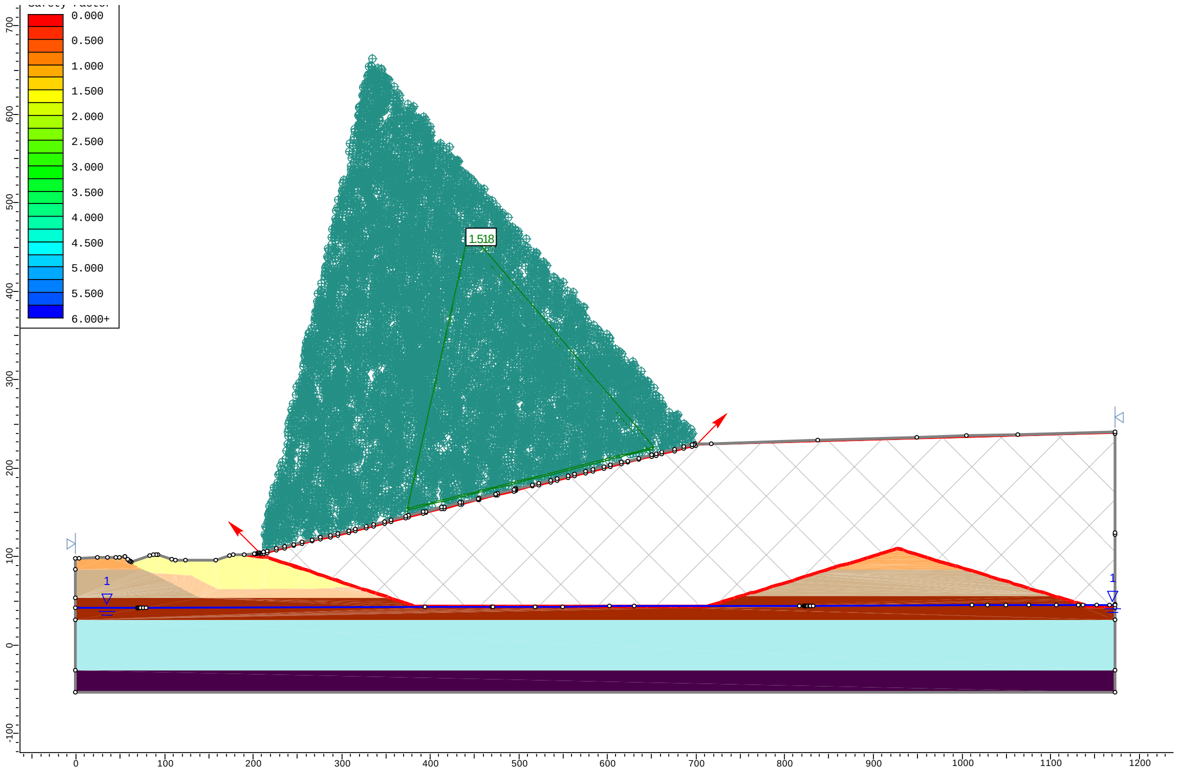
| Property | Constructed Fill |
|---|---:|
| Color | |
| Strength Type | Mohr-Coulomb |
| Unit Weight [lbs/ft3] | 120 |
| Cohesion [psf] | 250 |
| Friction Angle [deg] | 25 |
| Water Surface | None |
| Ru Value | 0 |

## *Global Minimums*

---

### Method: spencer

- FS: 1.518340
- Axis Location: 443.318, 468.313
- Left Slip Surface Endpoint: 373.559, 154.397
- Right Slip Surface Endpoint: 652.596, 224.156
- Resisting Moment=6.86305e+006 lb-ft
- Driving Moment=4.52011e+006 lb-ft
- Resisting Horizontal Force=22881 lb
- Driving Horizontal Force=15069.8 lb
- Total Slice Area=543.24 ft2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0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
1.518
700
600
500
400
300
200
100
0
-100
0
100
200
300
400
500
600
700
800
900
1000
1100
1200

# Analysis #10a

## *Project Summary*

- File Name: EastSlope 2014-04-10 Drained Block Final Cover System Veneer Backcalculated c, phi=0.slim
- Slide Modeler Version: 6.027
- Project Title: SLIDE - An Interactive Slope Stability Program
- Date Created: 11/12/2012, 3:14:56 PM

## *General Settings*

- Units of Measurement: Imperial Units
- Time Units: days
- Permeability Units: feet/second
- Failure Direction: Right to Left
- Data Output: Standard
- Maximum Material Properties: 20
- Maximum Support Properties: 20

## *Analysis Options*

**Analysis Methods Used**

- Spencer

- Number of slices: 30
- Tolerance: 0.005
- Maximum number of iterations: 50
- Check malpha < 0.2: Yes
- Initial trial value of FS: 1
- Steffensen Iteration: Yes

## *Groundwater Analysis*

- Groundwater Method: Water Surfaces
- Pore Fluid Unit Weight: 62.4 lbs/ft3
- Advanced Groundwater Method: None

## *Surface Options*

- Surface Type: Non-Circular Block Search
- Number of Surfaces: 5000
- Pseudo-Random Surfaces: Enabled
- Convex Surfaces Only: Disabled
- Left Projection Angle (Start Angle): 135
- Left Projection Angle (End Angle): 135
- Right Projection Angle (Start Angle): 45
- Right Projection Angle (End Angle): 45
- Minimum Elevation: Not Defined
- Minimum Depth: Not Defined

## *Material Properties*

| Property | Waste | Cover/Liner | Layer I: Clay | Layer II: Sand | Layer III: Clay | Layer IV: Sand/Silt | Layer V: Clay | Constructed Fill |
|---|---|---|---|---|---|---|---|---|
| Color | | | | | | | | |
| Strength Type | Shear Normal function | Mohr-Coulomb | Mohr-Coulomb | Mohr-Coulomb | Shear Normal function | Mohr-Coulomb | Mohr-Coulomb | Mohr-Coulomb |
| Unit Weight [lbs/ft3] | 90 | 120 | 134 | 126 | 130 | 136 | 123 | 120 |
| Cohesion [psf] | | 82 | 40 | 0 | | 0 | 0 | 250 |
| Friction Angle [deg] | | 0 | 35 | 33 | | 35 | 18 | 25 |
| Water Surface | None | None | None | None | None | Piezometric Line 2 | None | None |
| Hu Value | | | | | | 1 | | |
| Ru Value | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |

### Shear Normal Functions

- Name: Waste Conservative

| Normal (psf) | Shear (psf) |
|---|---|
| 0 | 501 |

| | |
|---|---|
| 772 | 501 |
| 62656 | 40690 |

- Name: Layer III Conservative Drained

| Normal (psf) | Shear (psf) |
|---|---|
| 0 | 0 |
| 1619 | 1052 |
| 43200 | 16598 |

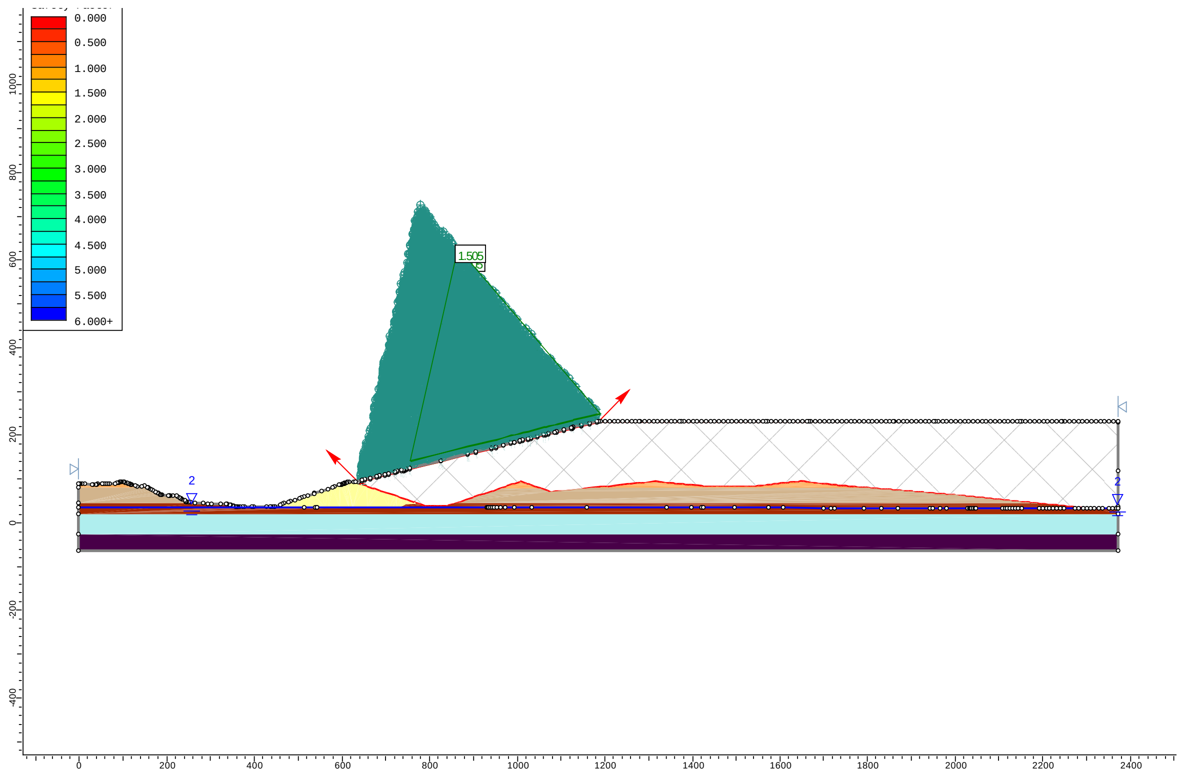
- Name: Fill Layer Conservative Drained

| Normal (psf) | Shear (psf) |
|---|---|
| 0 | 0 |
| 12525 | 4150 |
| 43200 | 11458 |

## *Global Minimums*

### Method: spencer

- FS: 1.504870
- Axis Location: 865.143, 627.803
- Left Slip Surface Endpoint: 756.661, 142.107
- Right Slip Surface Endpoint: 1188.611, 249.600
- Resisting Moment=1.63492e+007 lb-ft
- Driving Moment=1.08642e+007 lb-ft
- Resisting Horizontal Force=35419.9 lb
- Driving Horizontal Force=23536.8 lb
- Total Slice Area=843.806 ft2


0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
1.505
2
2
1000
800
600
400
200
0
-200
-400
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400

# Analysis #13a

## *Project Summary*

---

- File Name: InterimSlope 2014-04-10 Undrained Block Liner Backcalculated Su.slim
- Slide Modeler Version: 6.027
- Project Title: SLIDE - An Interactive Slope Stability Program
- Date Created: 11/12/2012, 1:08:13 PM

## *General Settings*

---

- Units of Measurement: Imperial Units
- Time Units: days
- Permeability Units: feet/second
- Failure Direction: Right to Left
- Data Output: Standard
- Maximum Material Properties: 20
- Maximum Support Properties: 20

## *Analysis Options*

---

**Analysis Methods Used**

- Spencer

- Number of slices: 30
- Tolerance: 0.005
- Maximum number of iterations: 50
- Check malpha < 0.2: Yes
- Initial trial value of FS: 1
- Steffensen Iteration: Yes

## *Groundwater Analysis*

---

- Groundwater Method: Water Surfaces
- Pore Fluid Unit Weight: 62.4 lbs/ft3
- Advanced Groundwater Method: None

## *Surface Options*

- Surface Type: Non-Circular Block Search
- Number of Surfaces: 5000
- Pseudo-Random Surfaces: Enabled
- Convex Surfaces Only: Disabled
- Left Projection Angle (Start Angle): 135
- Left Projection Angle (End Angle): 135
- Right Projection Angle (Start Angle): 45
- Right Projection Angle (End Angle): 45
- Minimum Elevation: Not Defined
- Minimum Depth: Not Defined

## *Material Properties*

| Property | Waste | Cover/Liner | Fill Layer | Layer I: Clay | Layer II: Sand | Layer III: Clay | Layer IV: Sand/Silt | Layer V: Clay |
|---|---|---|---|---|---|---|---|---|
| Color | | | | | | | | |
| Strength Type | Shear Normal function | Undrained | Undrained | Undrained | Mohr-Coulomb | Undrained | Mohr-Coulomb | Undrained |
| Unit Weight [lbs/ft3] | 90 | 120 | 130 | 134 | 126 | 130 | 136 | 123 |
| Cohesion [psf] | | | | | 0 | | 0 | |
| Friction Angle [deg] | | | | | 33 | | 35 | |
| Cohesion Type | | 375 | 2074 | 2304 | | 1490 | | 1500 |
| Water Surface | None | None | None | None | None | None | Piezometric Line 1 | None |
| Hu Value | | | | | | | 1 | |
| Ru Value | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |

### Shear Normal Functions

- Name: Waste Conservative

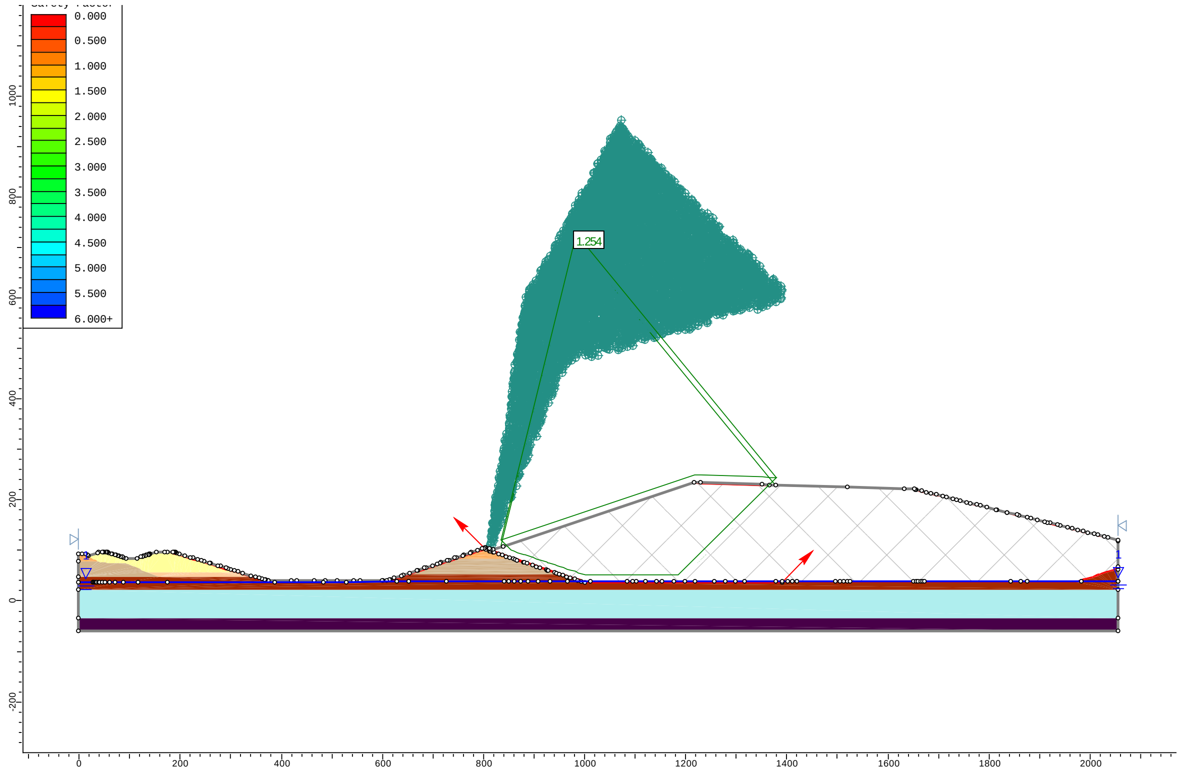
| Normal (psf) | Shear (psf) |
|---|---|
| 0 | 501 |
| 772 | 501 |
| 62656 | 40690 |

| Property | Constructed Fill |
|---|---|
| Color | |
| Strength Type | Undrained |
| Unit Weight [lbs/ft3] | 120 |
| Cohesion Type | 1600 |
| Water Surface | None |
| Ru Value | 0 |

## *Global Minimums*

### Method: spencer

- FS: 1.253510
- Axis Location: 982.578, 727.205
- Left Slip Surface Endpoint: 833.719, 120.771
- Right Slip Surface Endpoint: 1378.410, 244.257
- Resisting Moment=7.05809e+008 lb-ft
- Driving Moment=5.63069e+008 lb-ft
- Resisting Horizontal Force=838417 lb
- Driving Horizontal Force=668858 lb
- Total Slice Area=59263.8 ft2


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
1.254

# Analysis #18a

## *Project Summary*

- File Name: SouthSlope 2014-04-10 Drained Block Liner Backcalculated c, phi=0.slim
- Slide Modeler Version: 6.027
- Project Title: SLIDE - An Interactive Slope Stability Program
- Date Created: 11/12/2012, 11:59:43 AM

## *General Settings*

- Units of Measurement: Imperial Units
- Time Units: days
- Permeability Units: feet/second
- Failure Direction: Right to Left
- Data Output: Standard
- Maximum Material Properties: 20
- Maximum Support Properties: 20

## *Analysis Options*

**Analysis Methods Used**

- Spencer

- Number of slices: 30
- Tolerance: 0.005
- Maximum number of iterations: 50
- Check malpha < 0.2: Yes
- Initial trial value of FS: 1
- Steffensen Iteration: Yes

## *Groundwater Analysis*

- Groundwater Method: Water Surfaces
- Pore Fluid Unit Weight: 62.4 lbs/ft3
- Advanced Groundwater Method: None

## *Surface Options*

- Surface Type: Non-Circular Block Search
- Number of Surfaces: 5000
- Pseudo-Random Surfaces: Enabled
- Convex Surfaces Only: Disabled
- Left Projection Angle (Start Angle): 135
- Left Projection Angle (End Angle): 135
- Right Projection Angle (Start Angle): 45
- Right Projection Angle (End Angle): 45
- Minimum Elevation: Not Defined
- Minimum Depth: Not Defined

## *Material Properties*

| Property | Waste | Cover/Liner | Fill Layer | Layer I: Clay | Layer II: Sand | Layer III: Clay | Layer IV: Sand/Silt | Layer V: Clay |
|---|---|---|---|---|---|---|---|---|
| Color | | | | | | | | |
| Strength Type | Shear Normal function | Mohr-Coulomb | Shear Normal function | Mohr-Coulomb | Mohr-Coulomb | Shear Normal function | Mohr-Coulomb | Mohr-Coulomb |
| Unit Weight [lbs/ft3] | 90 | 120 | 130 | 134 | 126 | 130 | 136 | 123 |
| Cohesion [psf] | | 650 | | 40 | 0 | | 0 | 0 |
| Friction Angle [deg] | | 0 | | 35 | 33 | | 35 | 18 |
| Water Surface | None | None | None | None | None | None | Piezometric Line 1 | None |
| Hu Value | | | | | | | 1 | |
| Ru Value | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |

### Shear Normal Functions

- Name: Waste Conservative

| Normal (psf) | Shear (psf) |
|---|---|
| 0 | 501 |

| | |
|---|---|
| 772 | 501 |
| 62656 | 40690 |

- Name: Layer III Conservative Drained

| Normal (psf) | Shear (psf) |
|---|---|
| 0 | 0 |
| 1619 | 1052 |
| 43200 | 16598 |

- Name: Fill Layer Conservative Drained

| Normal (psf) | Shear (psf) |
|---|---|
| 0 | 0 |
| 12525 | 4150 |
| 43200 | 11458 |

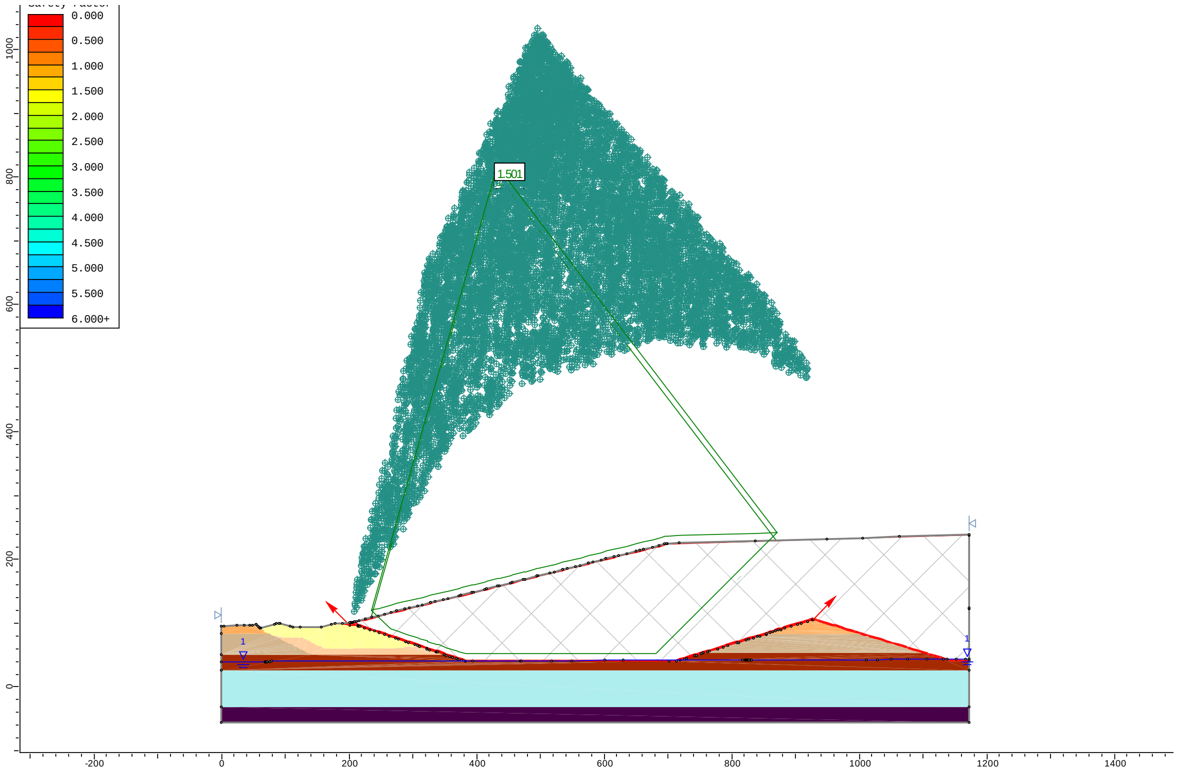
| Property | Constructed Fill |
|---|---|
| Color | |
| Strength Type | Mohr-Coulomb |
| Unit Weight [lbs/ft3] | 120 |
| Cohesion [psf] | 250 |
| Friction Angle [deg] | 25 |
| Water Surface | None |
| Ru Value | 0 |

## *Global Minimums*

---

### Method: spencer

- FS: 1.500760
- Axis Location: 432.038, 816.334
- Left Slip Surface Endpoint: 235.256, 119.821
- Right Slip Surface Endpoint: 871.179, 241.001
- Resisting Moment=9.25873e+008 lb-ft
- Driving Moment=6.16938e+008 lb-ft
- Resisting Horizontal Force=986941 lb
- Driving Horizontal Force=657629 lb
- Total Slice Area=69100.1 ft2


0.000
0.500
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2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
1.501
1000
800
600
400
200
0
-200
0
200
400
600
800
1000
1200
1400

# Analysis #23a

## *Project Summary*

---

- File Name: EastSlope 2014-04-10 Drained Block Liner Backcalculated c, phi=0.slim
- Slide Modeler Version: 6.027
- Project Title: SLIDE - An Interactive Slope Stability Program
- Date Created: 11/12/2012, 3:14:56 PM

## *General Settings*

---

- Units of Measurement: Imperial Units
- Time Units: days
- Permeability Units: feet/second
- Failure Direction: Right to Left
- Data Output: Standard
- Maximum Material Properties: 20
- Maximum Support Properties: 20

## *Analysis Options*

---

**Analysis Methods Used**

- Spencer

- Number of slices: 30
- Tolerance: 0.005
- Maximum number of iterations: 50
- Check malpha < 0.2: Yes
- Initial trial value of FS: 1
- Steffensen Iteration: Yes

## *Groundwater Analysis*

---

- Groundwater Method: Water Surfaces
- Pore Fluid Unit Weight: 62.4 lbs/ft3
- Advanced Groundwater Method: None

## *Surface Options*

- Surface Type: Non-Circular Block Search
- Number of Surfaces: 5000
- Pseudo-Random Surfaces: Enabled
- Convex Surfaces Only: Disabled
- Left Projection Angle (Start Angle): 135
- Left Projection Angle (End Angle): 135
- Right Projection Angle (Start Angle): 45
- Right Projection Angle (End Angle): 45
- Minimum Elevation: Not Defined
- Minimum Depth: Not Defined

## *Material Properties*

| Property | Waste | Cover/Liner | Layer I: Clay | Layer II: Sand | Layer III: Clay | Layer IV: Sand/Silt | Layer V: Clay | Constructed Fill |
|---|---|---|---|---|---|---|---|---|
| Color | | | | | | | | |
| Strength Type | Shear Normal function | Mohr-Coulomb | Mohr-Coulomb | Mohr-Coulomb | Shear Normal function | Mohr-Coulomb | Mohr-Coulomb | Mohr-Coulomb |
| Unit Weight [lbs/ft3] | 90 | 120 | 134 | 126 | 130 | 136 | 123 | 120 |
| Cohesion [psf] | | 490 | 40 | 0 | | 0 | 0 | 250 |
| Friction Angle [deg] | | 0 | 35 | 33 | | 35 | 18 | 25 |
| Water Surface | None | None | None | None | None | Piezometric Line 2 | None | None |
| Hu Value | | | | | | 1 | | |
| Ru Value | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |

### Shear Normal Functions

- Name: Waste Conservative

| Normal (psf) | Shear (psf) |
|---|---|
| 0 | 501 |

| | |
|---|---|
| 772 | 501 |
| 62656 | 40690 |

- Name: Layer III Conservative Drained

| Normal (psf) | Shear (psf) |
|---|---|
| 0 | 0 |
| 1619 | 1052 |
| 43200 | 16598 |

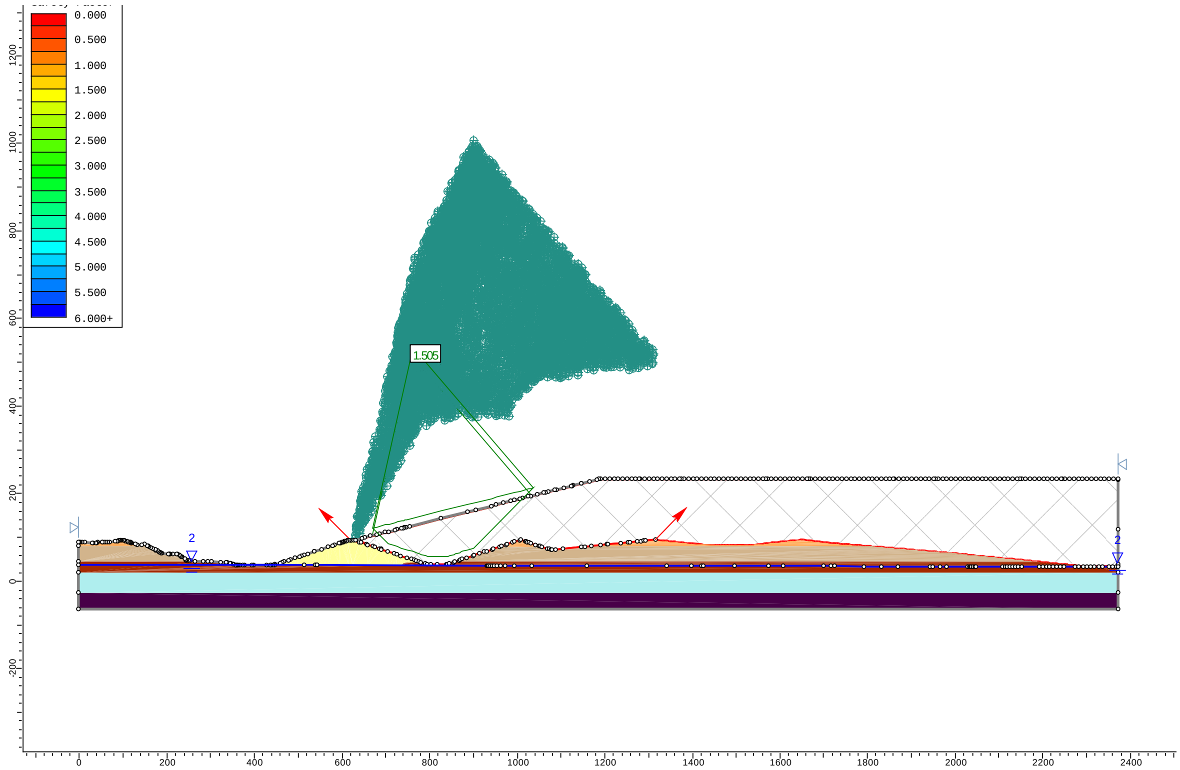
- Name: Fill Layer Conservative Drained

| Normal (psf) | Shear (psf) |
|---|---|
| 0 | 0 |
| 12525 | 4150 |
| 43200 | 11458 |

## *Global Minimums*

### Method: spencer

- FS: 1.504840
- Axis Location: 761.964, 532.629
- Left Slip Surface Endpoint: 670.345, 120.537
- Right Slip Surface Endpoint: 1036.667, 212.079
- Resisting Moment=2.38546e+008 lb-ft
- Driving Moment=1.58519e+008 lb-ft
- Resisting Horizontal Force=430971 lb
- Driving Horizontal Force=286389 lb
- Total Slice Area=24938.5 ft2


0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
1.505

# ATTACHMENT 3D.4.2

# BALLAST UPLIFT CALCULATION

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Written by: | J. McNash | Date: | 11/29/2012 | Reviewed & Revised by: | S. Graves | Date: | 5/2/2014 |
| Client: | USAWTXL | Project: | Fairbanks Landfill Expansion | Project No.: | TXL0263 | Phase No.: | 06 |

# BALLAST UPLIFT CALCULATION
# FAIRBANKS LANDFILL

5/9/2014

STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED PROFESSIONAL ENGINEER

FOR PERMIT PURPOSES ONLY;
CALCULATION PAGES 1
THROUGH 13

GEOSYNTEC CONSULTANTS, INC.
TX ENG. FIRM REGISTRATION NO. F-1182

## 1. INTRODUCTION

The purpose of this calculation package is to calculate the thickness of ballast required to resist uplift pressures on the liner system due to the presence of perched groundwater within Stratum II.

## 2. METHODOLOGY

The Texas Commission on Environmental Quality (TCEQ) recommends a minimum factor of safety ($FS_{min}$) against liner system uplift of 1.2 if no ballast is required or if soils are used as ballast. Alternatively, if waste is selected as ballast, the required long-term $FS_{min}$ is 1.5. The required thickness of ballast on the liner system to achieve these $FS_{min}$ values can be calculated by the following steps:

- Select critical points for evaluation of a cell (i.e., sector) (based on local groundwater conditions with respect to landfill base and/or side slope elevations), top of liner, and critical subsurface strata. Evaluate the elevations of the seasonal high groundwater table (SHGT) (synonymous with the "historical high" groundwater levels). Or, use observed groundwater levels if conditions are intermittent and not represented by a continuous water table.

- Select the required long-term factor of safety against uplift (1.2 or 1.5) depending on the ballast material.

- Calculate the maximum hydrostatic uplift force, $U_N$, acting normal to the liner (see free body diagram in Figure 3D.4.2-1) at each point:

$$U_N = \gamma_w \times H_{wt}$$

where: $\gamma_w$ = unit weight of water; $H_{wt}$ = vertical distance from the liner to the seasonal high groundwater table.

- Evaluate the unit weight of the ballast materials (soil and/or waste):

When possible, the total unit weight of the soil ballast layers should be verified by laboratory or field data. If these data are not available, the following unit weights may be used:

Waste - total unit weight of the waste used in uplift stability calculations For municipal solid waste, TCEQ requires in 30 TAC §330.337(h)(2) that the unit weight of waste used as ballast material be selected as 1,200 pounds per cubic yard, or 44 pounds per cubic foot. Since this landfill is a Type IV and will not have MSW, but rather will have a construction and demolition (C&D) type of waste, it is likely that the waste will be even denser (heavy). However, for conservatism, 44 pounds per cubic foot will be used as the unit weight of waste in these calculations.

Protective Cover - Assume loose dumped unit weight of protective cover soil as 70% of the typical in-situ unit weight. If material is lightly compacted during placement, 80% of the typical in-situ or standard Proctor maximum unit weight may be used. From these guidelines and the anticipated light compaction during placement (e.g., dozer), a value of 90 pounds per cubic foot was selected for the unit weight of protective cover material.

Compacted Clay Liner – The recompacted clay liner material will be compacted to 95% dry density. A value of 115.6 pcf was selected for computing the resistance to uplift by the compacted clay liner. Note that this value is slightly lower than the value used in the slope stability analyses in

Attachment 3D.2. The lower unit weight selected here is conservative in terms of this uplift calculation.

- Calculate the resisting force, $R_N$, provided by recompacted clay liner and protective cover soils acting normal to the liner (see free body diagram in Figure 3D.4.2-1) at each point:

$$R_N = R_V \times \cos\beta + R_H \times \sin\beta = \Sigma(\gamma_i \times T_i) \times \cos\beta + \Sigma(K_o \times \gamma_i \times T_i) \times \sin\beta$$

where: $R_V$ = vertical resisting force; $R_H$ = horizontal resisting force; $\gamma_i$ = total unit weight of the $i^{th}$ ballast component above the liner; $T_i$ = vertical thickness of the $i^{th}$ ballast component above the liner; $K_0$ = coefficient of static earth pressure provided by the liner (as shown in Figure 3D.4.2-2 (Holtz and Kovacs, 1981)); and $\beta$ = the slope of the liner system. It is noted that the lateral earth pressure from the liner and protective soil at the calculation point provide the resisting force against uplift.

- Calculate the provided FS without ballast at each point:

$$FS = R_N / U_N = [\Sigma(\gamma_i \times T_i) \times \cos\beta + \Sigma(K_o \times \gamma_i \times T_i) \times \sin\beta] / (\gamma_w \times H_{wt})$$

If the provided FS is greater than or equal to $FS_{min}$, then no ballast is required. If FS is less than the $FS_{min}$, then ballast is required.

- If ballast is required, calculate the required thickness, $T_i$, of the ballast materials assuming that only the vertical pressure of the ballast contributes to the additional resistance against uplift:

$$\Sigma(\gamma_i T_i) * \cos\beta = ((FS_{min} * U_N) - R_N)$$

## 3. CALCULATIONS

The following section presents the calculations to evaluate the required thickness of ballast to resist uplift for two potential ballast materials: Waste-as-Ballast (Case I) and Soil-as-Ballast (Case II). Geologic cross sections were developed for the site and are provided in the Geology Report (Part III, Attachment 4), which give an indication of where the water-bearing zone that will encounter the sidewall liner system in places is located (i.e., Stratum

II). The base liner system grading plan and final cover grading plan are presented in Part III, Attachment 3, Drawings 3-2 and 3-3, respectively. Finally, a map of the historical high groundwater elevations in Stratum II is presented in the Liner Quality Control Plan (LCQP) in Attachment 3C. The historical high groundwater elevations in Stratum II are used to calculate the uplift forces.

The liner in the southwestern part of landfill (Sector R) is selected as the critical case for design as this location has the highest elevation difference between the SHGT and the liner base grades. A representative typical/idealized cross section of the landfill liner at this worst-case location is provided in Figure 3D.4.2-3 of this calculation package. As shown in Figure 3D.4.2-3, the bottom of Stratum II (perched water bearing stratum) is located at elevation 60 ft MSL, and will encounter the liner sidewall. Therefore, hydrostatic uplift was evaluated along the 3 horizontal: 1 vertical (3H:1V) liner side slope a few feet above the Stratum II and Stratum III interface. At this location, the historical high groundwater table elevation is 86 ft MSL. The height of the water table in this area is calculated as:

$$H_{wt} = 86\ ft\ MSL - 60\ ft\ MSL = 26\ ft$$

The uplift force on the 3H:1V liner side slopes ($\beta = 18.43°$) is computed as:

$$U = (H_{wt} \times \gamma_w) = (26\ ft \times 62.4\ pcf) = 1622.4\ psf$$

The pre-ballast resisting force is evaluated based on resistance available from a 3-ft thick compacted clay liner with 1-ft of protective cover. The resisting force is a combination of horizontal and vertical components and computed as follows:

$$R_N = \Sigma(\gamma_i \times T_i) \times \cos\beta + \Sigma( K_0 \times \gamma_i \times T_i) \times \sin\beta$$

$$R_N = [(115.6\ pcf \times 3\ ft + 90.0\ pcf \times 1\ ft) \times \cos(18.43°)] + [1-\sin(18°)] \times (115.6\ pcf \times 3\ ft + 90.0\ pcf \times 1\ ft) \times \sin(18.43°)$$

$$R_N = 509.8\ psf$$

where, the coefficient of static earth pressure ($K_0$) is defined as 1-sin$\phi$; and $\phi$ was selected as 18° for recompacted clay liner for the purposes of this computation.

The calculated factor of safety without ballast is:

$FS = R_N / U_N = 509.8\ psf / 1622.4\ psf = 0.31$

Therefore, ballast will be required to resist calculated uplift pressures from Stratum II along the liner of this evaluated location in Sector R. If waste is selected as the ballast material (Case I), sufficient ballast should be placed to achieve a $FS_{min}$ equal to 1.5 against uplift. The thickness of waste to be used as ballast ($T_{wb}$) material is calculated as:

$T_{wb} = ((FS_{min} \times U_N) - R_N) / (\gamma_{wb} \times \cos\beta)$

$T_{wb} = ((1.5 \times 1622.4\ psf) - 509.8\ psf) / (44\ pcf \times \cos(18.43°)) = 46.1\ ft$

Therefore, the required thickness of waste if used as ballast in Sector R where it encounters Stratum II along the sidewall is 47.0 ft (rounded up).

Similarly, if soil material is selected as ballast (Case II), sufficient ballast should be placed to achieve a $FS_{min}$ equal to 1.2 against uplift. The thickness of soil ballast ($T_{sb}$) is calculated as:

$T_{sb} = ((FS_{min} \times U_N) - R_N) / (\gamma_{sb} \times \cos\beta)$

$T_{sb} = ((1.2 \times 1622.4\ psf) - 509.8\ psf) / (90\ pcf \times \cos(18.43°)) = 16.8\ ft$

Therefore, the required thickness of soil material if soil is used as ballast in Sector R where it encounters Stratum II along the sidewall is 17.0 ft (rounded up).

## 4. RESULTS

Design calculations as shown above were conducted for the north portion of Sector Q, the south portion of Sector Q, Sector R, Sector S, and Sector T (i.e., the proposed sectors that have not yet been constructed). The calculations for required thickness of ballast required in each sector are summarized in Table 3D.4.2-1. Since the base (floor) of the landfill liner will be keyed-in to the clayey Stratum III and groundwater is not expected to encounter the floor of the landfill, the computations presented herein are performed at the intersection of Stratum II and the liner side slopes, using the same methodology presented above.

## 5. CONCLUSIONS

Uplift and ballast computations were performed for various cells at Fairbanks landfill based on the SHGT elevation, the extent of Stratum II, and the landfill base grades. An underdrain system (i.e., pressure relief/dewatering system) will be used to control groundwater prior to sufficient ballast being in-place. When waste placement is high enough, it will serve as ballast to counteract uplift forces on the sidewall. The required thickness of ballast for the applicable landfill sectors is provided in Table 3D.4.2-1. Note that the calculations were performed for two cases - using either soil or waste as ballast - although it is expected that waste will be used as ballast. It is also noted that the required thickness of ballast refers to the ballast necessary to resist uplift forces at the intersection of the base of Stratum II with the sidewall (i.e., at the deepest/worst-case point).

As landfill waste filling progresses, the actual waste thickness will exceed the minimum required thickness of waste-ballast (See Figure 3D.4.2-3). This demonstrates that waste may be used as ballast, without the need to be supplemented by additional soil ballast placement.

As discussed in the Liner Quality Control Plan (LQCP), an underdrain will be provided in areas where the liner encounters Stratum II. The underdrain will be operated until the thickness of ballast (waste) placed within each cell reaches the required thickness to resist uplift with an adequate calculated factor of safety. Furthermore, placement of ballast will be documented in a Ballast Evaluation Report (BER) in accordance to the LQCP.

## 6. REFERENCES

Holtz, R.D. and W.D. Kovacs, (1981). “An Introduction to Geotechnical Engineering”, Prentice-Hall, Inc., New Jersey, pp. 225-226, 519.

# TABLES

- **Table 3D.4.2-1. Summary of Uplift and Ballast Calculation Results**

## Table 3D.4.2-1. Summary of Uplift and Ballast Calculation Results

| Cell No. | Base Elev. | Stratum II Elev. | SHGT Elev. [1] | $H_{wt}$ | $U_N$ | $R_V$ | $R_H$ | $R_N$ | FS[2] | $T_{wb}$[3] | $T_{sb}$[4] | $FS_{wb}$[5] | $FS_{sb}$[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | ft msl | ft msl | ft msl | ft | psf | psf | psf | psf | - | ft | ft | - | - |
| Sector Q (north) | 70.0 | 58.0 | 85.0 | 15.0 | 936.0 | 436.8 | 301.8 | 509.8 | 0.54 | 22.0 | 8.0 | 1.58 | 1.31 |
| Sector Q (south) | 60.0 | 60.0 | 79.5 | 19.5 | 1216.8 | 436.8 | 301.8 | 509.8 | 0.42 | 32.0 | 12.0 | 1.58 | 1.31 |
| Sector R | 55.0 | 60.0 | 86.0 | 26.0 | 1622.4 | 436.8 | 301.8 | 509.8 | 0.31 | 47.0 | 17.0 | 1.59 | 1.26 |
| Sector S | 55.0 | 60.0 | 84.0 | 24.0 | 1497.6 | 436.8 | 301.8 | 509.8 | 0.34 | 42.0 | 16.0 | 1.57 | 1.30 |
| Sector T | 55.0 | 59.5 | 81.0 | 21.5 | 1341.6 | 436.8 | 301.8 | 509.8 | 0.38 | 36.0 | 13.0 | 1.56 | 1.25 |

Notes:

1. SHGT = Seasonally High Groundwater Table (synonymous with historical high groundwater levels).
2. Factor of Safety without ballast material.
3. Thickness of Waste Ballast ($T_{wb}$) material (rounded up to nearest 1 ft) above the Stratum II Elevation needed to provide $FS_{min}$ of 1.5. **[Use this column to select the required minimum thickness of waste that would provide sufficient ballast to warrant ceasing operation of the underdrain system at that sector/location – provided that this is confirmed and documented in the requisite BER submittal.]**
4. Thickness of Soil Ballast ($T_{sb}$) material above the Stratum II Elevation (rounded up to nearest 1 ft) needed to provide $FS_{min}$ of 1.2.
5. Factor of Safety with $T_{wb}$ of waste ballast material.
6. Factor of Safety with $T_{sb}$ of soil ballast material.

# FIGURES

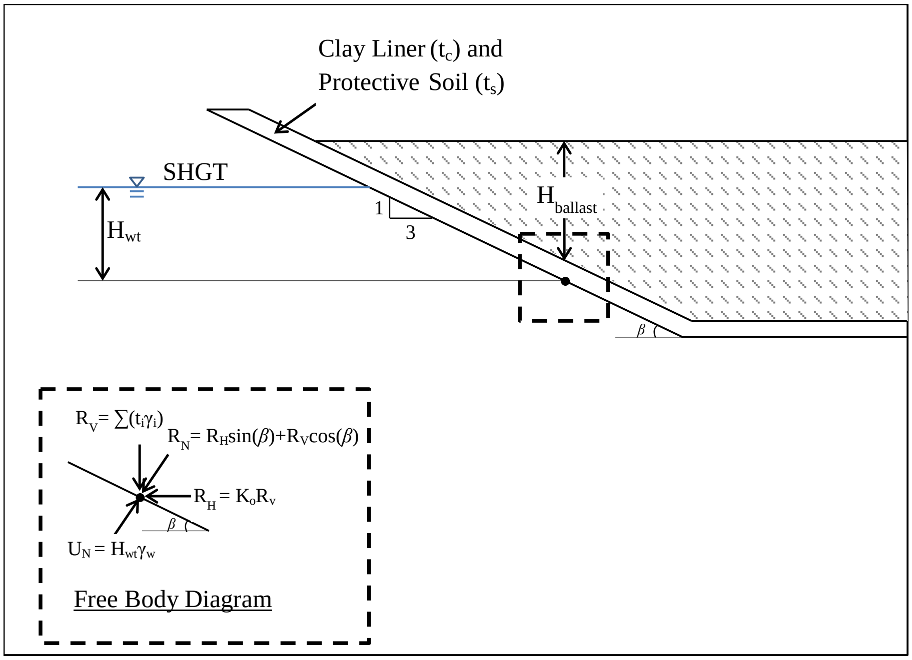



**Figure 3D.4.2-1: Example Free Body Diagram at Liner Side Slope**

Notes:

1. $H_{ballast}$ is the thickness of ballast (waste or soil) above the calculation point on the liner side slopes.
2. $K_o$ is the coefficient of static earth pressure of the clay liner material and is defined by the equation $K_o = 1-\sin(\phi)$ (Holtz and Kovacs, 1981); where $\phi$ was selected as 18° for this computation.
3. SHGT = Seasonally High Groundwater Table (synonymous with historical high groundwater levels).

## 7.6 RELATIONSHIP BETWEEN HORIZONTAL AND VERTICAL STRESSES

You may recall from hydrostatics that the pressure in a liquid is the same in any direction—up, down, sideways, or at any inclination, it doesn't matter. However this is not true in soils. Rarely in natural soil deposits is the horizontal stress in the ground equal exactly to the vertical stress. In other words, the stresses in situ are not necessarily hydrostatic. We can express the ratio of the horizontal to vertical stress in the ground as

$$\sigma_h = K\sigma_v \tag{7-18}$$

where $K$ is an *earth pressure coefficient*. Since the ground water table can fluctuate and the total stresses can change, the coefficient $K$ is *not* a constant for a particular soil deposit. However, if we express this ratio in terms of effective stresses, we take care of the problem of a variable water table, or

$$\sigma'_h = K_o\sigma'_v \tag{7-19}$$

$K_o$ is a very important coefficient in geotechnical engineering. It is called the *coefficient of lateral earth pressure at rest*. It expresses the stress conditions in the ground in terms of *effective stresses*, and it is independent of the location of the ground water table. Even if the depth changes, $K_o$ will be a constant as long as we are in the same soil layer and the density remains the same. However this coefficient is very sensitive to the geologic and engineering stress history, as well as to the densities of the overlying soil layers (see for example, Massarsch, et al., 1975). The value of $K_o$ is important in stress and analyses, in assessing the shearing resistance of

particular soil layers, and in such geotechnical problems as the design of earth-retaining structures, earth dams and slopes, and many foundation engineering problems.

The $K_o$ in natural soil deposits can be as low as 0.4 or 0.5 for sedimentary soils that have never been preloaded or up to 3.0 or greater for some very heavily preloaded deposits. Typical values of $K_o$ for different geologic conditions are given in Chapter 11.

**Figure 3D.4.2-2: Excerpts from Holtz and Kovacs (1981) on Lateral Earth Pressure**

The best known equation for estimating $K_o$ was derived by Jáky (1944, 1948), which is a theoretical relationship between $K_o$ and the angle of internal friction $\phi'$, or

$$K_o = 1 - \sin\phi' \qquad (11\text{-}6)$$

This relationship, as shown in Fig. 11.14, seems to be an adequate predictor of $K_o$ for normally consolidated sands. Since most of the points lie between 0.35 and 0.5 for these sands, $K_o$ of 0.4 to 0.45 would be a reasonable average value to use for preliminary design purposes.

**Figure 3D.4.2-2: Excerpts from Holtz and Kovacs (1981) on Lateral Earth Pressure (Continued)**

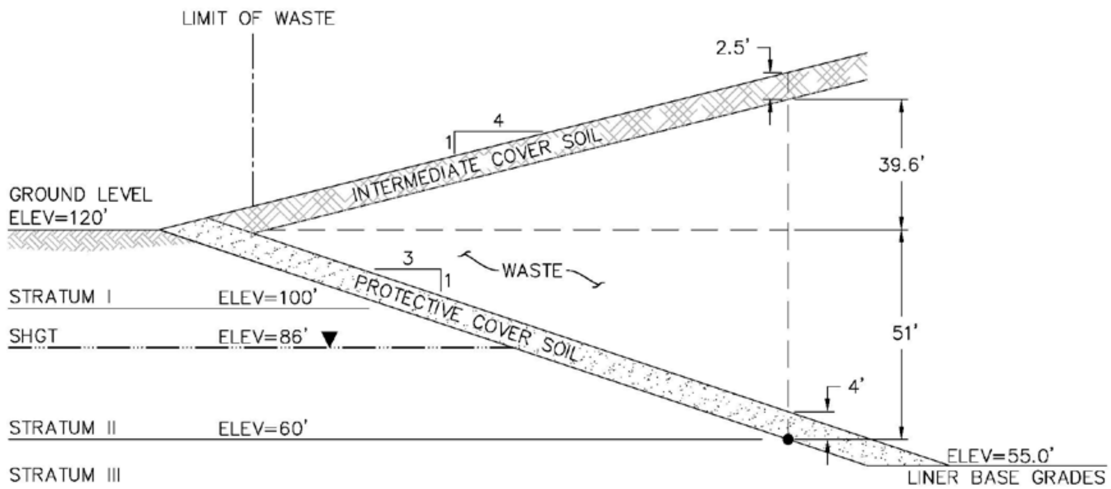



**Figure 3D.4.2-3: Typical/Idealized Cross-Section**

Note: This figure demonstrates that the typical waste filling operation to final permitted waste grades will provide over 90-ft of waste thickness above the critical sidewall location at the base of Stratum II. The calculations indicate that about 47-ft of waste ballast is required to provide a sufficient factor of safety against uplift in Sector R. This shows that through the course of waste filling, sufficient waste will be placed to resist uplift under the calculated conditions.

# ATTACHMENT 4

# GEOLOGY REPORT

# FAIRBANKS LANDFILL
# HARRIS COUNTY, TEXAS
# TCEQ PERMIT NO. MSW 1565B

# PERMIT AMENDMENT APPLICATION

# PART III – SITE DEVELOPMENT PLAN
# ATTACHMENT 4
# GEOLOGY REPORT

Prepared for

**USA WASTE OF TEXAS LANDFILLS, INC.**
**A WASTE MANAGEMENT COMPANY**

August 2013

Revised March 2014

Revised May 2014

STATE OF TEXAS
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5-2-2014

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## CONTENTS (Continued)

**Table 4-9**
**Hydraulic Conductivity Values**
**Fairbanks Landfill**

| Monitoring Well No. | Hydraulic Conductivity (cm/sec) | Rising/Falling Head |
|---|---|---|
| **Layer II** | | |
| MW-1A | $1.0 \times 10^{-3}$ | Rising Head |
| MW-1A | $8.5 \times 10^{-4}$ | Falling Head |
| MW-2A | $5.6 \times 10^{-4}$ | Rising Head |
| MW-2A | $6.0 \times 10^{-4}$ | Rising Head |
| MW-2A | $7.0 \times 10^{-4}$ | Falling Head |
| MW-7A | $7.5 \times 10^{-4}$ | Rising Head |
| MW-7A | $1.2 \times 10^{-3}$ | Rising Head |
| Geometric Mean Layer II | $7.84 \times 10^{-4}$ | |
| **Layer IV – Uppermost Aquifer** | | |
| P-3B | $2.6 \times 10^{-4}$ | Falling Head |
| P-3B | $5.2 \times 10^{-4}$ | Rising Head |
| P-4B | $3.0 \times 10^{-3}$ | Falling Head |
| P-4B | $3.3 \times 10^{-3}$ | Rising Head |
| P-5B | $1.9 \times 10^{-4}$ | Falling Head |
| P-5B | $1.7 \times 10^{-4}$ | Rising Head |
| Geometric Mean Layer IV | $5.92 \times 10^{-4}$ | |

## 6.3 Site Hydrogeology

Since the 1998 permit amendment application for the site, Layer II has been identified as the uppermost groundwater zone rather than the uppermost aquifer. Layer IV has been consistently identified as the uppermost aquifer in groundwater monitoring reports submitted to the TCEQ since that time and is referred to as the uppermost aquifer. The identification of Layer IV as the uppermost aquifer is appropriate because the Layer II sand was historically excavated for sand mining purposes resulting in dewatering of this stratum. This dewatering frequently created dry monitoring wells. In addition, Layer II occurs only in the sidewalls of the facility whereas Layer IV underlies the entirety of the waste fill excavation. Layer IV has been unaltered by excavation activities, and is present beneath the entire excavation, and monitoring wells in this zone routinely have groundwater to be sampled.

Because the Layer II sand has been removed from the Layer II sand at the downgradient south and east sides of the site and replaced by reconstructed clay sidewalls and backfilled material, it would not be possible to obtain representative groundwater samples from Layer II as required by 30 TAC 330.403. Details of the constructed fill can be found in Section 5 of the LQCP (Part III, Attachment 3C and in Attachment 3A, Drawings 3-6 through 3-11).

Furthermore, because the Layer II sand is (or will be) substantially removed from this site and no Layer II sand remains at the downgradient east and south perimeter of the site, Layer IV is the uppermost aquifer at the site.

### 6.3.1 Layer II Groundwater Zone

As described in Section 4.4, site stratigraphy is divided into five geologic units: Layer I (surficial sand, silt, and clay), Layer II (sand), Layer III (clay), Layer IV (sand) and Layer V (clay). The uppermost groundwater zone at the site is the Layer II sand unit. Water levels measured in site monitoring wells and exploratory borings indicate that groundwater in the upper Layer II sand unit occurs under generally unconfined, water-table conditions and is confined or retarded at its lower limit by the underlying Layer III clay. The thickness of Layer II ranges from approximately 20 to 40 feet and has an average thickness of approximately 35 feet. Open excavations on the site and adjacent properties have been excavated for sand mining and waste filling operations. Over most of the existing site the Layer II sand has been removed. When the excavation for the proposed waste area is complete Layer II will have been removed over most of the site across both the existing site and the proposed expansion area (see Figure 4C-9, 4F-2, and 4F-3). As shown on these site cross sections, Layer II sand will remain in place between the previous waste fill units but will not exist on the south and east perimeters of the site. Groundwater levels in Layer II are affected by natural dewatering related to evaporation in the open excavation. Monitoring wells and piezometers near the open excavations are frequently dry. Figure 4F-1 is a potentiometric surface map constructed from water levels in site piezometers during the site characterization prior to site excavation. Figure 4F-2 shows a potentiometric surface constructed from groundwater monitoring wells and piezometers from a May 2012 water level reading event. Groundwater currently only exists in the limited areas where Layer II still exists. Figure 4F-3 depicts that Layer II sand will have been removed from much of the site when the expansion area is excavated. The Layer II sand has been removed from the east and south perimeter of the site. Natural groundwater flow direction in the Layer II sand is toward the southeast. Because that groundwater flow has been cut off by the excavations, clay liners, clayey fill , and clayey constructed fill groundwater no longer will flow beneath the site, but rather will be diverted around the site to the northeast and southwest parts of the site.

### 6.3.2 Layer III Confining Unit

The low permeability (predominantly CH clay) and continuity of Layer III enable this thick clay unit to function as the confining unit between the uppermost Layer II sand groundwater zone and the deeper Layer IV sand. The thickness of Layer III clay encountered at the site ranges from approximately 18 to 34 feet and averages approximately 27 feet. The proposed landfill bottom will be excavated in the Layer III clay.

Three Layer III clay piezometers, P-3A, P-E1, and P-5A, were installed in July and August 1997. Water levels measured in these piezometers indicate that groundwater in this clay unit is limited and that the permeability of the clay is low. Piezometer P-E1 in the northwest corner of the site was basically dry until October 1997, with less than one foot of water in the bottom of the well. Water level measurement in P-E1 is 57.80 feet above msl, indicating a very slow recovery rate of less than 0.02 feet per day. P-5A in the southwest corner of the site has had approximately two feet of water column since its installation in August 1997. Because the clay piezometer borings were completed using wet rotary drilling techniques, the small volumes of water observed in these wells are probably artifacts of the drilling fluid. The highest groundwater elevation in P-3A was observed on November 21, 1997, at 63.96 feet above msl. The recovery rate for P-3A is about 0.03 feet per day. The high groundwater elevation (63.96 feet above msl) in the Layer III clay is 35 feet lower than the highest water level in the overlying Layer II groundwater zone and 10 feet higher than the highest water level in the underlying Layer IV groundwater zone.

### 6.3.3 Layer IV Uppermost Aquifer

The maximum thickness explored was approximately 60 feet; the average thickness of the Layer IV sand is approximately 50 feet.

Three Layer IV sand piezometers, P-3B, P-E2, and P-5B, were installed in July and August 1997. Groundwater elevations measured since August 5, 1997, indicate that water levels are stable in these wells. An additional five Layer IV sand piezometers, P-6 through P-10, were installed in October 1997. Eight monitoring wells (MW-8 through MW-15) were installed in 1997. Two piezometers were installed in the expansion area in 2012 as part of this study. The highest measured water level elevation in Layer IV was observed on July 16, 2009 at 54.62 feet above msl in monitoring well MW-15. This elevation is approximately 10 feet lower than the highest measured elevation in the overlying Layer III clay and approximately 55 feet lower than the highest elevation in the uppermost Layer II groundwater zone, indicating that these three geologic units are not hydraulically connected. Groundwater in the Layer IV sand is confined. Layer IV groundwater elevations are listed in Table 4-6 and Table 4-7.

### 6.3.4 Layer V Lower Confining Unit

Layer V is a continuous, low permeability clay layer that functions as the lower confining unit to the overlying Layer IV uppermost aquifer. The maximum thickness explored was approximately 30 feet. Laboratory hydraulic conductivity tests on samples of the Layer V clay resulted in hydraulic conductivity values of $4.8 \times 10^{-8}$ and $2.1 \times 10^{-8}$ centimeters per second (cm/sec). Layer V is interpreted to be continuous across the site. Its composition and permeability is similar to the Layer III clay, making it an effective lower confining unit.

## 6.4 Groundwater Flow Direction and Rate

Shallow Layer II groundwater in the site area naturally flows to the southeast. Because extensive excavation activities have removed a large portion of the sands in the uppermost Layer II zone, shallow groundwater flow within the site boundary is toward open excavations. When the waste fill excavations are complete, nearly all of the Layer II sand will be removed and replaced with clay liners, clayey fill materials, and constructed clay sidewalls and thus no groundwater will be able to flow in this sand beneath the site. Layer II groundwater flowing from the upgradient northwest will be cut off and diverted around the site toward the northeast and southwest corners of the site and toward offsite areas.

Groundwater flow in the deeper Layer IV sand unit is to the northwest. Groundwater in Layer IV is confined at its upper limit by the overlying Layer III clay and at its lower limit by the underlying Layer V clay. Groundwater in the deeper Layer IV zone is not hydraulically connected to groundwater in the uppermost Layer II zone.

Travel times across the site were estimated using the formula:

$$v = (k * i) / n_e$$

Where: v = travel velocity
k = hydraulic conductivity of the aquifer
i = hydraulic gradient
$n_e$ = effective porosity

Groundwater velocity for the deeper Layer IV uppermost aquifer was calculated using the geometric mean of the hydraulic conductivity values from slug tests in Layer IV piezometers (see Section 6.2), hydraulic gradients from the potentiometric surface maps on Figures 4F-4 and 4F-15 in Appendix 4F, and an effective porosity of 30 percent for fine sand. Groundwater flow velocity is estimated to flow at approximately *four feet per year* in Layer IV. All input values and calculation to determine groundwater velocity are shown on the groundwater velocity calculation sheet in Appendix F4, Figure 4F-16.

## 6.5 Arid Exemption

The applicant is not seeking an arid exemption for the landfill unit; therefore, 30 TAC §330.63(e)(6) is not applicable to this application.

# ATTACHMENT 5

# GROUNDWATER MONITORING PLAN

# FAIRBANKS LANDFILL
# HARRIS COUNTY, TEXAS
# TCEQ PERMIT NO. MSW 1565B

# PART III – SITE DEVELOPMENT PLAN
# ATTACHMENT 5
# GROUNDWATER MONITORING PLAN

Prepared for

**USA WASTE OF TEXAS LANDFILLS, INC.**
**A WASTE MANAGEMENT COMPANY**

August 2013

Revised March 2014

Revised May 2014

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# GROUNDWATER MONITORING SYSTEM DESIGN CERTIFICATION

## General Site Information

| | |
|---|---|
| Site: | Fairbanks Landfill |
| Site Location: | Harris County, Texas |
| MSW Permit Application No.: | 1565B |

## Qualified Groundwater Scientist Statement

I, Michael Snyder, am a licensed professional geoscientist in the State of Texas and a qualified groundwater scientist as defined in 30 TAC §330.3. I have reviewed the groundwater monitoring system and supporting data contained herein. In my professional opinion, the groundwater monitoring system is in compliance with the groundwater monitoring requirements specified in 30 TAC §330.401 through §330.421. This system has been designed for specific application to the Fairbanks Landfill (Permit Application No. MSW 1565B). The only warranty made by me in connection with this document is that I have used that degree of care and skill ordinarily exercised under similar conditions by reputable members of my profession, practicing in the same or similar locality. No other warranty, expressed or implied, is intended.

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Signature: John Michael Snyder, P.G.
No. 595-Texas

5-2-2014

Date:

Biggs & Mathews Environmental, Inc.
Firm Registration No. 50222

# 1 SITE HYDROGEOLOGY

## 1.1 Hydrogeologic Units

Since the 1998 permit amendment application for the site, Layer II has been identified as the uppermost groundwater zone rather than the uppermost aquifer. Layer IV has been consistently identified as the uppermost aquifer in groundwater monitoring reports submitted to the TCEQ since that time and is referred to as the uppermost aquifer. The identification of Layer IV as the uppermost aquifer is appropriate because the Layer II sand was historically excavated for sand mining purposes resulting in dewatering of this stratum. This dewatering frequently created dry monitoring wells. In addition, Layer II occurs only in the sidewalls of the facility whereas Layer IV underlies the entirety of the waste fill excavation. Layer IV has been unaltered by excavation activities, and is present beneath the entire excavation, and monitoring wells in this zone routinely have groundwater to be sampled.

Because the Layer II sand has been removed from the Layer II sand at the downgradient south and east sides of the site and replaced by reconstructed clay sidewalls and backfilled material, it would not be possible to obtain representative groundwater samples from Layer II as required by 30 TAC 330.403. Details of the constructed fill can be found in Section 5 of the LQCP (Part III, Attachment 3C and in Attachment 3A, Drawings 3-6 through 3-11).

Furthermore, because the Layer II sand is (or will be) substantially removed from this site and no Layer II sand remains at the downgradient east and south perimeter of the site, Layer IV is the uppermost aquifer at the site.

### 1.1.1 Layer II Groundwater Zone

As described in Section 4.4, site stratigraphy is divided into five geologic units: Layer I (surficial sand, silt, and clay), Layer II (sand), Layer III (clay), Layer IV (sand) and Layer V (clay). The uppermost groundwater zone at the site is the Layer II sand unit. Water levels measured in site monitoring wells and exploratory borings indicate that groundwater in the upper Layer II sand unit occurs under generally unconfined, water-table conditions and is confined or retarded at its lower limit by the underlying Layer III clay. The original thickness of Layer II ranged from approximately 20 to 40 feet and had an average thickness of approximately 35 feet.

Open excavations on the site and adjacent properties have been excavated for sand mining and waste filling operations. Over most of the existing site the Layer II sand has been removed. When the excavation for the proposed waste area is complete Layer II will have been removed across much of the existing site and the proposed expansion area (see Attachment 4, Figure 4C-9, 4F-2, and 4F-3). Groundwater levels in Layer II are affected by natural dewatering related to evaporation in the open excavation.

Monitoring wells and piezometers near the open excavations are frequently dry. Figure 4F-1 is a potentiometric surface map constructed from water levels in site piezometers during the site characterization prior to site excavation. Figure 4F-2 shows a potentiometric surface constructed from groundwater monitoring wells and piezometers from a May 2012 water level reading event. Groundwater currently only flows in the limited areas where Layer II still exists. Because that groundwater flow has been cut off by the excavations, clay liners, clayey fill, and clayey constructed fill groundwater no longer will flow beneath the site, but rather will be diverted around the site to the northeast and southwest parts of the site. Figure 4F-3 depicts that Layer II will have been removed from the new site when the expansion area is excavated. No Layer II sand will exist at the downgradient east and south perimeter of the site.

### 1.1.2 Layer III Confining Unit

The low permeability (predominantly CH clay) and continuity of Layer III enable this thick clay unit to function as the confining unit between the uppermost Layer II sand groundwater zone and the deeper Layer IV sand. The thickness of Layer III clay encountered at the site ranges from approximately 18 to 34 feet and averages approximately 27 feet. The proposed landfill bottom will be excavated in the Layer III clay.

Three Layer III clay piezometers, P-3A, P-E1, and P-5A, were installed in July and August 1997. Water levels measured in these piezometers indicate that groundwater in this clay unit is limited and that the permeability of the clay is low. Piezometer P-E1 in the northwest corner of the site was basically dry until October 1997, with less than 1 foot of water in the bottom of the well. Water level measurement in P-E1 is 57.80 feet above msl, indicating a very slow recovery rate of less than 0.02 feet per day. P-5A in the southwest corner of the site has had approximately two feet of water column since its installation in August 1997. Because the clay piezometer borings were completed using wet rotary drilling techniques, the small volumes of water observed in these wells are probably artifacts of the drilling fluid. The highest groundwater elevation in P-3A was observed on November 21, 1997, at 63.96 feet above msl. The recovery rate for P-3A is about 0.03 feet per day. The high groundwater elevation (63.96 feet above msl) in the Layer III clay is 35 feet lower than the highest water level in the overlying Layer II groundwater zone and 10 feet higher than the highest water level in the underlying Layer IV groundwater zone.

### 1.1.3 Layer IV Uppermost Aquifer

Layer IV consists primarily of sand, silty sand, and gravel. It occurs below the Layer III sands and is the uppermost aquifer. The maximum thickness explored was approximately 60 feet; the average thickness of the Layer IV sand is approximately 50 feet.

Three Layer IV sand piezometers, P-3B, P-E2, and P-5B, were installed in July and August 1997. Groundwater elevations measured since August 5, 1997, indicate that water levels are stable in these wells. An additional five Layer IV sand piezometers, P-6 through P-10, were installed in October 1997. Eight monitoring wells (MW-8 through

MW-15) were installed in 1997. Two piezometers were installed in the expansion area in 2012 as part of this study. The highest measured water level elevation in Layer IV was observed on July 16, 2009 is 54.62 feet above msl in monitoring well MW-15. This elevation is approximately 10 feet lower than the highest measured elevation in the overlying Layer III clay and approximately 55 feet lower than the highest elevation in the uppermost Layer II groundwater zone, indicating that these three geologic units are not hydraulically connected. Groundwater in the Layer IV sand is confined. Layer IV groundwater elevations are listed in Table 4-6 and Table 4-7.

### 1.1.1 Layer V Lower Confining Unit

Layer V is a continuous, low permeability clay layer that functions as the lower confining unit to the overlying Layer IV groundwater zone. The maximum thickness explored was approximately 30 feet. Laboratory hydraulic conductivity tests on samples of the Layer V clay resulted in hydraulic conductivity values of $4.8 \times 10^{-8}$ and $2.1 \times 10^{-8}$ centimeters per second (cm/sec). Layer V is interpreted to be continuous across the site. Its composition and permeability is similar to the Layer III clay, making it an effective lower confining unit.

## 1.2 Groundwater Flow Direction and Rate

Shallow groundwater in the site area naturally flows to the southeast. Because extensive excavation activities have removed a large portion of the sands in the uppermost Layer II zone, shallow groundwater flow within the site boundary is toward open excavations. Once excavation of the Layer II sand at the south and east downgradient perimeter of the site is complete, lined areas will cut off flow within remaining Layer II. Layer II groundwater flowing from the upgradient northwest will be cut off and diverted around the site toward the northeast and southwest corners of the site and toward offsite areas.

Groundwater flow in the deeper Layer IV sand unit is to the northwest. Groundwater in Layer IV is confined at its upper limit by the overlying Layer III clay and at its lower limit by the underlying Layer V clay. Groundwater in the deeper Layer IV zone is not hydraulically connected to groundwater in the uppermost Layer II zone or the deeper Chicot Aquifer sand unit.

Groundwater velocity for the deeper Layer IV uppermost aquifer was calculated using the geometric mean of the hydraulic conductivity values from slug tests in Layer IV piezometers (see Attachment 4, Section 6.2), hydraulic gradients from the potentiometric surface maps on Figures 4F-4 and 4F-15 in Appendix 4F, and an effective porosity of 30 percent for fine sand. Calculations indicate that groundwater in Layer IV moves approximately four feet per year (see Figure 4F-16).

# ATTACHMENT 6

# LANDFILL GAS MANAGEMENT PLAN

*Prepared for:*

**USA Waste of Texas Landfills, Inc.**

# PERMIT AMENDMENT APPLICATION
# PART III – SITE DEVELOPMENT PLAN
# ATTACHMENT 6

# LANDFILL GAS MANAGEMENT PLAN

## FAIRBANKS LANDFILL
## MSW PERMIT NO. 1565B
## HOUSTON, HARRIS COUNTY, TEXAS

*Prepared by:*

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FOR PERMIT PURPOSES ONLY

Submitted August 2013

Revised March 2014

Revised May 2014

# TABLE OF CONTENTS
# LANDFILL GAS MANAGEMENT PLAN



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# 4. RECORDKEEPING AND REPORTING

## 4.1 Gas Monitoring Probe Installation Report

A gas monitoring probe installation report shall be prepared upon completion of each gas probe installation project and submitted to TCEQ. The installation report will include the following:

- A figure showing the site plan and gas monitoring probe locations/designations (e.g., copy of Drawing 6-1 of this plan, or similar figure).
- Boring logs for each new gas probe installed, including the drilling date and method, name(s) of the engineer or geologist who logged the hole, and information on the subsurface findings (soil types and depths, groundwater depth, if present, etc.).
- Construction summary logs for each new installed gas probe, providing the surveyed location coordinates of the probe, surveyed elevation of existing ground and top of probe riser casing, and identification of the probe materials, dimensions and depths/elevations, screen type and interval length, extent and types of filter pack, extent and types of annular seal, material and extent of backfill, presence of concrete pad, protective bollards, etc.

As previously discussed, GP-1 through GP-10, are existing gas monitoring probes. Installation information for these existing gas probes is presented in Appendix 6-A of this plan.

When additional gas monitoring probes are installed, their installation records will be submitted to TCEQ as mentioned above, and the records may be added to Appendix 6-A of this plan.

## 4.2 Quarterly Gas Monitoring Records

Quarterly monitoring records for the gas probes and facility structures will be maintained in the facility's Site Operating Record throughout the active life of the facility and during the post-closure period. The monitoring records will be recorded on data sheets similar to the one attached to this document (Appendix 6-B). The exact format of the monitoring form may be modified from the example attached to this document, but the data recorded during each monitoring event will at a minimum include the information identified in Section 3.5 of this plan.

In the event that the maximum allowable landfill gas concentrations set forth in Section 3.1 of this plan are exceeded, the facility must report the results to TCEQ and take other steps required by 30 TAC §330.371(c)(1) through (3), and as described subsequently in Section 5 of this plan.

c. If the initial detection is verified to be an exceedance, the following parties shall be notified of the situation:
    - TCEQ Region 12;
    - the local Fire Department and Harris County Public Health and Environmental Services; and
    - neighboring landowners within 500-ft of the exceedance location.

2. Within Seven Days of Verified Exceedance. A record of the methane gas levels detected and a description of the immediate actions taken to protect human health will be placed in the Site Operating Record.

3. Within 60 Days of Verified Exceedance.
    a. A detailed evaluation will be made to determine the potential source and extent of the methane gas migration. A Remediation Plan will be prepared and must be submitted to the TCEQ Executive Director. The Remediation Plan will present the results of the detailed evaluation, along with the remedial measures taken, which may include additional monitoring, source control t (e.g., installation of gas vent(s)) a passive interceptor trench/barrier system, active building ventilation systems,), etc.
    b. The Remediation Plan will incorporate remediation performance monitoring. The remediation performance monitoring will be conducted on a monthly basis at the affected gas monitoring location(s) and will submitted to TCEQ, until methane concentrations in the affected gas monitoring location(s) are below the allowable limits specified at the beginning of this section for six (6) consecutive months.

As allowed by 30 TAC §330.371(d), alternate schedules to those given above may be established by the TCEQ Executive Director.

# ATTACHMENT 7

# CLOSURE PLAN

*Prepared for:*

**USA Waste of Texas Landfills, Inc.**

# PERMIT AMENDMENT APPLICATION

# PART III – SITE DEVELOPMENT PLAN ATTACHMENT 7

# CLOSURE PLAN

## FAIRBANKS LANDFILL
## PERMIT NO. MSW-1565B
## HOUSTON, HARRIS COUNTY, TEXAS

*Prepared by:*

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Submitted August 2013

Revised March 2014

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# TABLE OF CONTENTS
# CLOSURE PLAN



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5/9/2014
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# 3. DESCRIPTION OF CLOSURE DESIGN AND CLOSURE SEQUENCE

## 3.1 Introduction

This section describes the design and installation requirements for the landfill final cover system, and discusses the closure sequence.

## 3.2 Final Cover System Design

The final cover system is designed to meet the requirements of 30 TAC §330.453(a), (b), and (c).

### 3.2.1 Cross Section and Areas of Installed Final Cover

The proposed final cover system for the facility is shown on an engineering detail on Drawing 3-11 in Attachment 3A (Landfill Design Drawings) of this Permit Amendment Application, and is described as follows (from bottom to top):

- 1.5-ft thick compacted soil layer composed of clayey soil, classified by the Unified Soil Classification System (USCS) as "SC" (sandy clay), "CL" (lean clay), or "CH" (fat clay) and having a coefficient of permeability (i.e., a hydraulic conductivity) no greater than 1 $\times 10^{-5}$ cm/sec (i.e., $k \leq 1 \times 10^{-5}$cm/sec); and

- a 6-inch or 12-inch thick topsoil layer(1) capable of sustaining native plant growth and seeded or sodded immediately after installation.

(1)If the underlying compacted soil layer is classified as SC or CL, the minimum topsoil thickness is 6 inches. If the underlying compacted soil layer is classified as CH, the minimum topsoil thickness is 12 inches.

The material requirements specified for the final cover system are included in the Final Cover Quality Control Plan (FCQCP) provided in Attachment 7B to this Plan. Soils with USCS classifications other than those listed above may be used in the final cover system with prior written approval from the TCEQ Executive Director.

As mentioned in Section 2.2, it is anticipated that the largest area of the landfill that could potentially be open and require final cover is 52.2 acres, as shown on Drawing 7-1 in Attachment 7A of this Plan. Drawing 7-1 also shows that as of March 2014, 30.6 acres have been final capped; and a note on the drawing references the Final Cover System Evaluation Reports (FCSERs) for the two capping events to-date. These 30.6 acres were final capped with the same final cover system as listed above.

*Prepared for:*
**USA Waste of Texas Landfills, Inc.**

# PERMIT AMENDMENT APPLICATION

# PART III – SITE DEVELOPMENT PLAN
# ATTACHMENT 7B

# FINAL COVER QUALITY CONTROL PLAN

## FAIRBANKS LANDFILL
## PERMIT NO. MSW-1565B
## HOUSTON, HARRIS COUNTY, TEXAS

*Prepared by:*
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Submitted August 2013
Revised March 2014
Revised May 2014

# TABLE OF CONTENTS
# FINAL COVER QUALITY CONTROL PLAN



STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED
PROFESSIONAL ENGINEER
5/9/2014
FOR PERMIT PURPOSES ONLY

## TABLE OF CONTENTS (CONTINUED)



5/9/2014
STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED PROFESSIONAL ENGINEER
FOR PERMIT PURPOSES ONLY

**TABLES**

# TABLE 7B-3
# FIELD TESTING AND ONGOING CONFORMANCE TESTING REQUIREMENTS FOR COMPACTED SOIL LAYER

| TEST | METHOD | MINIMUM FREQUENCY OF TESTING | PASSING CRITERIA |
|---|---|---|---|
| In-Place Density and In-Place Moisture Content (Nuclear Gauge) | ASTM D 6938 | 1 per acre per lift | See Section 2.2.2 |
| Particle Size Analysis | ASTM D 422 | Sample: 1 per acre through full layer<br>Test: 1 per 3 acres per lift(2) | ≤ 1.5 in. max particle size |
| Atterberg Limits | ASTM D 4318 | Sample: 1 per acre through full layer<br>Test: 1 per 3 acres per lift(2) | None |
| Soil Classification | ASTM D 2487 | Sample: 1 per acre through full layer<br>Test: 1 per 3 acres per lift(2) | SC, CL, or CH |
| Undisturbed Hydraulic Conductivity | ASTM D 5084(1) | Sample: 1 per acre through full layer<br>Test: 1 per 3 acres per lift(2) | ≤ 1 x $10^{-5}$ cm/s |
| Layer Thickness Verification | See Section 2.3.7 | 1 per acre | ≥ 1.5 ft thick |

Note:

(1) Undisturbed hydraulic conductivity tests shall be tested using tap water or a 0.05N solution of $CaSO_4$. Use effective stress of 5 psi. Distilled or deionized water shall not be used. The permeant should be deaired. All hydraulic conductivity test data shall be submitted with the FCSER.

(2) The suggested sampling and testing method of the constructed compacted soil is as follows:

- Soil samples for particle size analysis, Atterberg limits, classification, and undisturbed hydraulic conductivity tests shall be obtained using thin-walled push tube sampler (e.g., Shelby tube) advanced into the constructed materials using a drill rig hydraulic system, a bulldozer, an excavator, or other appropriate equipment.
- Samples will be sealed and placed in protective core boxes or similar containers for transport to the independent soils laboratory for testing.
- After obtaining survey/layer thickness information, the sample location boreholes will be backfilled with wetted bentonite or a cement-bentonite grout tremied into the borehole from the bottom to the top of the compacted soil layer.
- The specified sampling will be performed at a frequency of one full layer sample per acre, and the tests specimens will be evenly distributed through the lifts, such that the minimum testing frequency indicated above is met on a per lift basis.

An alternate sampling method may be used as approved by the POR, provided that undisturbed Shelby tube samples are obtained for hydraulic conductivity testing, that the above-specified minimum testing frequency is met on a per lift basis, and that the other related requirements of this FCQCP are met.

*Prepared for:*

**USA Waste of Texas Landfills, Inc.**

# PERMIT AMENDMENT APPLICATION

# PART IV – SITE OPERATING PLAN (SOP)

# FAIRBANKS LANDFILL
# MSW PERMIT NO. 1565B
# HOUSTON, HARRIS COUNTY, TEXAS

*Prepared by:*

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SEALED FOR THIS PART IV SITE OPERATING PLAN, AND FOR PERMITTING PURPOSES ONLY

Submitted August 2013

Revised March 2014

Revised May 2014

# TABLE OF CONTENTS
# SITE OPERATING PLAN (SOP)



SCOTT M. GRAVES 86557 LICENSED PROFESSIONAL ENGINEER — STATE OF TEXAS
5/9/2014
FOR PERMIT PURPOSES ONLY

STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED PROFESSIONAL ENGINEER
FOR PERMIT PURPOSES ONLY
5/9/2014

STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED PROFESSIONAL ENGINEER
5/9/2014
FOR PERMIT PURPOSES ONLY

**TABLES**



STATE OF TEXAS
SCOTT M. GRAVES
86557
LICENSED
PROFESSIONAL ENGINEER

5/9/2014

SEALED FOR THIS PART IV SITE OPERATING PLAN, AND FOR PERMITTING PURPOSES ONLY.

CONTENTS OF THE APPENDICES ARE SIGNED, SEALED, AND DATED, AS APPROPRIATE, BY THE RESPONSIBLE PROFESSIONAL.

**FIGURE**



**APPENDICES**

# SITE OPERATING PLAN (SOP)

## 1. INTRODUCTION

### 1.1 Terms of Reference

The Fairbanks Landfill (hereafter referred to as the "facility" or "site") is a Type IV municipal solid waste (MSW) facility, owned and operated by USA Waste of Texas Landfills, Inc. This Site Operating Plan (SOP) provides general instructions for site management and personnel to operate the facility in a manner consistent with the design of the facility and with the Texas Commission on Environmental Quality's (TCEQ's) rules to protect human health and the environment. This SOP complies with the requirements of 30 TAC Chapter 330 Subchapter D of the TCEQ Municipal Solid Waste Management Regulations (MSWMR) "Operational Standards for Solid Waste Land Disposal Sites" for Type IV landfills.

The specific procedures outlined in this SOP are operational requirements and must be understood, acknowledged, and followed by the site personnel. This SOP will be maintained as part of the Site Operating Record in an easily accessible location to allow the site operating personnel to review the SOP as needed. This SOP will be retained during the active life of the site and throughout the site's post-closure care maintenance period.

References to the terms "Executive Director" or "TCEQ" used in this SOP shall refer to the Executive Director of the TCEQ or the designated representative of the TCEQ. References to information in the permit or "permit application" for this facility shall refer to the most current version of these documents, including any amendments, modifications, or revisions as approved.

The Site Manager has overall responsibility for implementation and adherence to this SOP. Wherever this SOP describes procedures or requirements without naming a specific individual or position responsible for those requirements, the Site Manager shall have primary responsibility for those requirements. Where a specific position is responsible for a particular task, that responsibility is described. Otherwise, the Site Manager may assign any qualified personnel to accomplish the requirements of this SOP.

### 1.2 Facilities Addressed by this SOP

As mentioned in Section 1.1, this SOP has been prepared to address 30 TAC Chapter 330 Subchapter D for Type IV landfills. Disposal of waste in the landfill is the primary site activity. Additionally, the following recycling areas will be established on-site: (i) a staging area to collect large/heavy/bulky items (e.g., appliances) for recycling or salvaging; (ii) a wood recycling area; and (iii) a construction and demolition (C&D) waste recycling area. This SOP

During dry weather, the operator will control dust by watering site roads using the water truck and/or sweeping the roads. The on-site water source that can be used for this purpose are the surface water ponds.

As mentioned in Section 11 of this SOP, litter and other debris on site roads will be picked up at least once per day each day that the facility is operating and disposed of properly.

### 18.3 Road Maintenance Frequencies

Internal roads will be inspected at least once every two months for the presence of ruts, soft spots, potholes and drainage to determine the need for regrading. The frequency of road regrading will be dependent on the results of inspections and whether ruts, potholes, or soft spots of sufficient severity are detected. However, at a minimum, road regrading will occur once per year. As directed by the Site Manager or designated alternate, wet weather operations may require more frequent regrading to properly maintain the roads. Roadside ditches or culverts will be maintained as necessary to provide drainage. The on-site fleet of equipment, such as the on-site motor grader, broom, backhoe excavator, and dozers, may be used to provide maintenance, as appropriate.

Road inspections and maintenance/repair activities will be documented by the Site Manager or designated alternate and placed in the Site Operating Record. Minimum information will include date of inspection and/or repairs, name of employee performing work, and the relevant findings/actions.