May 10, 2016

Mr. Kurt Detrich
The Dow Chemical Company
Michigan Operations
1561 Building
Midland, Michigan 48667

RE: Response to MDEQ Technical Comments Specific to Leak Detection System Isolation for Cells 20-22 Final Closure Design Submittal From Meeting on April 21, 2016
Salzburg Landfill, Midland, Michigan

Dear Mr. Detrich:

AECOM is pleased to provide this response to technical comments received from the Michigan Department of Environmental Quality, Office of Waste Management and Radiological Protection (MDEQ-OWMRP) via conference call on April 21, 2016 specific to the isolation of the leak detection system for the Final Closure Design Submittal of Cells 20-22 at the Salzburg Landfill in Midland, Michigan. The response to comments provides the necessary technical resolution to issues presented by the MDEQ-OWMRP and allow them to approve the design submittal. Calculations, documentation, and revisions to previously submitted drawings are provided as an attachment to this submittal.

AECOM looks forward to providing continued support to Dow and working together on this important program. Please do not hesitate to call John Davis at 810-730-5203 (mobile) or Doug Wehner at 248-613-4880 (mobile), if you have any questions or comments on this Response to Comments.

Sincerely,

AECOM

Doug Wehner
Senior Project Manager

doug.wehner@aecom.com

John A. Davis, PE
Senior Civil Engineer

john.davis2@aecom.com

Attachment:

A. Revised Drawing
B. Appendix J-1 – West Berm Anchor Trench Drain Analysis
C. Appendix L – North and South Berm Leak Detection System Borings

The Dow Chemical Company (Dow) previously submitted the Cells 20-22 Final Cover Design Submittal (Design Submittal) to the Michigan Department of Environmental Quality, Office of Waste Management and Radiological Protection (MDEQ-OWMRP) on February 11, 2016 for review and approval. On March 2, 2016 and March 16, 2016, the MDEQ-OWMRP provided technical comments to Dow via electronic mail and a Response to Comments was submitted by Dow on April 7, 2016. A subsequent meeting was held between the MDEQ-OWMRP, Dow and AECOM on April 21, 2016 where additional comments were received specifically related to the isolation of the leak detection system of Cells 20-22, and the sufficiency of the final cover design to address potential modes of impact to the leak detection system. This memorandum provides a technical response to the comments which should provide resolution to the issues raised by the MDEQ-OWMRP and allow for approval of the Design Submittal. The comments shown below are summaries of the discussion between the MDEQ-OWMRP, Dow and AECOM since no official comment was received in writing. Each comment by the MDEQ-OWMRP is shown in bold italics and the response is shown in normal print. The focus of the discussion was the proposed final cover terminations on the four sides of Cells 20-22 took place with concerns being raised specifically to the west, north and south berms. The proposed design of the east berm of Cells 20-22, which incorporated the rain flap extending to the inside top of slope of Cells 23-26, was agreed by all parties to be adequate as currently designed.

Comment 1: For the west berm, the concerns were raised about the proximity of the Cells 17-19 east berm final cover anchor trench, the Cells 20-22 west berm final cover anchor trench and the Cells 20-22 leak detection anchor trench.

Response 1: AECOM proposed to widen the Cells 20-22 west berm final cover anchor trench to include the Cells 17-19 east berm final cover anchor trench. This will require excavating the existing Cells 17-19 west berm final cover anchor trench, temporarily folding back the Cells 17-19 final cover geocomposite, extending the Cells 20-22 final cover geomembrane to at least 2-feet west of the top of the widened anchor trench, installing a continuous extrusion weld to attach the Cells 20-22 final cover geomembrane to the Cells 17-19 final cover geomembrane, re-installing the Cells 17-19 final cover geocomposite into the widened anchor trench, installing a new 12-inch diameter perforated HDPE drain pipe in the anchor trench, and backfilling the anchor trench with pea stone in accordance with the project specifications. This change is shown on the revised drawing B2-013-141499 and is included as Attachment A to this memo.

The new 12-inch diameter perforated HDPE anchor trench drain pipe was increased from the 8-inch diameter pipe previously proposed due to the increase in flow to the anchor trench from the east slope of Cells 17-19 final cover geocomposite. Design information pertaining to the Cells 17-19 final cover geocomposite was obtained from the Cells 17-19 Final Cover Design Submittal dated September 2004. This information was used in conjunction with the design information of the Cells 20-22 final cover geocomposite to adequately size the anchor trench drain pipe. The anchor trench drain pipe size had to be increased to 12-inch diameter in order to satisfy the flow capacity requirements of the geocomposite drainage layer inflow rate without exceeding the top of the anchor trench. The change in pipe size is reflected on revised sheet B2-013-141499 and is provided in Attachment A to this memo. The pipe capacity analysis is identified as Appendix J-1 to the Basis of Design Report, and is included as Attachment B to this memo.

Comment 2: For the north and south berms, the concern was raised about the possibility of storm water and/or shallow groundwater infiltration into the Cells 20-22 leak detection anchor trench.

Response 2: AECOM conducted a series of profile soil borings along the north and south sides of Cells 20-22, adjacent to the leak detection anchor trench, to determine if the existing compacted clay liner soils are saturated by storm water and/or shallow groundwater. A total of twelve (12) profile soil borings were completed, six (6) of which were adjacent to Cells 20-22. The borings for Cells 20-22 were identified as B-1 through B-6. The borings were advanced to the depth of the leak detection system anchor trench and were located approximately 2-feet outboard, or away from, the anchor trench. The locations of the soil borings are shown on Figure 1 and are provided as Appendix L to the Basis of Design Report, and are provided as Attachment C to this memo. The borings were advanced to a depth of 6-feet below existing ground surface which corresponds to approximately 1-foot below the top of the leak detection anchor trench. Soil samples were collected off of the augers at approximately 5-feet below ground surface elevation and were analyzed for moisture content in accordance with ASTM D-2216. The results of the analyses are summarized below in Table 1.

Table 1. Moisture Content of Soil Samples

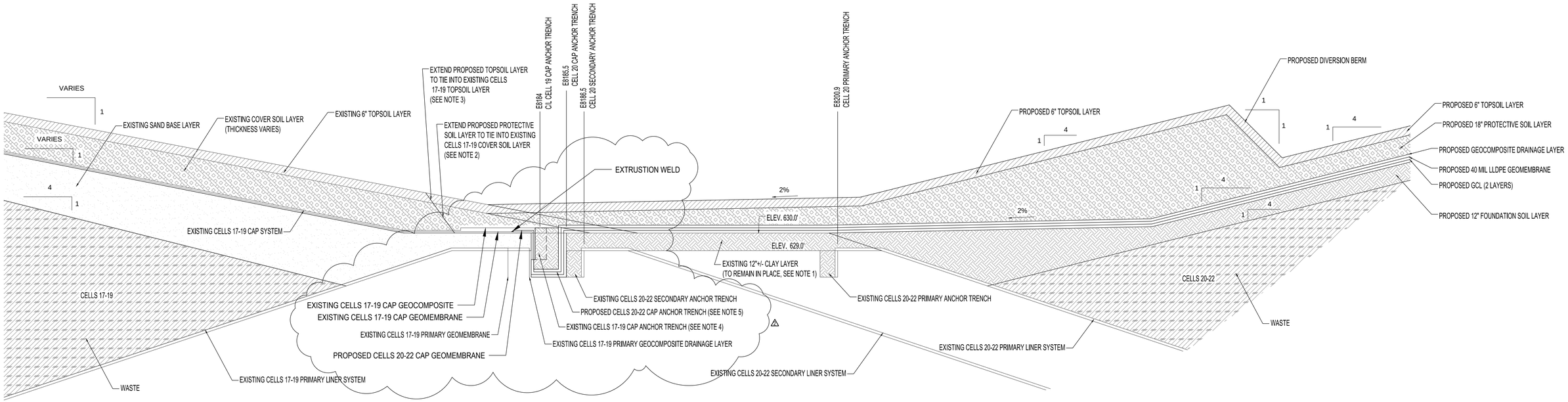
Sample ID	Description	Elevation (ft)			Moisture Content
		Surface	Anchor Trench	Sample	
B-1	Moist, brown, firm clay	629.52	624.00	624.52	14.7%
B-2	Damp, brown, medium stiff clay	629.44	624.00	624.44	12.9%
B-3	Moist, brown, firm clay	629.68	624.00	624.68	12.9%
B-4	Moist, brown, medium stiff clay	629.58	624.00	624.58	15.5%
B-5	Moist, brown, firm clay	629.81	624.00	624.81	14.5%
B-6	Moist, brown firm clay	629.97	624.00	624.97	14.4%

The moisture content results from the borings were then compared to the moisture-density test results of the compacted clay liner at the time of installation in 2000. According to the report titled "As-Built and Construction Certification for Salzburg Landfill Cells 20, 21 and 22" dated January 18, 2001 by Dow, the optimum moisture content of the clay material used for the construction of the compacted clay liner ranged from 7.7% to 9.5% as determined by the modified proctor test method ASTM D-1557. The specified moisture content for the compacted clay liner was from 0% to 5% above the optimum moisture content. Based upon this as-built data, the clay samples obtained from the six borings located adjacent to the Cells 20-22 leak detection anchor trench are within the acceptable range of moisture as it was installed in 2000 with two samples being only slightly above the specified range. It is concluded that the existing compacted clay liner is not saturated and has not been adversely impacted by surface water or shallow groundwater infiltration. Therefore, no design modification to the anchor Cells 20-22 final cover anchor trench is required for the north and south berms.

The boring logs, moisture content test results, and as-built compacted clay liner material optimum moisture content results are provided as Appendix L to the Basis of Design Report, and are provided as Attachment C to this memo.

ATTACHMENT A

Revised Drawing



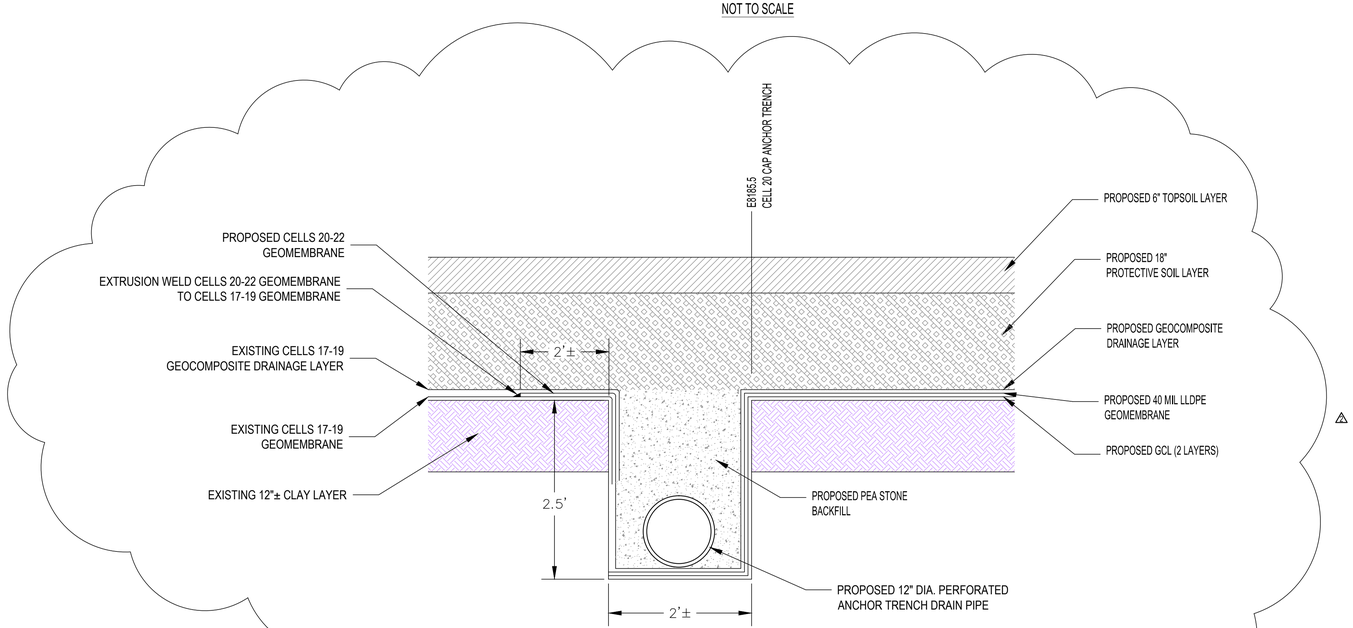
WEST BERM - CROSS SECTION D-D

(TYPICAL, LOOKING NORTH)

NOT TO SCALE

NOTES:

1. CONTRACTOR SHALL REMOVE EXISTING GRAVEL ROAD MATERIALS TO EXPOSE EXISTING 12" CLAY LAYER. CONTRACTOR SHALL STOCKPILE EXISTING GRAVEL ROAD MATERIALS ON SITE FOR FUTURE USE.
2. CONTRACTOR SHALL TIE PROPOSED PROTECTIVE SOIL LAYER INTO EXISTING CELLS 17-19 COVER SOIL LAYER BEYOND THE CELLS 17-19 CAP ANCHOR TRENCH.
3. CONTRACTOR SHALL TIE PROPOSED TOPSOIL LAYER INTO EXISTING CELLS 17-19 TOPSOIL LAYER BEYOND THE CELLS 17-19 CAP ANCHOR TRENCH.
4. EXISTING CELLS 17-19 CAP GEOSYNTHETICS ANCHOR TRENCH SHALL BE EXCAVATED AND THE GEOCOMPOSITE FOLDED BACK TO ALLOW FOR THE CELLS 20-22 GEOMEMBRANE TO BE WELDED TO THE CELLS 17-19 GEOMEMBRANE. UPON COMPLETION OF THE WELD THE CELLS 17-19 GEOCOMPOSITE SHALL BE LAID BACK INTO THE COMBINED ANCHOR TRENCH AND BACKFILLED AS SHOWN IN THE DRAWINGS. 2
5. PROPOSED CELLS 20-22 ANCHOR TRENCH SHALL INCLUDE, AND COMBINE, THE ANCHOR TRENCH FOR THE CELLS 17-19 CAP GEOSYNTHETICS. THE CELLS 20-22 CAP GEOMEMBRANE SHALL BE EXTENDED INTO, AND OUT THE WEST SIDE OF, THE ANCHOR TRENCH AND WELDED TO THE CELLS 17-19 CAP GEOMEMBRANE WITH A CONTINUOUS EXTRUSION WELD ALONG THE ENTIRE LENGTH OF THE WEST BERM ANCHOR TRENCH.



WEST BERM ANCHOR TRENCH DETAIL

(TYPICAL, LOOKING NORTH)

SCALE: 1" = 1'-0"

REV. MARK	REVISION	BY	CHK	APP	DATE

CONSULTANT

URS

URS CORPORATION
MIDLAND, MI
POSLN BUILDING, DOOR 1

URS PROJECT NUMBER: 60440134

DRAWING ISSUE RECORD

ISSUE NO.	REV	MATERIAL OR JOB SPEC	BID	FAB	CONST	REF
2	2	REVISED ANCHOR TRENCH	05/2016			
1	2	BULLETIN #1	04/2016			

DATE ISSUED FOR

DESIGNED	URS CORPORATION	12/2015
DRAWN	URS CORPORATION	12/2015
CHECKED	URS CORPORATION	12/2015
APPROVED	K. DETRICH	12/2015
PROJ. ENGR.	J. DAVIS	12/2015
MFG. REP.	R. GAINES	12/2015

STATUS

PLANT NO.

P.E. SEAL

THE DOW CHEMICAL COMPANY

MICHIGAN OPERATIONS — MIDLAND, MICHIGAN

PROJECT — POSLN

SALZBURG LANDFILL
CELLS 20-22 FINAL CLOSURE PROJECT
WEST BERM CROSS SECTION

PROJECT NUMBER	SCALE		REV.
141499	AS NOTED	B2-013-141499	2

PRINTED

VER.

ATTACHMENT B

Appendix J.1 West Berm Anchor Trench Drain Analysis

APPENDIX J-1

WEST BERM ANCHOR TRENCH DRAIN ANALYSIS

ANCHOR TRENCH DRAIN FLOW CAPACITY ANALYSIS
WEST BERM OF CELLS 20-22 WITH EAST SLOPE OF CELLS 17-19

Determine the Inflow Rate to the Anchor Trench from the Geocomposite Drainage Layer

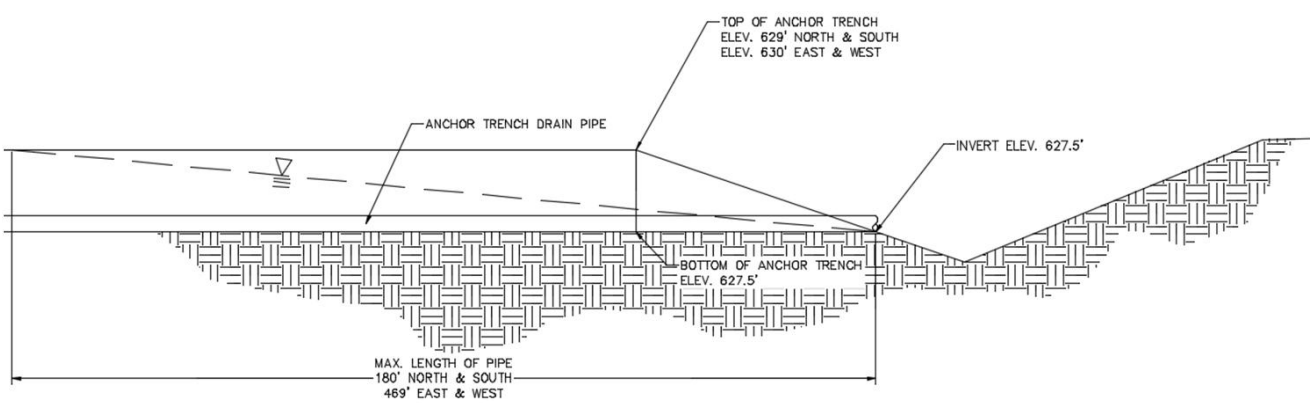
longterm transmissivity, $\mathbf{T_{req'd\text{-}west}}$ =	6E-05	m^2/sec	West slope of Cells 20-22, from Geocomposite Drainage Layer Capacity Calculation, Appendix F of Basis of Design Report
	6.46E-04	cfs/unit width	

1. CALCULATE THE LONG-TERM TRANSMISSIVITY OF THE GEOCOMPOSITE IN CELLS 17-19 FINAL COVER

liquid impingement rate, q_h =	4.8E-06	cm/sec	*Maximum infiltration from Cells 17-19 design submittal by Richardson*
GEOCOMPOSITE PROPERTIES			
ultimate transmissivity, Q =	6.10E-03	m^2/sec	*Richardson*
aggregate thickness, t =	**200**	**mil**	Thickness of geonet (assumed value)
reduction factor for elastic deformation, RF_{in} =	1.5		Upper range from Koerner & Koerner (2005) - Steel plates used in test
reduction factor for creep deformation, RF_{cr} =	1.4		Upper range from Koerner & Koerner (2005)
reduction factor for chemical clogging, RF_{cc} =	1.2		Upper range from Koerner & Koerner (2005)
reduction factor for biological clogging, RF_{bc} =	2.3		Middle range from Narejo (2004)
design factor of safety, FS =	2.5		Conservative, 2 is standard
longterm transmissivity, $T_{req'd}$ =	4.21E-04	m^2/sec	
allowable hydraulic conductivity, k =	8.3E+00	cm/sec	
SLOPE PROPERTIES			
slope, z =	25	%	*flattest sideslope of east side slope of Cells 17-19*
slope, b =	14.04	°	
length of slope, L =	79.5	ft	*longest length of east side slope of Cells 17-19*
RESULTS			
characteristic parameter, I =	0.06971429		
modifying factor, j =	0.915812081		
max. liquid thickness, t_{max} =	0.00	in	
max. liquid thickness, t_{max} =	**2.28**	**mil**	
longterm transmissivity, $\mathbf{T_{req'd\text{-}east}}$ =	4.53E-03	cfs/unit width	

Determine the Flow Capacity of the Anchor Trench Drain

Use Manning's Equation to calculate flow velocity in anchor trench drain



1. ANCHOR TRENCH ALONG WEST SIDE SLOPE OF CELLS 20-22 PLUS EAST SIDE SLOPE OF CELLS 17-19

the maximum drain length, L =	438	feet	1/2 of the WEST embankment length (876 lineal feet)
Top of Anchor Trench Elevation, H_1 =	629	feet	
Bottom of Anchor Trench Elevation, H_2 =	627.5	feet	
the maximum head in anchor trench, H =	1.5	feet	difference between top and bottom of anchor trench
the maximum slope of energy grade line, s =	0.0034	ft/ft	
Manning's Roughness Coefficient, n =	0.01		
Anchor Trench Drain Diameter, D =	12	inches	
Hydraulic Radius, R =	0.25	ft	assume 12" pipe flowing full
Flow Area, A =	0.785	ft^2	assume 12" pipe flowing full

Solve for velocity using Manning's Equation, V = $V = \frac{1.486}{n} R^{2/3} s^{1/2}$

V = 3.44 ft/sec

Maximum flow in anchor trench drain, Q_{max} = $A \times V$

Q_{max} = 2.7 cfs

Maximum inflow to the anchor trench, $Q_{in\text{-}west}$ = $T_{req'd-west} \times L$ West slope of Cells 20-22

Maximum inflow to the anchor trench, $Q_{in\text{-}east}$ = $T_{req'd-east} \times L$ East slope of Cells 17-19

Q_{in} = $Q_{in-west} + Q_{in-east}$

Q_{in} = 2.268 cfs

Since maximum flow in anchor trench drain (Q_{max}) exceeds the maximum inflow from Geocomposite Drainage Layer (Q_{in}), the depth of flow in the anchor trench will not exceed the top of the anchor trench

2. ANCHOR TRENCH ALONG SOUTH SIDE SLOPE OF CELLS 20-22

the maximum drain length, L =	180	feet	1/2 of the south embankment length to SW outlet pipe of Cells 20-22
Top of Anchor Trench Elevation, H_1 =	629	feet	
Bottom of Anchor Trench Elevation, H_2 =	627.5	feet	
the maximum head in anchor trench, H =	1.5	feet	difference between top and bottom of anchor trench
the maximum slope of energy grade line, s =	0.0083	ft/ft	
Manning's Roughness Coefficient, n =	0.012		
Anchor Trench Drain Diameter, D =	8	inches	
Hydraulic Radius, R =	0.167	ft	assume 8" pipe flowing full
Flow Area, A =	0.349	ft^2	assume 8" pipe flowing full

Solve for velocity using Manning's Equation, V = $V = \frac{1.486}{n} R^{2/3} s^{1/2}$

V = 3.42 ft/sec

Maximum flow in anchor trench drain, Q_{max} = $A \times V$

Q_{max} = 1.194 cfs

Maximum inflow to the anchor trench, Q_{in} = $T_{req'd} \times L$

Q_{in} = 0.011 cfs

Since maximum flow in anchor trench drain (Q_{max}) exceeds the maximum inflow from Geocomposite Drainage Layer (Q_{in}), the depth of flow in the anchor trench will not exceed the top of the anchor trench

3. DOWNDRAIN PIPE

Determine the Flow Capacity of the GDM Collection Tile Downdrain

Use Manning's Equation to calculate flow velocity in GDM Collection Tile Downdrain

Downdrain length, L =	12	feet	
Top of Anchor Trench Elevation, H_1 =	629	feet	
Outlet Pipe Invert Elevation, H_2 =	627.5	feet	
Maximum head at downdrain, H =	1.5	feet	difference between top of anchor trench and pipe invert elevation
the maximum slope of energy grade line, s =	0.125	ft/ft	
Manning's Roughness Coefficient, n =	0.012		
GDM Toe Drain Diameter, D =	8	inches	
Hydraulic Radius, R =	0.167	ft	assume 8" pipe flowing full
Flow Area, A =	0.349	ft^2	assume 8" pipe flowing full

Solve for velocity using Manning's Equation, V = $V = \frac{1.486}{n} R^{2/3} s^{1/2}$

V = 13.28 ft/sec

Maximum flow in downdrain pipe drain, Q_{max} = $A \times V$

Q_{max} = 4.635 cfs

Maximum inflow to the downdrain pipe, Q_{in} = $Q_{in-west} + Q_{in-south}$

Q_{in} = 2.279 cfs

Since maximum flow in downdrain pipe (Q_{max}) exceeds the maximum inflow from both sides of the Geocomposite Drainage Layer

Cells 17-19 Geocomposite Drainage Layer Design Calculation

G.N. RICHARDSON & ASSOCIATES
Engineering and Geological Services

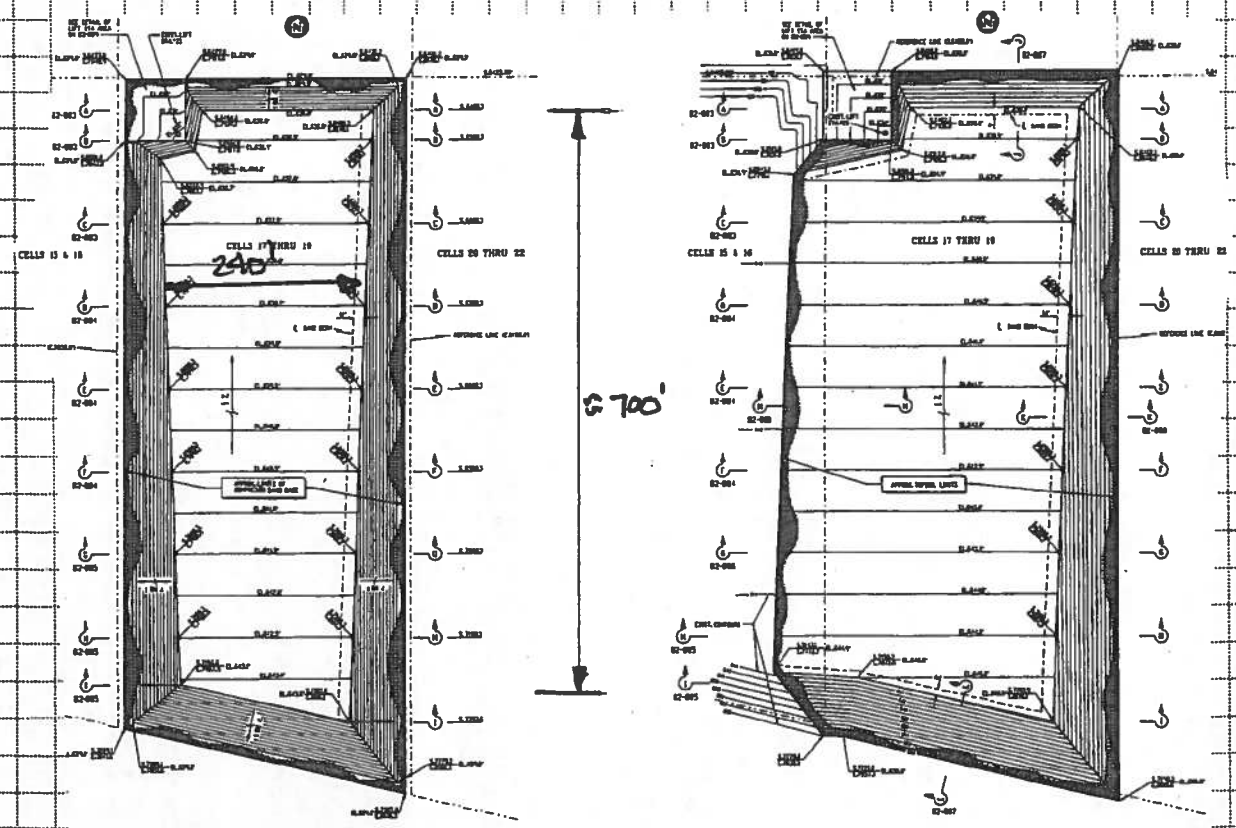
PROJECT Dow Chemical
LOCATION Midland Michigan
DESCRIPTION HW LF Cells 17-19
DATE 9-29-04 BY GNR SHEET 1 OF 3

Proposed Final Cover Section

"Bottom - Up"

- Compacted Sand Base - 12" min
- Reinforced GCL
- Geomembrane - 40 mil THDPE white/blk
- Geocomposite Drain - $\Theta = 3 \times 10^{-3}$ $m^2/m/sec$ (GDM)
- Cover Soil - 18" CL or CL-ML w/ $K = 1 \times 10^{-4}$ to 1×10^{-8} cm/sec
- Top Soil - 6"

Proposed Final Cover Contours



Minimum Transmissivity, θ, of GDM

- Slope = 1%
- Slope Length = 700 ft
- Maximum Infiltration
  - Assume saturated cover soils
  - Assume root penetration into vegetative support soils

$K_{soil} = 10^{-6}$ to 10^{-8} ⇒ suggest 10^{-6} practical limit

$$(K_{soil})_{root} = \left[1.0 + .60\,LAI + .13\,LAI^2 + .112\,LAI^3 - .048\,LAI^4 + .0043\,LAI^5\right] K_{soil}$$

Ref EPA/600/R-94/168a pg 16

LAI = leaf area index = 4.0

Ref EPA/600/R-94/168a pg 26

$$\Rightarrow (K_{soil})_{root} = 4.8 \times 1\times10^{-6} = 4.8\times10^{-6}\ \text{cm/sec}$$

⇒ Maximum infiltration, Q_{inf}, for unit width

$$Q_{inf} = w \times l \times (K_{soil})_{root}$$

$$= 1 \times 700 \times 4.8\times10^{-6}\ \text{cm/sec} \rightarrow 1.57\times10^{-7}\ \text{ft/sec}$$

$$= 1.10\times10^{-4}\ \text{ft}^3/\text{sec/ft} = 3.1\times10^{-6}\ \text{m}^3/\text{sec/ft}$$

- Minimum Transmissivity (FS = 1.0) $= 1.02\times10^{-5}\ \text{m}^3/\text{m/s}$

$$Q_{out} = \theta i = \theta \times .01$$

Setting $Q_{out} = Q_{inf}$ ⇒ $\theta = 1.02\times10^{-3}\ \text{m}^3/\text{m/s}$

Minimum Recommended FS = 6.0

$$\Rightarrow \theta_{long\ term} = 6.1\times10^{-3}\ \text{m}^3/\text{m/s}$$ ✓ OK w/ Tri-Planar (7×10^{-3} @ $i = .1$)

EPA/600/R-94/168b, The Hydrologic Evaluation of Landfill Performance (HELP) Model Engineering Documentation for Version 3

Available GDMs

Required $\theta = 6.1 \times 10^{-3}$ m²/m/s

w/ Single Bonded GDM on Smooth HDPE GM (i = 0.1) (σ = 1000 psf)

- Skap TN 330 w/ 6 osy nonwoven
- GSE Hypernet H5 or HF w/ 6 osy nonwoven
- Tenax Tendrain 9100-1

w/ Single Bonded GDM on THDPE GM (i = 0.1) (σ = 1000 psf)

- Skap TN 330 w/ 6 osy nonwoven
- Tenax Tendrain 9100-1

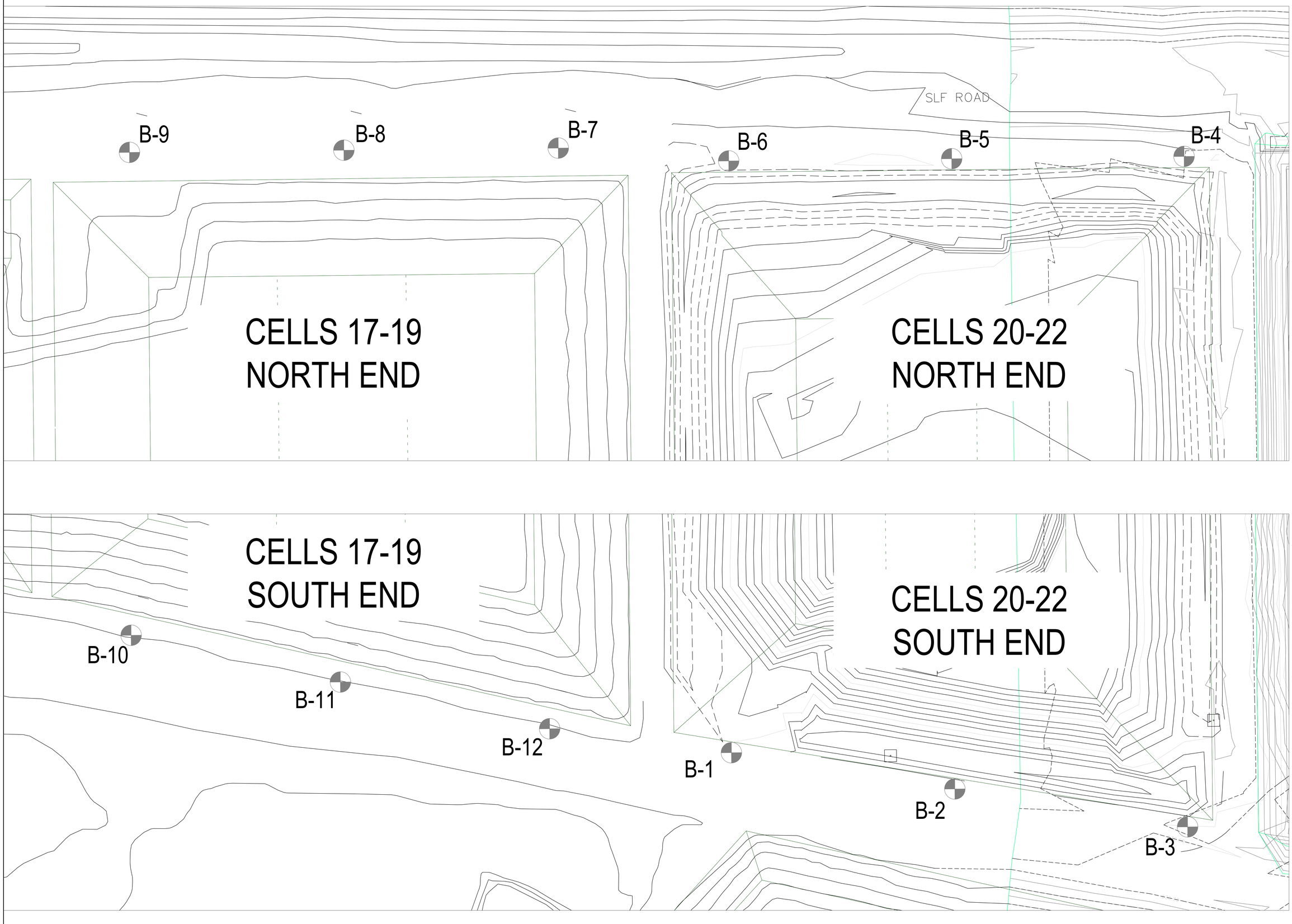
w/ Double Bonded GDM on THDPE GM

- Tenax Tenflow Class 2

ATTACHMENT C

North and South Berm Leak Detection System Borings and Test Data

Boring Location Map



DA/E	TN
DR	JAD
CK	TR
APP	
IN CHARGE	

DATE	ISSUED FOR
/05/2016	ISSUED FOR BID

URS

SOUTHFIELD, MI.
27777 FRANKLIN ROAD,
AMERICAN CENTER BLDG.
48034-8353
248 204-5900

THE DOW CHEMICAL COMPANY
MICHIGAN OPERATIONS

DOW

SALZBURG LANDFILL CELLS 17-19 AND 20-22 BORING LOCATION PLAN

FIGURE 1

FILE
60440134

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Boring Logs

AECOM
27777 Franklin, Suite 2000
Southfield, MI 48034
Telephone: 248-204-5900
Fax: 248-204-5901

BORING NUMBER B-1

CLIENT The Dow Chemical Company
PROJECT NAME SLF LDS Isolation
PROJECT NUMBER 60440134
PROJECT LOCATION Cells 20-22 South Side
DATE STARTED 5/4/16 **COMPLETED** 5/4/16
GROUND ELEVATION 629.516 ft **HOLE SIZE** -- inches
DRILLING CONTRACTOR McDowell
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY A. Crawford **CHECKED BY** Aaron Michaels
AT END OF DRILLING ---
NOTES Auger cutting sample submitted for moisture analysis.
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE	SAMPLE DEPTH & TIME	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM (Casing Type: No well installed)
0.0				SAND and GRAVEL. Fine sand and fine gravel. Brown. Dry.	Borehole backfilled with hydrated bentonite
1				CLAY. Medium stiff clay. Brown. Damp.	
2.5					
3.5				CLAY. Soft to medium stiff clay. Brown. Damp.	
4.8				CLAY. Soft clay. Brown. Moist.	
5.0	AU	5' @ 13:40			
6					

Bottom of borehole at 6.0 feet.
Southing: -7304.079
Easting: 8237.091

AECOM
27777 Franklin, Suite 2000
Southfield, MI 48034
Telephone: 248-204-5900
Fax: 248-204-5901

BORING NUMBER B-2

CLIENT The Dow Chemical Company
PROJECT NAME SLF LDS Isolation
PROJECT NUMBER 60440134
PROJECT LOCATION Cells 20-22 South Side
DATE STARTED 5/4/16 **COMPLETED** 5/4/16
GROUND ELEVATION 629.436 ft **HOLE SIZE** -- inches
DRILLING CONTRACTOR McDowell
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY A. Crawford **CHECKED BY** Aaron Michaels
AT END OF DRILLING ---
NOTES Auger cutting sample submitted for moisture analysis.
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE	SAMPLE DEPTH & TIME	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0.0					Casing Type: No well installed
				SAND and GRAVEL. Fine sand and gravel with clay and silt. Gray brown. Dry.	
				1.2 CLAY. Medium stiff clay. Brown. Damp.	
2.5					Borehole backfilled with hydrated bentonite
5.0	AU	5' @ 13:25			
				5.8 CLAY. Soft clay. Brown. Damp.	
				6	

Bottom of borehole at 6.0 feet.
Southing: -7326.997
Easting: 8367.797

ENVIRONMENTAL BH - GINT STD US LAB.GDT - 5/10/16 14:03 - C:\TEMP\GINT - DO NOT DELETE\PROJECTS\SLF LDS 0516.GPJ

AECOM
27777 Franklin, Suite 2000
Southfield, MI 48034
Telephone: 248-204-5900
Fax: 248-204-5901

BORING NUMBER B-3

CLIENT The Dow Chemical Company
PROJECT NAME SLF LDS Isolation
PROJECT NUMBER 60440134
PROJECT LOCATION Cells 20-22 South Side
DATE STARTED 5/4/16 **COMPLETED** 5/4/16
GROUND ELEVATION 629.679 ft **HOLE SIZE** -- inches
DRILLING CONTRACTOR McDowell
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY A. Crawford **CHECKED BY** Aaron Michaels
AT END OF DRILLING ---
NOTES Auger cutting sample submitted for moisture analysis.
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE	SAMPLE DEPTH & TIME	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0.0					Casing Type: No well installed
				SAND and GRAVEL. Fine sand and gravel with clay and silt. Brown. Damp.	
				1.2 CLAY. Soft to medium stiff clay. Brown. Damp.	
2.5					Borehole backfilled with hydrated bentonite
				3.5 CLAY. Soft clay. Brown. Damp.	
5.0	AU	5' @ 13:00		5 CLAY. Soft clay. Brown. Moist.	
				6	

Bottom of borehole at 6.0 feet.
Southing: -7349.255
Easting: 8495.474

AECOM
27777 Franklin, Suite 2000
Southfield, MI 48034
Telephone: 248-204-5900
Fax: 248-204-5901

BORING NUMBER B-4

CLIENT The Dow Chemical Company
PROJECT NAME SLF LDS Isolation
PROJECT NUMBER 60440134
PROJECT LOCATION Cells 20-22 South Side
DATE STARTED 5/4/16 **COMPLETED** 5/4/16
GROUND ELEVATION 629.577 ft **HOLE SIZE** -- inches
DRILLING CONTRACTOR McDowell
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY A. Crawford **CHECKED BY** Aaron Michaels
AT END OF DRILLING ---
NOTES Auger cutting sample submitted for moisture analysis.
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE	SAMPLE DEPTH & TIME	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0.0					Casing Type: No well installed
				SAND and GRAVEL. Fine sand and gravel with clay and silt. Brown. Dry.	
				1.2 CLAY. Soft Clay. Brown. Dry.	
2.5					
				3 CLAY. Very soft clay. Brown. Damp.	Borehole backfilled with hydrated bentonite
				4 CLAY. Very soft clay. Brown. Moist.	
5.0	AU	5' @ 09:35		5 CLAY. Soft clay. Brown. Very moist.	
				6	

Bottom of borehole at 6.0 feet.
Southing: -6417.250
Easting: 8501.576

ENVIRONMENTAL BH - GINT STD US LAB.GDT - 5/10/16 14:03 - C:\TEMP\GINT - DO NOT DELETE\PROJECTS\SLF LDS 0516.GPJ

AECOM
27777 Franklin, Suite 2000
Southfield, MI 48034
Telephone: 248-204-5900
Fax: 248-204-5901

BORING NUMBER B-

CLIENT The Dow Chemical Company
PROJECT NAME SLF LDS Isolation
PROJECT NUMBER 60440134
PROJECT LOCATION Cells 20-22 South Side
DATE STARTED 5/4/16 **COMPLETED** 5/4/16
GROUND ELEVATION 629.812 ft **HOLE SIZE** -- inches
DRILLING CONTRACTOR McDowell
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY A. Crawford **CHECKED BY** Aaron Michaels
AT END OF DRILLING ---
NOTES Auger cutting sample submitted for moisture analysis.
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE	SAMPLE DEPTH & TIME	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0.0					Casing Type: No well installed
				SAND and GRAVEL. Fine sand and gravel with clay and silt. Brown. Dry.	
				1.4 CLAY. Soft to medium stiff clay. Brown. Damp.	
2.5					Borehole backfilled with hydrated bentonite
5.0	AU	5' @ 10:05		5 CLAY. Soft clay. Brown. Moist.	
				6	

Bottom of borehole at 6.0 feet.
Southing: -6416.754
Easting: 8367.227

ENVIRONMENTAL BH - GINT STD US LAB.GDT - 5/10/16 14:03 - C:\TEMP\GINT - DO NOT DELETE\PROJECTS\SLF LDS 0516.GPJ

AECOM
27777 Franklin, Suite 2000
Southfield, MI 48034
Telephone: 248-204-5900
Fax: 248-204-5901

BORING NUMBER B-6

CLIENT The Dow Chemical Company
PROJECT NAME SLF LDS Isolation
PROJECT NUMBER 60440134
PROJECT LOCATION Cells 20-22 South Side
DATE STARTED 5/4/16 **COMPLETED** 5/4/16
GROUND ELEVATION 629.972 ft **HOLE SIZE** -- inches
DRILLING CONTRACTOR McDowell
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY A. Crawford **CHECKED BY** Aaron Michaels
AT END OF DRILLING ---
NOTES Auger cutting sample submitted for moisture analysis.
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE	SAMPLE DEPTH & TIME	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0.0					Casing Type: No well installed
				SAND and GRAVEL. Fine sand and gravel with clay and silt. Brown. Dry.	
			2		
				CLAY. Soft to medium stiff clay. Brown. Damp.	
2.5					Borehole backfilled with hydrated bentonite
			4		
				CLAY. Soft clay. Brown. Moist.	
5.0	AU	5' @ 10:20			
			6		

Bottom of borehole at 6.0 feet.
Southing: -6416.996
Easting: 8237.143

ENVIRONMENTAL BH - GINT STD US LAB.GDT - 5/10/16 14:03 - C:\TEMP\GINT - DO NOT DELETE\PROJECTS\SLF LDS 0516.GPJ

Moisture Content Test Results

McDowell & Associates
Geotechnical, Environmental & Hydrogeological Services • Materials Testing & Inspection
3730 James Savage Road • Midland, MI 48642
Phone (989) 496-3610 • Fax (989) 496-3190

May 9, 2016

AECOM
27777 Franklin Road
Suite 2000
Southfield, Michigan 48034

Attention: John A. Davis, P.E.

Job No. 16-63335

Subject: Moisture Testing
Salzburg Landfill Leak Detection System Isolation
The Dow Chemical Company
Salzburg Landfill
2314 Salzburg Road
Midland, Michigan 48640

Dear Mr. Davis,

In accordance with your request, McDowell & Associates has performed the required soil tests on the provided samples from the aforementioned subject project.

The soil samples were provided by you, on May 4, 2016 and May 6, 2016, and labeled by your field personal. Testing was done in general accordance with the Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass (ASTM D2216).

Test results are expressed in the following table.

Sample ID	Date	Time	Sampler	Moisture Content
B-1	5/4/16	1340	AC	14.7%
B-2	5/4/16	1325	AC	12.9%
B-3	5/4/16	1300	AC	12.9%
B-4	5/4/16	935	AC	15.5%
B-5	5/4/16	1005	AC	14.5%
B-6	5/4/16	1020	AC	14.4%
B-7	5/4/16	1130	AC	12.4%
B-8	5/4/16	1155	AC	13.7%
B-9	5/4/16	1215	AC	14.8%
B-10	5/6/16	1035	AC	12.2%
B-11	5/6/16	0905	AC	16.4%
B-12	5/4/16	1510	AC	16.1%

The supplied samples will be retained for 30 days and then discarded. If you wish us to hold the samples longer than 30 days please contact us.

If you have any questions, or if we can be of further service, please feel free to call.

Respectfully Submitted,
McDOWELL & ASSOCIATES

Michael S. Keenan, P.E.
Project Engineer

As-Built Compacted Clay Liner Optimum Moisture Content Results

MODIFIED PROCTOR SUMMARY FORM

Project: SALZBURG LANDFILL - CELL NOS. 20, 21 AND 22 **RC Project No.:** T-023632

Client: The Dow Chemical Company **Client Job No.:** S1302-852

Date: 2000 **Tests:** 1 through 16

REPORT NO.	DATE	LOCATION	MAXIMUM DRY DENSITY (p.c.f.)	OPTIMUM MOISTURE (%)	SPECIFIC GRAVITY
1	04/17/00	#1	136.5	7.7	2.68
2	04/17/00	#2	134.4	8.4	2.68
3	04/18/00	#3	136.7	7.8	2.68
4	04/24/00	#4	131.5	9.5	2.68
5	04/21/00	#5	131.9	9.4	2.68
6	04/19/00	#6	131.4	9.3	2.68
7	04/25/00	#7	131.5	9.3	2.66
8	04/25/00	#8	131.5	9.3	2.68
9	04/26/00	#9	131.8	9.3	2.68
10	05/11/00	#10	130.4	9.3	2.68
11	05/12/00	#11	132.7	9.3	2.70
12	05/12/00	#12	132.7	8.9	2.68
13	05/12/00	#13	133.8	8.5	2.68
14	05/12/00	#14	131.4	8.8	2.66
15	06/27/00	#15	128.4	9.5	2.68
16	06/27/00	#16	133.5	8.9	2.68