SCS ENGINEERS

Initial Closure Plan
OML Existing Landfill
OML Expansion Phase 1

Ottumwa-Midland Landfill

Prepared for:

Interstate Power and Light Company

Ottumwa-Midland Landfill
15300 130th Street
Ottumwa, Iowa 52501

Prepared by:

SCS ENGINEERS
2830 Dairy Drive
Madison, Wisconsin 53718-6751
(608) 224-2830

September 2016
File No. 25216110.00

Offices Nationwide
www.scsengineers.com

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PE CERTIFICATION

I, Eric J. Nelson, hereby certify the following:

- This Initial Closure Plan meets the requirements of 40 CFR 257.102(b)
- The final cover system described in this Initial Closure Plan meets the design requirements in 40 CFR 257.102(d)(3)

The Initial Closure Plan was prepared by me or under my direct supervision, and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

[signature] 9/29/16

(signature) (date)

Eric J. Nelson

(printed or typed name)

License number 23136

My license renewal date is December 31, 2016.

Pages or sheets covered by this seal:

September 2016 Initial Closure Plan

IPL OML

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1.0 INTRODUCTION AND PROJECT SUMMARY

On behalf of Interstate Power and Light Company (IPL), SCS Engineers (SCS) has prepared this Initial Closure Plan for the Ottumwa-Midland Landfill (OML) Existing Landfill and Expansion Phase 1 CCR units as required by 40 CFR 257.102(b).

40 CFR 257.102(b) *"Written closure plan—(1) Content of the plan. The owner or operator of a CCR unit must prepare a written closure plan that describes the steps necessary to close the CCR unit at any point during the active life of the CCR unit consistent with recognized and generally accepted good engineering practices. The written closure plan must include, at a minimum, the information specified in paragraphs (b)(1)(i) through (vi) of this section."*

The OML Landfill includes an active coal combustion residue (CCR) landfill, which currently consists of two existing CCR units which are subject to this closure plan. These CCR units are listed below along with their current status as it relates to the closure plan:

- OML Existing Landfill – this unit is currently being filled
- OML Expansion Phase 1 – this unit is currently being filled

Five future CCR units (OML Expansion Phases 2, 3, 4, 5, and 6) are permitted with the Iowa Department of Natural Resources (IDNR), but have not been developed. When developed, the units will be new CCR landfills, as defined in 40 CFR 257.53. Future CCR units are not addressed with this plan and are not discussed further herein.

Figure 1 shows the site location. **Figure 2** shows the closure areas. A detail of the final cover system is also included on **Figure 2**.

2.0 PROPOSED CLOSURE PLAN NARRATIVE

40 CFR 257.102(b)(1)(i) *"A narrative description of how the CCR unit will be closed in accordance with this section."*

When CCR is completed in a CCR unit, or if early closure is required, the unit will be closed by covering the CCR with the final cover system described in **Section 3.0**. Prior to final cover system construction, the CCR surfaces will be graded and compacted to establish a firm subgrade for final cover construction. The timing for completion of CCR placement in the units that are addressed with this closure plan will depend on CCR generation and disposal rates. Future CCR unit development will also impact the timing of closure. Each of the existing CCR units is designed to receive additional CCR once adjacent units are constructed and overlay airspace is available for filling. Based on the current CCR units alone, if early closure of all units were required, final cover will be placed in the active landfill areas shown on **Figure 2**. A closure schedule is discussed in **Section 6.0** and presented in **Appendix B**.

The initiation of closure activities will commence no later than 30 days after the final receipt of CCR as required by 40 CFR 257.102(e)(1) or in accordance with 40 CFR 257.102(e)(2).

3.0 FINAL COVER SYSTEM AND PERFORMANCE

40 CFR 257.102(b)(1)(iii). *"If closure of the CCR unit will be accomplished by leaving CCR in place, a description of the final cover system, designed in accordance with paragraph (d) of this section, and the methods and procedures to be used to install the final cover. The closure plan must also discuss how the final cover system will achieve the performance standards specified in paragraph (d) of this section."*

"(d) Closure performance standard when leaving CCR in place.
(1) The owner or operator of a CCR unit must ensure that, at a minimum, the CCR unit is closed in a manner that will:

(i) *Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere;*

The final cover system design will minimize or eliminate infiltration, as further described below.

(ii) *Preclude the probability of future impoundment of water, sediment, or slurry;*

The final cover system will meet these criteria, as further described below.

(iii) *Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period;*

The final cover system is designed to provide slope stability and to prevent sloughing or movement during the closure and post-closure care period. Stability of the final cover system was assessed as part of the IDNR landfill permitting process and is further addressed below.

(iv) *Minimize the need for further maintenance of the CCR unit; and*

Maintenance of the final cover will be minimized by the establishment of vegetative cover and the erosion control systems, which are further described below.

(v) *Be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices."*

All closure activities for the CCR units will be completed within 6 months, as stated in **Section 7.0** below.

"(2) Drainage and stabilization of CCR surface impoundments."

This does not apply to the OML CCR units.

"(3) Final cover system"

The final cover system (see **Figure 2**) planned for the landfill is as follows from the bottom up:

- Eighteen inches of clay, compacted to $1x10^{-7}$ cm/sec permeability
- Forty-mil linear low density polyethylene (LLDPE) geomembrane
- Geonet geocomposite drainage layer
- Eighteen inches of rooting zone soils
- Six inches of topsoil

This final cover meets and exceeds the minimum requirements of 40 CFR 257.102(d)(3)(i)(A) through (D) as follows:

- Per 257.102(d)(3)(i)(A), the permeability of the final cover system is less than or equal to the permeability of the bottom liner system and is less than the $1x10^{-5}$ cm/sec required by the Rule. The final cover system, 1.5-foot-thick clay cap, will be compacted to $1x10^{-7}$ cm/sec permeability. The geomembrane above the 1.5-foot-thick clay cap makes the cover system even more impermeable.

  The bottom liner system for the CCR Units is as follows:

  - OML Existing Landfill:
    - Four feet of clay, compacted to a permeability of $1x10^{-7}$ cm/sec. There is no geomembrane is this liner system, therefore it is not as impermeable as the final cover system.

  - OML Expansion Phase 1:
    - Two feet of clay, compacted to a permeability of $1x10^{-7}$ cm/sec
    - Sixty-mil high density polyethylene (HDPE) geomembrane

    Based on the design slopes and drainage system components in the liner system and final cover system, the final cover system is less permeable than the liner system in OML Expansion Phase 1. Per 257.102(d)(3)(i)(B), the final cover system includes 3.5 feet of soil, which is greater than the 18 inches of earthen material required to minimize infiltration.

- Per 257.102(d)(3)(i)(C), erosion of the final cover system is minimized with a vegetative support layer consisting of 18 inches of uncompacted rooting zone material and 6 inches of topsoil. This provides more than the required 6-inch thickness for sustaining plant growth.

  This final cover system limits infiltration while promoting surface water runoff in a controlled manner to minimize erosion and promote stability. The surface layer of 24 inches of soil supports vegetation that assists with erosion control. Water that infiltrates through the vegetative support layers is collected by the lateral drainage layer (geonet geocomposite) and routed to the perimeter drainage system.

In addition, the surface will have intermediate drainage swales to reduce the flow lengths down the final cover slope, also aiding in erosion control. Where needed, the intermediate drainage swales are connected to downslope flumes and energy dissipators to control storm water runoff and prevent erosion of the final cover.

- Per 257.102(d)(3)(i)(D), the design of the final cover system minimizes disruptions to the final cover system. Stability of the final cover system was assessed as part of the IDNR landfill permitting process. The stability calculations are included in **Attachment A**.

  The design of the final cover system accommodates settling and subsidence of the CCR fill below the cover. The CCR at OML is dry and compacted when placed and will continue to consolidate and gain strength as filling progresses prior to final cover placement. The final cover is designed with a maximum slope of 25 percent (4 horizontal to 1 vertical). Because the final cover has a relatively large positive slope and the CCR has been gaining strength over time, the final cover is expected to easily accommodate the remaining relatively minor settlement potential of the CCR fill when fill placement ends and the landfill is closed.

All final cover materials will be tested to confirm they meet the required specifications and construction will be overseen and documented by a licensed engineer. Clay material placement will be tested for compaction, permeability, and thickness. Rooting zone and topsoil layers will be checked for thickness. All areas will be restored after final cover is placed. Vegetation will be monitored and maintained.

4.0 MAXIMUM INVENTORY OF CCR

40 CFR 257.102(b)(1)(iv). *"An estimate of the maximum inventory of CCR ever on-site over the active life of the CCR unit."*

The following table reflects the estimated maximum volumes of CCR in each CCR unit at OML.

Area	Capacity (CY)
Existing Landfill	1,947,246
Expansion Phase 1	1,444,835
Total Maximum CCR Quantity	**3,392,081**

The estimated maximum inventory of CCR on-site over the active life of the Existing Landfill is based on an airspace survey conducted in 2015. The Expansion Phase 1 capacity is taken from Appendix 4 of the November 27, 2013, Permit Amendment Request submitted to IDNR.

5.0 LARGEST AREA OF CCR UNIT REQUIRING FINAL COVER

40 CFR 257.102(b)(1)(v). *"An estimate of the largest area of the CCR unit ever requiring a final cover as required by paragraph (d) of this section at any time during the CCR unit's active life."*

The largest remaining areas requiring final cover are as follows (from Attachment G of Appendix 1 of the 2013 Permit Amendment Request submitted to IDNR):

CCR Unit	Closure Area (acres)
Existing Landfill	14.7
Expansion Phase 1	9.0
Total Cover Area	**23.7**

6.0 SCHEDULE OF SEQUENTIAL CLOSURE ACTIVITIES

40 CFR 257.102(b)(1)(vi). *"A schedule for completing all activities necessary to satisfy the closure criteria in this section, including an estimate of the year in which all closure activities for the CCR unit will be completed."*

CCR placement is estimated to be complete in each existing CCR unit as follows:

CCR Unit	Filling Completed
Existing Landfill	June 2071
Expansion Phase 1	June 2071

These estimated closure dates are based on the site life calculated from the design capacity of each unit and currently anticipated disposal rates. These dates also account for periods when the sideslopes will not receive CCR or non-CCR waste. These periods are a part of normal plant operations, as described in the Plan of Operations approved by WDNR. Finally, the dates assume that the adjacent future CCR units that are currently permitted with the IDNR will be constructed as planned allowing for the overlay of additional CCR onto the existing units. The preliminary schedule for closure of the existing CCR units is provided in **Appendix B**.

7.0 COMPLETION OF CLOSURE ACTIVITIES

40 CFR257.102((f)(1). *"Except as provided for in paragraph (f)(2) of this section, the owner or operator must complete closure of the CCR unit:*

(i)For existing and new CCR landfills and any lateral expansion of a CCR landfill, within six months of commencing closure activities."

As shown on the enclosed schedule, closure of each CCR unit will be completed within 6 months of commencing closure activities.

40 CFR 257.102(f)(3). *"Upon completion, the owner or operator of the CCR unit must obtain a certification from a qualified professional engineer verifying that closure has been completed in accordance with the closure plan specified in paragraph (b) of this section and the requirements of this section."*

A qualified licensed engineer will oversee final cover construction. The engineer will verify final cover materials and methods, and perform material testing. At the end of construction, the engineer will provide a report summarizing and documenting construction and will certify compliance with the requirements.

8.0 CERTIFICATION

40 CFR 257.102(b)(4) *"The owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the initial and any amendment of the written closure plan meets the requirement of this section."*

Eric Nelson, PE, a licensed professional engineer in the State of Iowa has overseen the preparation of this Initial Closure Plan. A certification statement is provided on **page iii** of this plan.

40 CFR 257.102(d)(2)(iii). *"The owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the design of the final cover system meets the requirement of this section."*

Eric Nelson, PE, a licensed professional engineer in the State of Iowa has reviewed the final cover design and certifies that the design meets the requirements of 40 CFR 257.102(d). The certification statement is provided on **page iii** of this plan.

9.0 RECORDKEEPING AND REPORTING

40 CFR 257.102(b)(vi)(2)(iii). *"The owner or operator has completed the written closure plan when the plan including the certification required by paragraph (b)(4) of this section, has been placed in the facility's operating record as required by Section 257.105(i)(4)."*

The Closure Plan will be placed in the facility's operating record, and on Alliant Energy's CCR Rule Compliance Data and Information website.

Amendments to the written closure plan will be done when there is a change in the operation of the CCR unit that affects the plan or when unanticipated events warrant revision to the written closure plan as required by 40 CFR 102(b)(3). The amendments will be made at least 60 days prior to the operations or event revisions.

OML will provide notification as follows:

- Intent to initiate closure
- Closure completion
- Availability of the written Closure Plan and any amendments

All notifications will be placed in the facility's operating record and on the website (40 CFR 257.105(i), 257.106(i), 257.107 (i)).

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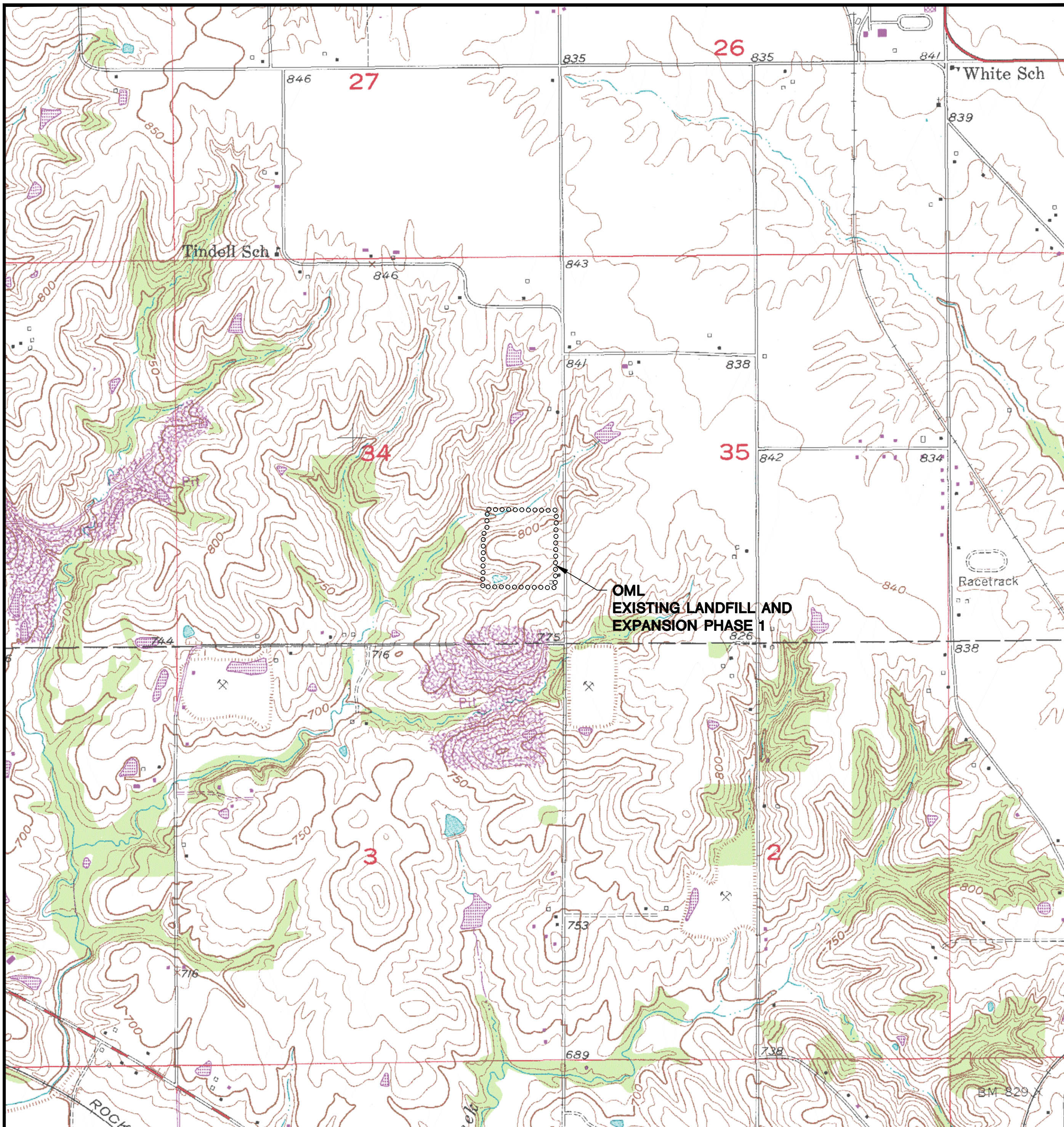
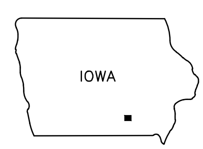
FIGURES



OTTUMWA NORTH QUADRANGLE
IOWA–WAPELLO CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SW/4 OTTUMWA NORTH 15' QUADRANGLE
1976
SCALE: 1" = 2,000'

N



CLIENT: INTERSTATE POWER AND LIGHT CO.
15300 130th STREET
OTTUMWA, IA 52501

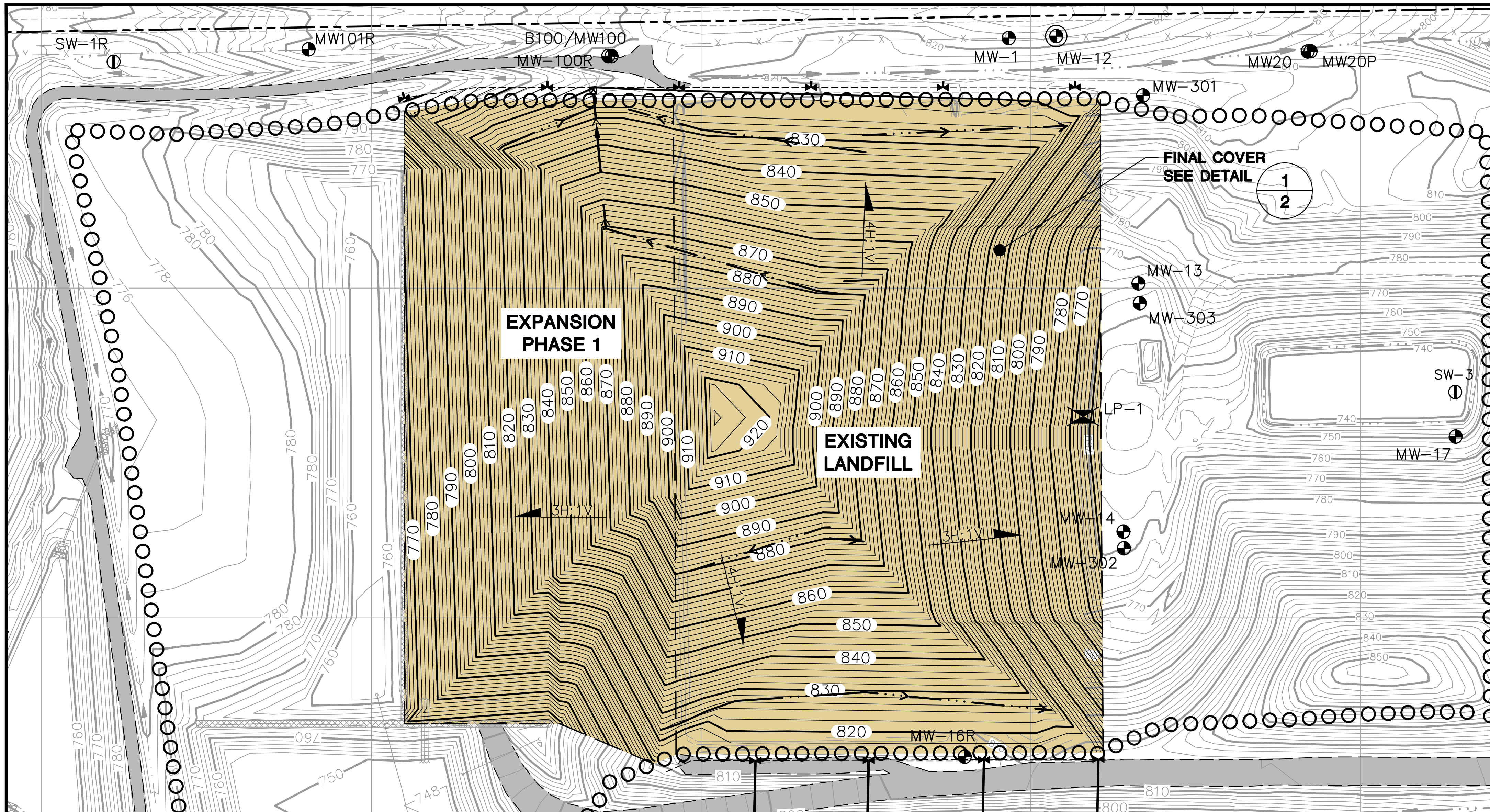
SITE: INITIAL CLOSURE PLAN
OTTUMWA MIDLAND LANDFILL
OTTUMWA, IOWA

SITE LOCATION MAP

PROJECT NO.	25216110	DRAWN BY:	KP
DRAWN:	09/15/11	CHECKED BY:	JO
REVISED:	08/23/16	APPROVED BY:	EN 09/28/16

ENGINEER: SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718–6751
PHONE: (608) 224–2830

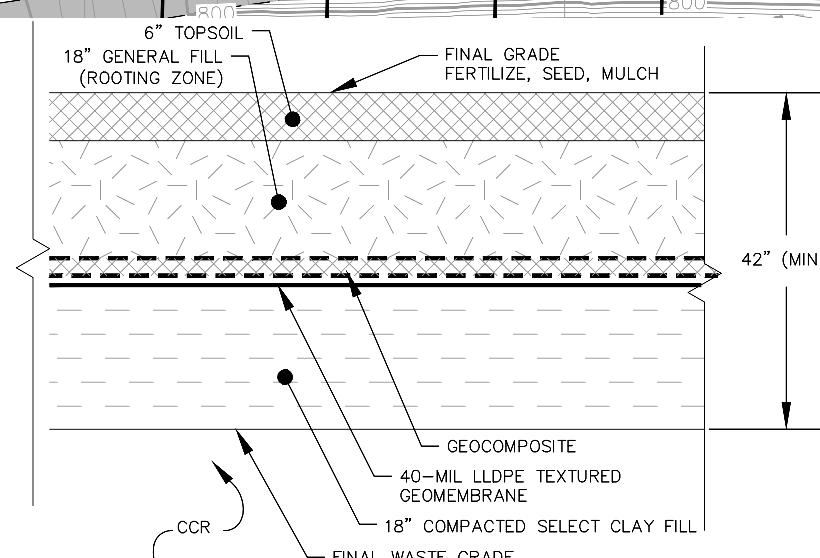
FIGURE
1



N

200 0 200

SCALE: 1" = 200'



1/2 **FINAL COVER SYSTEM**

(SCALE: 1" = 2')

LEGEND

- APPROXIMATE PROPERTY LINE
- LIMITS OF WASTE
- PHASE LIMITS
- EXISTING GROUND SURFACE (10' CONTOUR)
- EXISTING GROUND SURFACE (2' CONTOUR)
- EXISTING DITCH
- EXISTING STREAM
- EXISTING CULVERT
- EXISTING FENCE
- EXISTING WETLAND
- EXISTING RIPRAP
- PROPOSED FINAL GRADES (10' CONTOUR)
- PROPOSED FINAL GRADES (2' CONTOUR)
- ACCESS ROAD
- MW20 MONITORING WELL
- AREAS TO BE CLOSED
- PROPOSED FINAL COVER DIVERSION BERM
- PROPOSED DOWNSLOPE FLUME
- PROPOSED ENERGY DISSIPATOR
- PROPOSED TOE DRAIN AND DISCHARGE PIPE

NOTES

1. TOPOGRAPHIC BASE MAP WAS COMPILED FROM IOWA DEPARTMENT OF NATURAL RESOURCES GENERALIZED TWO FOOT CONTOURS OF WAPELLO COUNTY IOWA DERIVED FROM LIDAR DATA. THE LIDAR DATA WAS ACQUIRED IN THE SPRING OF 2008. THE CONTOUR DATA WAS FIELD VERIFIED BY GLOBAL POSITIONING SURVEY (GPS) IN THE SPRING OF 2012. CONTOUR DATA WITHIN THE LIMITS OF PHASE 1 EXPANSION CONSTRUCTION ACTIVITIES IS BASED ON THE NOVEMBER 2015 CONSTRUCTION DOCUMENTATION REPORT BY SCS ENGINEERS. CONTOUR INTERVAL IS 2 FOOT.
2. TOPOGRAPHIC BASE MAP WITHIN THE EXISTING LANDFILL IS SUPPLEMENTED WITH SURVEYS PERFORMED BY FRENCH-RENEKER ASSOCIATES, INC., FAIRFIELD, IOWA. DATES OF GROUND SURVEYS ARE FEBRUARY 22, 2011, AND JANUARY 22, 2013.
3. ELEVATIONS ARE BASED ON NAVD 88 DATUM.
4. THE GRID SYSTEM IS BASED ON THE IOWA STATE PLANE COORDINATE SYSTEM NAD 83 (2007 ADJUSTMENT) AS DERIVED FROM NATIONAL GEODETIC SYSTEM (NGS) CONTROL MONUMENT DESIGNATION D 6.
5. PROPERTY LINE SOUTH OF 130TH STREET FROM SURVEY MAP PREPARED BY GARDEN & ASSOCIATES, OSKALOOSA, IOWA, DATED DECEMBER 20, 1988.
6. PROPERTY LINE NORTH OF 130TH STREET FROM PLAT OF SURVEY MAP PREPARED BY SCS ENGINEERS, MADISON, WISCONSIN, DATED FEBRUARY 20, 2013.
7. EXISTING WETLAND LIMITS BASED ON WETLAND DELINEATIONS PERFORMED BY STANTEC CONSULTING SERVICES, INC., ON APRIL 15, 2012 AND OCTOBER 17, 2012.
8. EXISTING STREAM ALIGNMENT SHOWN IN NORTH EXPANSION AREA IS APPROXIMATE CENTERLINE BASED ON GENERALIZED CONTOURS (EXISTING GRADE). EXISTING STREAM ALIGNMENT AT SOUTH END OF PROPERTY BASED ON SITE OBSERVATIONS BY STANTEC CONSULTING SERVICES, INC. ON OCTOBER 17, 2012.

PROJECT NO.	25216110.00	DRAWN BY:	AHB
DRAWN:	08/22/16	CHECKED BY:	JMO
REVISED:	08/09/16	APPROVED BY:	EN 09/28/16

ENGINEER: SCS ENGINEERS
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PHONE: (608) 224-2830

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OTTUMWA MIDLAND LANDFILL
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OTTUMWA, IOWA 52501

SITE: INITIAL CLOSURE PLAN
OTTUMWA MIDLAND LANDFILL
OTTUMWA, IOWA

INITIAL CLOSURE PLAN

FIGURE 2

I:\25216110.00\Drawings\Initial Cover Plan\Site Plan.dwg, 9/28/2016 3:43:52 PM

APPENDIX A

Stability Calculations

Environmental Consultants
and Contractors

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SCS ENGINEERS

October 2013
File No. 25211509

TECHNICAL MEMORANDUM

ANALYSIS BY: Phillip Gearing

REVIEWED BY: Deb Nelson

SUBJECT: Ottumwa Midland Landfill Expansion
Slope Stability Analyses

PURPOSE

The purposes of the slope stability analyses were to evaluate:

- The interim 4H:1V waste slope in the expansion area at the highest waste grade (Phase 1/Phase 2 boundary)
- The final 4H:1V waste slope at the highest waste grade

CONCLUSION AND RECOMMENDATIONS

The attached results confirm that the final and interim waste slope of 4H:1V will be stable during and after the construction of the expansion phases.

APPROACH

SCS Engineers (SCS) evaluated the waste mass slope stability of the final and interim waste slopes at the most critical/highest waste grade cross-sections. The location of the cross-sections are shown on the attached figure. The interim waste slope was evaluated for both block and cicular failure and the final waste slope was evaluated for circular failure. Peak and large displacement (residual) liner interface shear strengths were used for the evaluation.

BACKGROUND INFORMATION

There has been much debate among researchers and practitioners concerning the use of peak versus residual (large displacement) geosynthetic interface shear strength values for landfill liner slope stability analysis. An article by Koerner and Bowman (2003) and commentary by Koerner and Richardson (2003) highlight some of the debate. Based on our review of the literature, there seem to be two main schools of thought:

1) Only peak values should be used except in special cases where interface displacement is expected, such as seismic loading or where there may be large settlements occurring below the liner.

2) Both peak and residual values should be considered because the interface shear strength in reality is not a constant value along the interface and will vary between the peak value and the residual value.

In our opinion, it is prudent to consider both the peak and residual interface shear strength. Unless there is a likelihood of seismic activity or large settlement below the liner, we feel that the safety factor using the residual values is acceptable if it is greater than 1.0. The safety factor using peak values should be much greater than 1.0 depending on how long the slope will be present, the comfort level of how well the slope conditions and shear strength values can be defined, and the consequences of failure. We recommend a minimum safety factor of 1.2 for a temporary liner slope such as the waste mass along the interim slope at a phase line. A higher minimum safety factor of approximately 1.5 is recommended for permanent slopes such as a landfill final cover.

RESULTS

The calculated safety factors for each of the slope conditions are shown in the attached summary table.

SCS recommends a minimum safety factor of 1.2 for the interim waste slope using peak liner interface shear strength parameters, and a safety factor of greater than 1.0 using large displacement (residual) liner interface shear strength values. The results indicate that a 4H:1V waste slope with the assumed parameters has an acceptable minimum safety factor of 1.47 and 1.26 at the peak and residual interface shear strengths respectively.

SCS recommends a minimum safety factor of approximatley1.5 for the final waste slope. The results indicate that the 4H:1V waste slope with the assumed parameters has a safety factor of 1.46 which is deemed acceptable based on the conservative ash waste properties used for this analysis.

SCS recommends that the waste slope be reevaluated for slope stability if the interim waste slope will be steeper than the evaluated 4H:1V slope. SCS also recommends evaluation of the waste properties once waste filling begins. In particular, SCS recommends shear strength testing of the waste produced from flue gas desulfurization. SCS recommends that the project geotechnical engineer be contacted to coordinate and appropriate shear strength testing program for the waste. SCS used conservative values for the ash waste material and steeper slopes may be obtained if the waste properties are known and additional analysis shows that acceptable safety factors are obtained for steeper slopes.

REFERENCES

1. TRI, Interface Test Reports, Previous project experience for GSE Textured 60-mil HDPE Material vs GSE 12 oz. Non-woven Geotextile
2. Ottumwa Midland Landfill, Clay Borrow Samples, Summary of Soils Physical Testing Results, 2013, (Average of typical properties)

3. Koerner, Robert M. and H. L. Bowman, 2003, A Recommendation to Use Peak Shear Strengths for Geosynthetic Interface Design: Geotechnical Fabrics Report (GFR), v. 21. no. 3, Industrial Fabrics Association International, Roseville, MN, p. 28-30.
4. Koerner, Robert M. and Greg Richardson, 2003, Forum: Interface Design: GFR, v. 21, no. 6, p. 14-15.
5. Ottumwa Midland Landfill Expansion, Final Grades and Base Grades Drawings, SCS Engineers, 2013
6. WinSTABL (PC STABL6) slope stability software developed by Purdue University and modified by the University of Wisconsin – Madison.
7. U.S. Department of Transportation, Federal Highway Administration, Recycled Materials, Coal Ash User's Guide
8. Stabilization of FGD By-Products by Using Fly Ash, Cement, and Sialite, 2009 WOCA Conference

ASSUMPTIONS

- The waste is flue gas desulfurization ash, flyash and bottom ash from coal combustion processes.
- A final waste fill slope of 4H:1V is representative of the design final waste slope for the expansion waste material.
- Circular and sliding block failure stability analyses are appropriate to evaluate the waste mass stability.
- Material properties are as shown in the table below, based on the indicated references and assumed values based on experience.

Material	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	Reference
Ash Waste Material	120	20	0	7,8
Geosynthetics (Textured, Peak)	58	27.5	0	1
Geosynthetics (Textured, Residual)	58	12.4	271	1
Bottom Ash Drainage Material	130	35	0	7
Clay Liner	121.7	28	0	2
Clay Fill/Native Clay	121.7	28	0	2

Attachments: Calculations organized as follows:

- Factor of Safety Summary Table
- X-Section Location
- WinSTABL Outputs

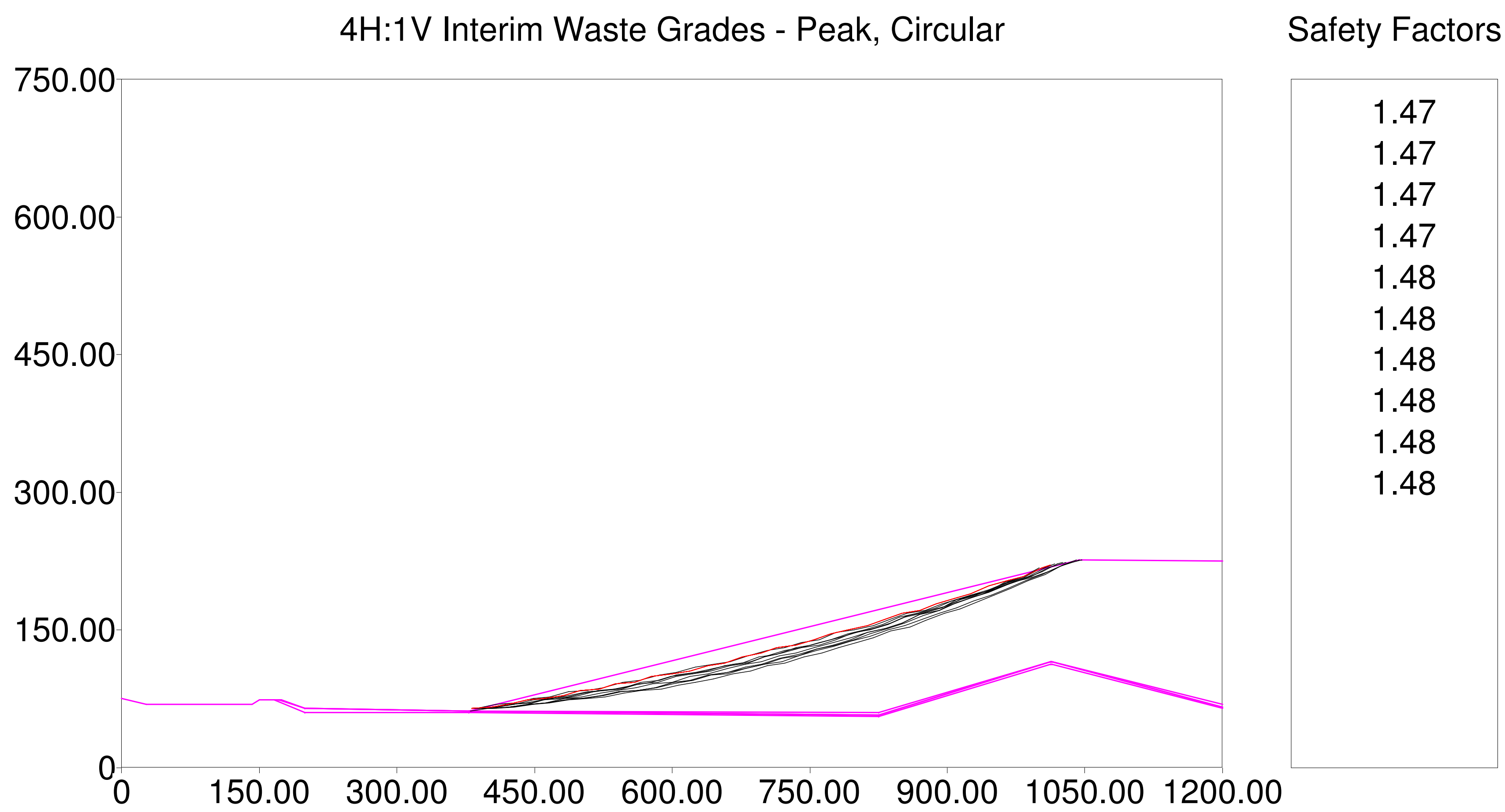
PEG/DLN

I:\25211509\Reports\Permit Amendment\Appendices\Geotechnical Analysis\Final Cover Stability\Tech_Memo_Waste_Stability_131001.doc

Ottumwa Midland Landfill
Expansion Waste Slope Stability

Scenario	Failure Type	Calculated Safety Factor	Recommended Min. Safety Factor
Phase 1 Interim Waste Grades - Peak	Circular	1.47	1.2
Phase 1 Interim Waste Grades - Residual	Block	1.26	Greater than 1.0
Final Waste Grades	Circular	1.47	Approximately 1.5

I:\25211509\Reports\Permit Amendment\Appendices\Geotechnical Analysis\Final Cover Stability\[Slope Stability Results_131021.xlsx]Expansion Results


4H:1V Interim Waste Grades - Peak, Circular
750.00
600.00
450.00
300.00
150.00
0
0
150.00
300.00
450.00
600.00
750.00
900.00
1050.00
1200.00
Safety Factors
1.47
1.47
1.47
1.47
1.48
1.48
1.48
1.48
1.48
1.48

** PCSTABL6 **

by
Purdue University

modified by
Peter J. Bosscher
University of Wisconsin-Madison

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

PROBLEM DESCRIPTION 4H:1V Interim Waste Grades - Peak, Circu
lar

BOUNDARY COORDINATES

11 Top Boundaries
33 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	76.00	29.00	70.00	5
2	29.00	70.00	144.00	70.00	5
3	144.00	70.00	152.00	73.00	5
4	152.00	73.00	166.00	73.00	5
5	166.00	73.00	172.00	73.00	4
6	172.00	73.00	172.30	73.00	3
7	172.30	73.00	175.30	73.00	2
8	175.30	73.00	200.00	65.10	2
9	200.00	65.10	380.10	63.50	2
10	380.10	63.50	1044.00	228.00	1
11	1044.00	228.00	1200.00	226.00	1
12	380.10	63.50	825.00	59.60	2
13	825.00	59.60	1012.00	117.60	2
14	1012.00	117.60	1016.00	117.60	2
15	1016.00	117.60	1200.00	69.10	2
16	172.30	73.00	200.00	64.10	3
17	200.00	64.10	380.10	62.50	3
18	380.10	62.50	825.00	58.60	3
19	825.00	58.60	1012.00	116.60	3
20	1012.00	116.60	1016.00	116.60	3
21	1016.00	116.60	1200.00	68.10	3
22	172.00	73.00	200.00	64.00	4
23	200.00	64.00	380.10	62.40	4
24	380.10	62.40	825.00	58.50	4
25	825.00	58.50	1012.00	116.50	4

26	1012.00	116.50	1016.00	116.50	4
27	1016.00	116.50	1200.00	68.00	4
28	166.00	73.00	200.00	62.00	5
29	200.00	62.00	380.10	60.40	5
30	380.10	60.40	825.00	56.50	5
31	825.00	56.50	1012.00	114.50	5
32	1012.00	114.50	1016.00	114.50	5
33	1016.00	114.50	1200.00	66.00	5

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	20.0	0.00	0.0	0
2	130.0	130.0	0.0	35.0	0.00	0.0	0
3	58.0	58.0	0.0	27.5	0.00	0.0	0
4	121.7	121.7	0.0	28.0	0.00	0.0	0
5	121.7	121.7	0.0	28.0	0.00	0.0	0

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

5000 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of500 Points Equally Spaced
Along The Ground Surface Between X = 300.00 ft.
and X = 390.00 ft.

Each Surface Terminates Between X =1000.00 ft.
and X =1200.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

20.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	382.79	64.17
2	402.57	67.09
3	422.34	70.13
4	442.09	73.29
5	461.81	76.58
6	481.52	79.98
7	501.21	83.51
8	520.87	87.15
9	540.52	90.92
10	560.14	94.80
11	579.73	98.80
12	599.30	102.93
13	618.85	107.17
14	638.36	111.53
15	657.86	116.02
16	677.32	120.62
17	696.75	125.34
18	716.16	130.17
19	735.54	135.13
20	754.88	140.21
21	774.20	145.40
22	793.48	150.71
23	812.73	156.14
24	831.94	161.68
25	851.13	167.35
26	870.27	173.12
27	889.38	179.02
28	908.46	185.03
29	927.50	191.16
30	946.49	197.41
31	965.46	203.77
32	984.38	210.25
33	1003.26	216.84
34	1013.09	220.34

*** 1.472 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	388.92	65.68
2	408.69	68.70
3	428.44	71.83
4	448.18	75.06
5	467.90	78.40
6	487.60	81.85
7	507.28	85.41
8	526.94	89.07
9	546.58	92.84
10	566.21	96.71
11	585.81	100.69
12	605.38	104.78

13	624.94	108.97
14	644.47	113.27
15	663.98	117.68
16	683.46	122.19
17	702.92	126.80
18	722.36	131.53
19	741.77	136.36
20	761.15	141.29
21	780.50	146.33
22	799.83	151.47
23	819.13	156.72
24	838.40	162.07
25	857.64	167.53
26	876.85	173.09
27	896.03	178.76
28	915.18	184.53
29	934.30	190.40
30	953.39	196.38
31	972.44	202.46
32	991.46	208.64
33	1010.45	214.93
34	1029.40	221.32
35	1048.31	227.81
36	1048.68	227.94

*** 1.473 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	389.46	65.82
2	409.32	68.19
3	429.16	70.72
4	448.98	73.40
5	468.77	76.23
6	488.55	79.22
7	508.30	82.36
8	528.03	85.65
9	547.73	89.10
10	567.40	92.70
11	587.05	96.45
12	606.66	100.35
13	626.25	104.41
14	645.80	108.61
15	665.32	112.97
16	684.81	117.48
17	704.26	122.14
18	723.67	126.95
19	743.04	131.91
20	762.38	137.02
21	781.68	142.28
22	800.93	147.69
23	820.14	153.25
24	839.31	158.95
25	858.44	164.81
26	877.51	170.81
27	896.54	176.96

28	915.53	183.26
29	934.46	189.71
30	953.34	196.30
31	972.17	203.04
32	990.95	209.92
33	1009.67	216.95
34	1028.34	224.12

*** 1.474 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	380.80	63.67
2	400.66	66.04
3	420.50	68.57
4	440.32	71.25
5	460.12	74.09
6	479.89	77.08
7	499.64	80.23
8	519.37	83.53
9	539.07	86.99
10	558.74	90.60
11	578.38	94.36
12	597.99	98.28
13	617.58	102.35
14	637.12	106.57
15	656.64	110.95
16	676.12	115.48
17	695.56	120.16
18	714.97	125.00
19	734.34	129.98
20	753.67	135.12
21	772.96	140.41
22	792.20	145.85
23	811.41	151.44
24	830.56	157.18
25	849.68	163.07
26	868.74	169.11
27	887.76	175.30
28	906.73	181.63
29	925.65	188.12
30	944.52	194.75
31	963.33	201.54
32	982.09	208.46
33	1000.80	215.54
34	1013.40	220.42

*** 1.474 ***

Failure Surface Specified By 34 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	386.75	65.15
2	406.63	67.37
3	426.49	69.76
4	446.32	72.31
5	466.14	75.03
6	485.93	77.91
7	505.69	80.96
8	525.43	84.17
9	545.15	87.55
10	564.83	91.09
11	584.49	94.79
12	604.11	98.66
13	623.70	102.69
14	643.25	106.88
15	662.77	111.24
16	682.26	115.76
17	701.70	120.44
18	721.11	125.28
19	740.47	130.28
20	759.79	135.45
21	779.07	140.77
22	798.30	146.26
23	817.49	151.90
24	836.63	157.71
25	855.72	163.67
26	874.76	169.79
27	893.75	176.07
28	912.68	182.51
29	931.56	189.10
30	950.39	195.86
31	969.16	202.77
32	987.87	209.83
33	1006.52	217.05
34	1017.68	221.48

*** 1.475 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	382.97	64.21
2	402.87	66.12
3	422.76	68.22
4	442.63	70.50
5	462.48	72.95
6	482.31	75.59
7	502.11	78.41
8	521.88	81.40
9	541.63	84.58
10	561.34	87.94
11	581.03	91.47
12	600.68	95.19
13	620.30	99.08
14	639.88	103.15
15	659.42	107.40

16	678.93	111.82
17	698.39	116.43
18	717.81	121.21
19	737.19	126.16
20	756.52	131.29
21	775.80	136.60
22	795.04	142.08
23	814.22	147.74
24	833.35	153.57
25	852.43	159.58
26	871.45	165.76
27	890.41	172.11
28	909.32	178.63
29	928.17	185.32
30	946.95	192.19
31	965.67	199.23
32	984.33	206.43
33	1002.92	213.81
34	1021.44	221.35
35	1027.68	223.96

*** 1.476 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	384.23	64.52
2	404.17	66.08
3	424.09	67.84
4	443.99	69.80
5	463.88	71.95
6	483.74	74.30
7	503.58	76.84
8	523.39	79.58
9	543.17	82.52
10	562.92	85.66
11	582.64	88.98
12	602.33	92.51
13	621.98	96.23
14	641.60	100.14
15	661.17	104.25
16	680.70	108.55
17	700.19	113.05
18	719.63	117.74
19	739.03	122.62
20	758.37	127.69
21	777.67	132.95
22	796.91	138.41
23	816.10	144.05
24	835.23	149.88
25	854.30	155.91
26	873.31	162.12
27	892.26	168.52
28	911.14	175.11
29	929.96	181.88
30	948.71	188.85
31	967.39	195.99

32	986.00	203.32
33	1004.53	210.84
34	1022.99	218.54
35	1041.37	226.42
36	1044.94	227.99

*** 1.478 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	383.51	64.34
2	403.45	65.83
3	423.38	67.52
4	443.29	69.44
5	463.17	71.57
6	483.03	73.92
7	502.87	76.49
8	522.68	79.27
9	542.45	82.27
10	562.19	85.48
11	581.89	88.91
12	601.56	92.55
13	621.18	96.40
14	640.77	100.47
15	660.30	104.76
16	679.79	109.25
17	699.23	113.96
18	718.61	118.88
19	737.95	124.01
20	757.22	129.35
21	776.43	134.90
22	795.59	140.66
23	814.68	146.62
24	833.70	152.80
25	852.65	159.18
26	871.54	165.77
27	890.35	172.56
28	909.08	179.56
29	927.74	186.76
30	946.32	194.16
31	964.82	201.77
32	983.23	209.58
33	1001.03	217.35

*** 1.479 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	385.13	64.75

2	405.08	66.12
3	425.02	67.71
4	444.94	69.53
5	464.83	71.58
6	484.70	73.84
7	504.55	76.33
8	524.36	79.04
9	544.15	81.98
10	563.89	85.14
11	583.61	88.52
12	603.28	92.12
13	622.91	95.94
14	642.50	99.98
15	662.04	104.24
16	681.53	108.72
17	700.97	113.42
18	720.36	118.34
19	739.69	123.48
20	758.96	128.83
21	778.17	134.40
22	797.31	140.18
23	816.39	146.18
24	835.40	152.40
25	854.34	158.82
26	873.21	165.46
27	892.00	172.32
28	910.71	179.38
29	929.34	186.65
30	947.89	194.13
31	966.35	201.82
32	984.72	209.71
33	1003.01	217.82
34	1003.14	217.88

*** 1.479 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	388.56	65.60
2	408.53	66.71
3	428.48	68.06
4	448.42	69.63
5	468.34	71.43
6	488.23	73.46
7	508.11	75.71
8	527.95	78.19
9	547.77	80.89
10	567.55	83.82
11	587.30	86.97
12	607.02	90.35
13	626.69	93.95
14	646.32	97.78
15	665.91	101.83
16	685.45	106.10
17	704.93	110.59
18	724.37	115.30

19	743.75	120.23
20	763.08	125.39
21	782.34	130.76
22	801.54	136.35
23	820.68	142.16
24	839.75	148.19
25	858.75	154.43
26	877.68	160.89
27	896.54	167.57
28	915.31	174.45
29	934.01	181.55
30	952.62	188.87
31	971.15	196.39
32	989.60	204.12
33	1007.95	212.07
34	1026.22	220.22
35	1042.12	227.53

*** 1.481 ***

```
           Y            A     X     I     S            F     T

           0.00    150.00    300.00    450.00    600.00    750.00

X       0.00 +----*----+---------+---------+---------+---------+
             -    *
             -
             -
             -
             -
      150.00 +    *
             -    *
             -   *
             -
             -
             -
A     300.00 +   .
             -  ..
             -  ..
             - ..*
             -...12
             -....1
X     450.00 +....1
             .....1
             .....21
             .....61
             .....81
             ......21
I     600.00 ......61
             ......71
             .......11
             .......51
             .......01
             ........31
S     750.00 ........71
             -.......031
             -........61
```

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            -...*....011
            -.........71
            - .........31
     900.00 + .........61
            -  .........21
            -   .........1
            -   .........21
            -     ...*.....19
            -      ..*......1
F   1050.00 +       ........*
            -        ........
            -         .......
            -          ......
            -           .....
            -             ...
T   1200.00 +   **         .*
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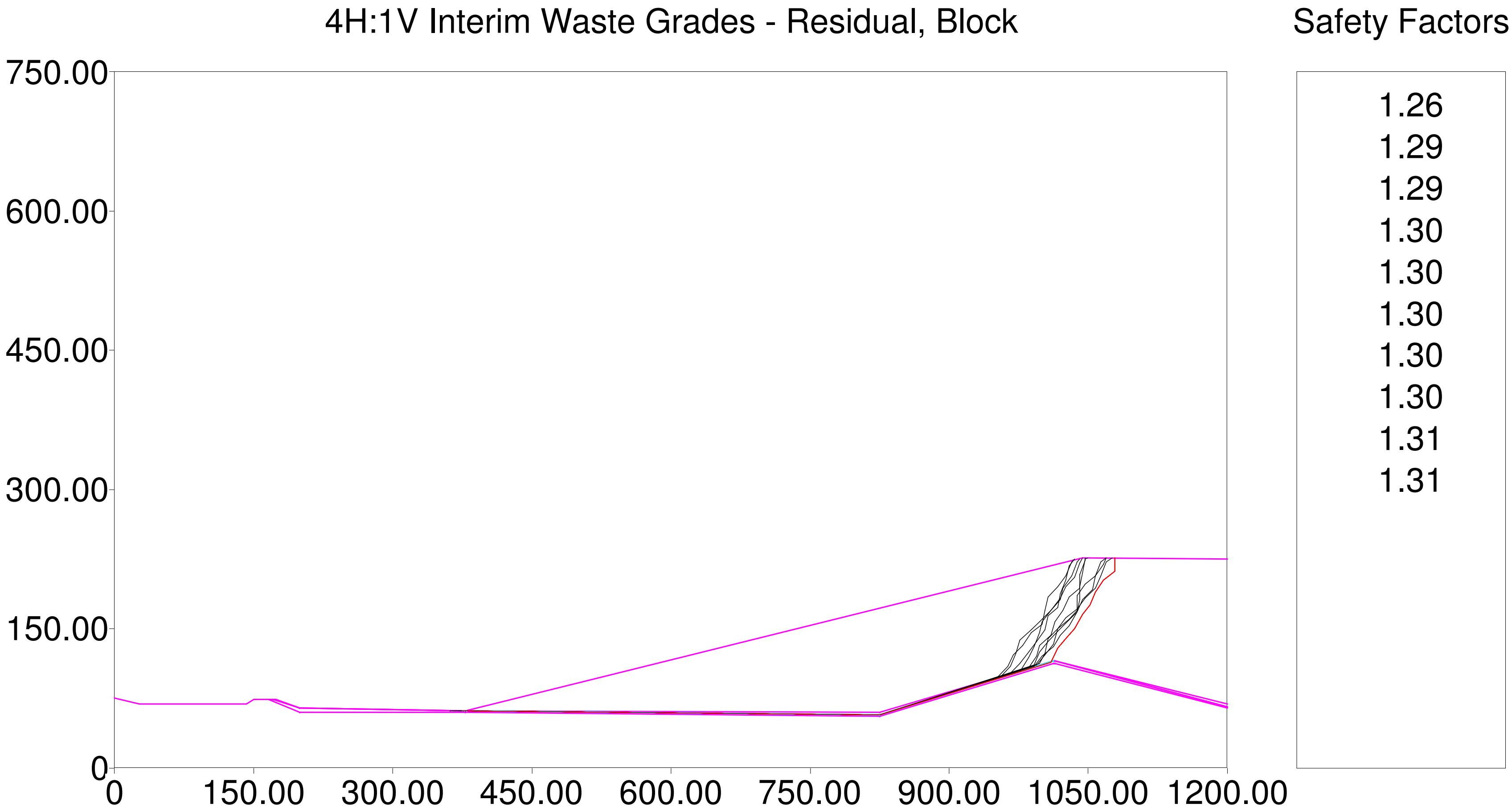

4H:1V Interim Waste Grades - Residual, Block
Safety Factors
750.00
600.00
450.00
300.00
150.00
0
0
150.00
300.00
450.00
600.00
750.00
900.00
1050.00
1200.00
1.26
1.29
1.29
1.30
1.30
1.30
1.30
1.30
1.31
1.31

** PCSTABL6 **

by
Purdue University

modified by
Peter J. Bosscher
University of Wisconsin-Madison

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

PROBLEM DESCRIPTION 4H:1V Interim Waste Grades - Residual, Block

BOUNDARY COORDINATES

11 Top Boundaries
33 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	76.00	29.00	70.00	5
2	29.00	70.00	144.00	70.00	5
3	144.00	70.00	152.00	73.00	5
4	152.00	73.00	166.00	73.00	5
5	166.00	73.00	172.00	73.00	4
6	172.00	73.00	172.30	73.00	3
7	172.30	73.00	175.30	73.00	2
8	175.30	73.00	200.00	65.10	2
9	200.00	65.10	380.10	63.50	2
10	380.10	63.50	1044.00	228.00	1
11	1044.00	228.00	1200.00	226.00	1
12	380.10	63.50	825.00	59.60	2
13	825.00	59.60	1012.00	117.60	2
14	1012.00	117.60	1016.00	117.60	2
15	1016.00	117.60	1200.00	69.10	2
16	172.30	73.00	200.00	64.10	3
17	200.00	64.10	380.10	62.50	3
18	380.10	62.50	825.00	58.60	3
19	825.00	58.60	1012.00	116.60	3
20	1012.00	116.60	1016.00	116.60	3
21	1016.00	116.60	1200.00	68.10	3
22	172.00	73.00	200.00	64.00	4
23	200.00	64.00	380.10	62.40	4
24	380.10	62.40	825.00	58.50	4
25	825.00	58.50	1012.00	116.50	4

26	1012.00	116.50	1016.00	116.50	4
27	1016.00	116.50	1200.00	68.00	4
28	166.00	73.00	200.00	62.00	5
29	200.00	62.00	380.10	60.40	5
30	380.10	60.40	825.00	56.50	5
31	825.00	56.50	1012.00	114.50	5
32	1012.00	114.50	1016.00	114.50	5
33	1016.00	114.50	1200.00	66.00	5

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	20.0	0.00	0.0	0
2	130.0	130.0	0.0	35.0	0.00	0.0	0
3	58.0	58.0	271.0	12.4	0.00	0.0	0
4	121.7	121.7	0.0	28.0	0.00	0.0	0
5	121.7	121.7	0.0	28.0	0.00	0.0	0

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

***** Trial Surfaces Have Been Generated.

3 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 15.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	375.00	62.50	381.10	62.45	0.01
2	390.00	62.38	825.00	58.55	0.01
3	825.01	58.56	1012.00	116.55	0.01

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	376.15	63.54
2	379.36	62.47
3	824.86	58.55
4	1009.67	115.83
5	1017.68	128.51
6	1026.89	140.35
7	1036.86	151.55
8	1044.13	164.68
9	1052.98	176.79
10	1057.24	191.17
11	1067.85	201.78
12	1078.15	212.68
13	1080.63	227.47
14	1080.64	227.53

*** 1.261 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	379.13	63.51
2	380.30	62.46
3	824.91	58.55
4	993.33	110.76
5	997.12	125.28
6	1007.64	135.97
7	1017.53	147.25
8	1027.98	158.00
9	1038.45	168.75
10	1044.99	182.25
11	1055.46	192.99
12	1056.83	207.93
13	1067.41	218.56
14	1069.00	227.68

*** 1.292 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	370.63	63.58
2	380.40	62.45
3	824.84	58.56
4	956.69	99.40
5	967.24	110.07
6	972.29	124.19
7	978.47	137.86
8	989.05	148.49

9	999.59	159.16
10	1009.08	170.78
11	1019.66	181.41
12	1024.10	195.74
13	1031.62	208.71
14	1037.89	222.34
15	1040.71	227.19

*** 1.294 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	377.55	63.52
2	378.64	62.47
3	824.99	58.55
4	997.17	111.95
5	1005.12	124.66
6	1007.21	139.52
7	1017.37	150.55
8	1027.53	161.59
9	1037.67	172.64
10	1048.24	183.28
11	1058.22	194.48
12	1063.45	208.54
13	1070.92	221.55
14	1076.75	227.58

*** 1.297 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	377.74	63.52
2	378.99	62.47
3	824.69	58.55
4	976.53	105.55
5	984.89	118.01
6	993.41	130.35
7	997.38	144.82
8	1001.46	159.25
9	1009.81	171.72
10	1019.55	183.12
11	1026.14	196.60
12	1036.64	207.31
13	1042.85	220.96
14	1044.86	227.99

*** 1.300 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	375.51	63.54
2	377.19	62.49
3	824.69	58.55
4	952.90	98.22
5	962.94	109.36
6	969.87	122.67
7	980.19	133.55
8	989.79	145.08
9	999.95	156.11
10	1003.62	170.65
11	1007.44	185.16
12	1016.59	197.05
13	1026.55	208.26
14	1033.70	221.45
15	1034.90	225.74

*** 1.300 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	374.21	63.55
2	376.60	62.49
3	824.94	58.55
4	990.98	110.03
5	1001.58	120.64
6	1011.95	131.48
7	1020.84	143.56
8	1030.45	155.08
9	1038.81	167.53
10	1042.62	182.04
11	1043.12	197.03
12	1045.99	211.75
13	1048.89	226.47
14	1050.34	227.92

*** 1.300 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	361.93	63.66
2	362.01	63.62

3	376.97	62.49
4	824.69	58.56
5	984.98	108.17
6	994.87	119.45
7	999.31	133.77
8	1009.82	144.48
9	1015.31	158.44
10	1022.97	171.33
11	1029.97	184.60
12	1040.46	195.32
13	1040.89	210.31
14	1046.48	224.23
15	1049.00	227.94

*** 1.305 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	364.49	63.64
2	365.64	62.51
3	380.64	62.46
4	824.77	58.55
5	966.48	102.43
6	976.52	113.58
7	984.99	125.96
8	995.37	136.79
9	1004.82	148.44
10	1007.35	163.22
11	1017.63	174.15
12	1021.04	188.75
13	1026.91	202.56
14	1030.94	217.01
15	1035.87	225.99

*** 1.309 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	379.10	63.51
2	380.22	62.45
3	824.98	58.55
4	994.60	111.16
5	1003.72	123.07
6	1012.43	135.28
7	1017.77	149.30
8	1028.38	159.90
9	1038.98	170.51
10	1038.99	185.51
11	1047.60	197.79

```
     12        1058.06      208.55
     13        1064.90      221.90
     14        1070.64      227.66


         ***      1.309    ***




             Y            A     X     I     S           F     T


             0.00    150.00    300.00    450.00    600.00    750.00
X       0.00 +----*----+---------+---------+---------+---------+
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             -
             -
             -
             -
      150.00 +    *
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             -
A     300.00 +
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X     450.00 +   .
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I     600.00 +   .
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S     750.00 +   .
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      900.00 +    .........
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             -      333.....
             -      2*2336...
             -       *1123336
F    1050.00 +         .1112*
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T    1200.00 +    **           *
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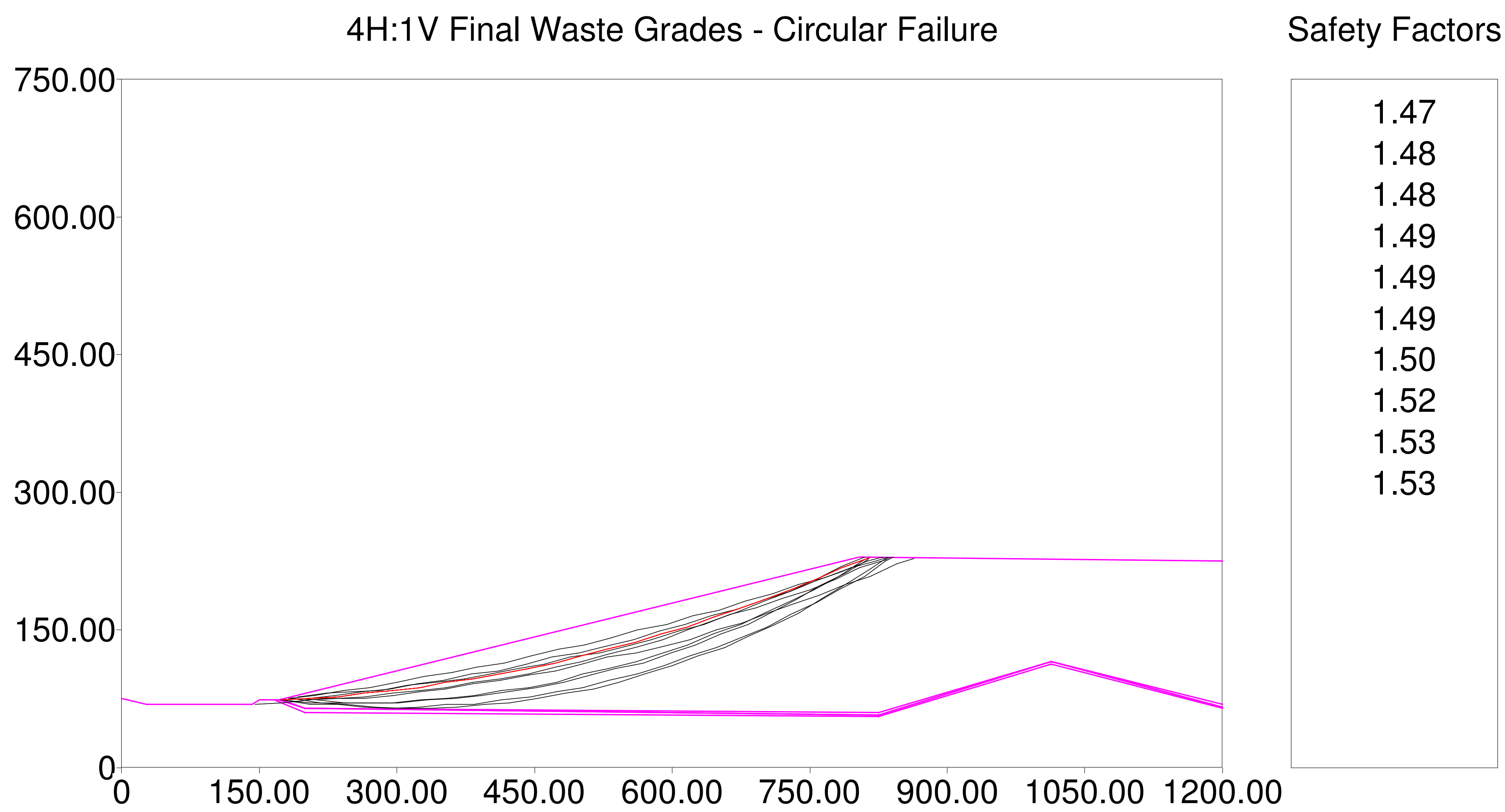
4H:1V Final Waste Grades - Circular Failure
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450.00
300.00
150.00
0
0
150.00
300.00
450.00
600.00
750.00
900.00
1050.00
1200.00
Safety Factors
1.47
1.48
1.48
1.49
1.49
1.49
1.50
1.52
1.53
1.53

** PCSTABL6 **

by
Purdue University

modified by
Peter J. Bosscher
University of Wisconsin-Madison

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

PROBLEM DESCRIPTION 4H:1V Final Waste Grades - Circular Failure

BOUNDARY COORDINATES

7 Top Boundaries
29 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	76.00	29.00	70.00	5
2	29.00	70.00	144.00	70.00	5
3	144.00	70.00	152.00	73.00	5
4	152.00	73.00	166.00	73.00	5
5	166.00	73.00	172.00	73.00	4
6	172.00	73.00	805.00	231.00	1
7	805.00	231.00	1200.00	226.00	1
8	172.00	73.00	172.30	73.00	3
9	172.30	73.00	175.30	73.00	2
10	175.30	73.00	200.00	65.10	2
11	200.00	65.10	825.00	59.60	2
12	825.00	59.60	1012.00	117.60	2
13	1012.00	117.60	1016.00	117.60	2
14	1016.00	117.60	1200.00	69.10	2
15	172.30	73.00	200.00	64.10	3
16	200.00	64.10	825.00	58.60	3
17	825.00	58.60	1012.00	116.60	3
18	1012.00	116.60	1016.00	116.60	3
19	1016.00	116.60	1200.00	68.10	3
20	172.00	73.00	200.00	64.00	4
21	200.00	64.00	825.00	58.50	4
22	825.00	58.50	1012.00	116.50	4
23	1012.00	116.50	1016.00	116.50	4
24	1016.00	116.50	1200.00	68.00	4
25	166.00	73.00	200.00	62.00	5

26	200.00	62.00	825.00	56.50	5
27	825.00	56.50	1012.00	114.50	5
28	1012.00	114.50	1016.00	114.50	5
29	1016.00	114.50	1200.00	66.00	5

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	20.0	0.00	0.0	0
2	130.0	130.0	0.0	35.0	0.00	0.0	0
3	58.0	58.0	0.0	27.5	0.00	0.0	0
4	121.7	121.7	0.0	28.0	0.00	0.0	0
5	121.7	121.7	0.0	28.0	0.00	0.0	0

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of100 Points Equally Spaced
Along The Ground Surface Between X = 0.00 ft.
and X = 200.00 ft.

Each Surface Terminates Between X = 805.00 ft.
and X =1000.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

30.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	175.76	73.94
2	205.70	75.75
3	235.61	78.07
4	265.48	80.90
5	295.29	84.24
6	325.05	88.09
7	354.73	92.44
8	384.33	97.30
9	413.85	102.66
10	443.27	108.52
11	472.59	114.89
12	501.79	121.75
13	530.88	129.11
14	559.83	136.96
15	588.65	145.31
16	617.31	154.15
17	645.83	163.47
18	674.18	173.28
19	702.36	183.56
20	730.36	194.33
21	758.18	205.57
22	785.79	217.29
23	813.21	229.47
24	816.19	230.86

*** 1.473 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	175.76	73.94
2	205.75	74.76
3	235.71	76.20
4	265.64	78.26
5	295.52	80.93
6	325.34	84.21
7	355.09	88.11
8	384.75	92.61
9	414.31	97.73
10	443.76	103.45
11	473.08	109.78
12	502.27	116.71
13	531.31	124.24
14	560.19	132.36
15	588.90	141.08
16	617.42	150.38
17	645.74	160.27
18	673.86	170.74
19	701.75	181.78
20	729.41	193.40
21	756.82	205.58
22	783.98	218.32
23	809.50	230.94

*** 1.475 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	173.74	73.43
2	203.60	76.31
3	233.42	79.57
4	263.20	83.22
5	292.93	87.26
6	322.60	91.68
7	352.21	96.48
8	381.76	101.67
9	411.24	107.24
10	440.64	113.19
11	469.97	119.52
12	499.21	126.23
13	528.36	133.31
14	557.42	140.78
15	586.37	148.62
16	615.23	156.83
17	643.97	165.42
18	672.60	174.38
19	701.11	183.70
20	729.50	193.40
21	757.77	203.47
22	785.89	213.89
23	813.89	224.69
24	828.89	230.70

*** 1.479 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	181.82	75.45
2	211.53	79.62
3	241.20	84.05
4	270.83	88.74
5	300.42	93.69
6	329.96	98.90
7	359.46	104.37
8	388.91	110.09
9	418.31	116.08
10	447.65	122.32
11	476.94	128.82
12	506.17	135.57
13	535.34	142.58
14	564.44	149.84
15	593.49	157.36
16	622.46	165.14
17	651.37	173.17
18	680.20	181.45

19	708.96	189.98
20	737.65	198.76
21	766.26	207.80
22	794.78	217.08
23	823.23	226.62
24	834.83	230.62

*** 1.487 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	175.76	73.94
2	205.72	72.33
3	235.70	71.54
4	265.70	71.58
5	295.69	72.44
6	325.65	74.12
7	355.54	76.62
8	385.36	79.94
9	415.07	84.07
10	444.66	89.02
11	474.10	94.78
12	503.38	101.34
13	532.46	108.70
14	561.33	116.85
15	589.97	125.80
16	618.35	135.52
17	646.45	146.02
18	674.25	157.29
19	701.74	169.31
20	728.88	182.08
21	755.67	195.59
22	782.07	209.83
23	808.08	224.79
24	817.95	230.84

*** 1.492 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	193.94	78.48
2	223.87	80.50
3	253.77	82.98
4	283.62	85.93
5	313.43	89.34
6	343.18	93.22
7	372.86	97.55
8	402.48	102.35
9	432.01	107.61

10	461.46	113.32
11	490.82	119.49
12	520.08	126.11
13	549.24	133.19
14	578.27	140.72
15	607.19	148.70
16	635.99	157.13
17	664.64	166.00
18	693.16	175.32
19	721.53	185.07
20	749.74	195.27
21	777.80	205.91
22	805.68	216.97
23	833.39	228.47
24	838.25	230.58

*** 1.493 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	183.84	75.96
2	213.76	73.75
3	243.73	72.43
4	273.73	72.00
5	303.72	72.45
6	333.69	73.79
7	363.61	76.02
8	393.45	79.13
9	423.18	83.12
10	452.78	87.99
11	482.23	93.74
12	511.49	100.35
13	540.54	107.82
14	569.36	116.16
15	597.92	125.34
16	626.20	135.36
17	654.17	146.21
18	681.80	157.89
19	709.08	170.38
20	735.98	183.67
21	762.47	197.74
22	788.53	212.60
23	814.14	228.22
24	818.15	230.83

*** 1.497 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	175.76	73.94
2	205.59	70.76
3	235.50	68.49
4	265.47	67.12
5	295.47	66.66
6	325.47	67.10
7	355.43	68.45
8	385.35	70.70
9	415.18	73.86
10	444.91	77.92
11	474.50	82.87
12	503.92	88.72
13	533.16	95.45
14	562.17	103.06
15	590.95	111.55
16	619.45	120.90
17	647.66	131.11
18	675.55	142.17
19	703.09	154.06
20	730.26	166.78
21	757.04	180.32
22	783.39	194.66
23	809.29	209.78
24	834.73	225.69
25	841.98	230.53

*** 1.522 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	185.86	76.46
2	215.58	72.41
3	245.43	69.36
4	275.36	67.31
5	305.34	66.27
6	335.34	66.24
7	365.33	67.21
8	395.26	69.19
9	425.11	72.18
10	454.84	76.16
11	484.43	81.14
12	513.83	87.12
13	543.01	94.07
14	571.94	102.01
15	600.59	110.90
16	628.93	120.76
17	656.91	131.56
18	684.52	143.30
19	711.72	155.95
20	738.48	169.52
21	764.77	183.97
22	790.56	199.30
23	815.82	215.48
24	837.73	230.59

*** 1.526 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	145.46	70.55
2	175.44	71.47
3	205.41	72.87
4	235.35	74.74
5	265.26	77.08
6	295.13	79.89
7	324.95	83.18
8	354.71	86.94
9	384.41	91.17
10	414.04	95.86
11	443.59	101.03
12	473.06	106.65
13	502.43	112.75
14	531.71	119.31
15	560.88	126.33
16	589.93	133.81
17	618.86	141.74
18	647.66	150.14
19	676.33	158.98
20	704.85	168.28
21	733.22	178.03
22	761.44	188.23
23	789.49	198.87
24	817.36	209.95
25	845.06	221.47
26	865.24	230.24

*** 1.535 ***

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            Y            A     X     I     S           F     T

            0.00     150.00     300.00     450.00     600.00     750.00

X      0.00 +----*----+---------+---------+---------+---------+
            -   .*
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            -  ...
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     150.00 +....*
            -....*
            -...*1
            .....1.
            .....74
            ....813
A    300.00 ....821
            ....8514
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                    ....9513
                    .....7.3
                    .....8514
X     450.00 .....8513
                    .....95214
                    ......8514
                    ......85214
                    ......9751
                    .......9763
I     600.00 +......8521
                    -.......8514
                    -........8514
                    -........8521
                    - ........8514
                    -  ........851
S     750.00 +  ........9841
                    -   ........9812
                    -    ........94*
                    -   * ........91
                    -      ........6
                    -       .......0
      900.00 +        .......
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T    1200.00 +   **         *
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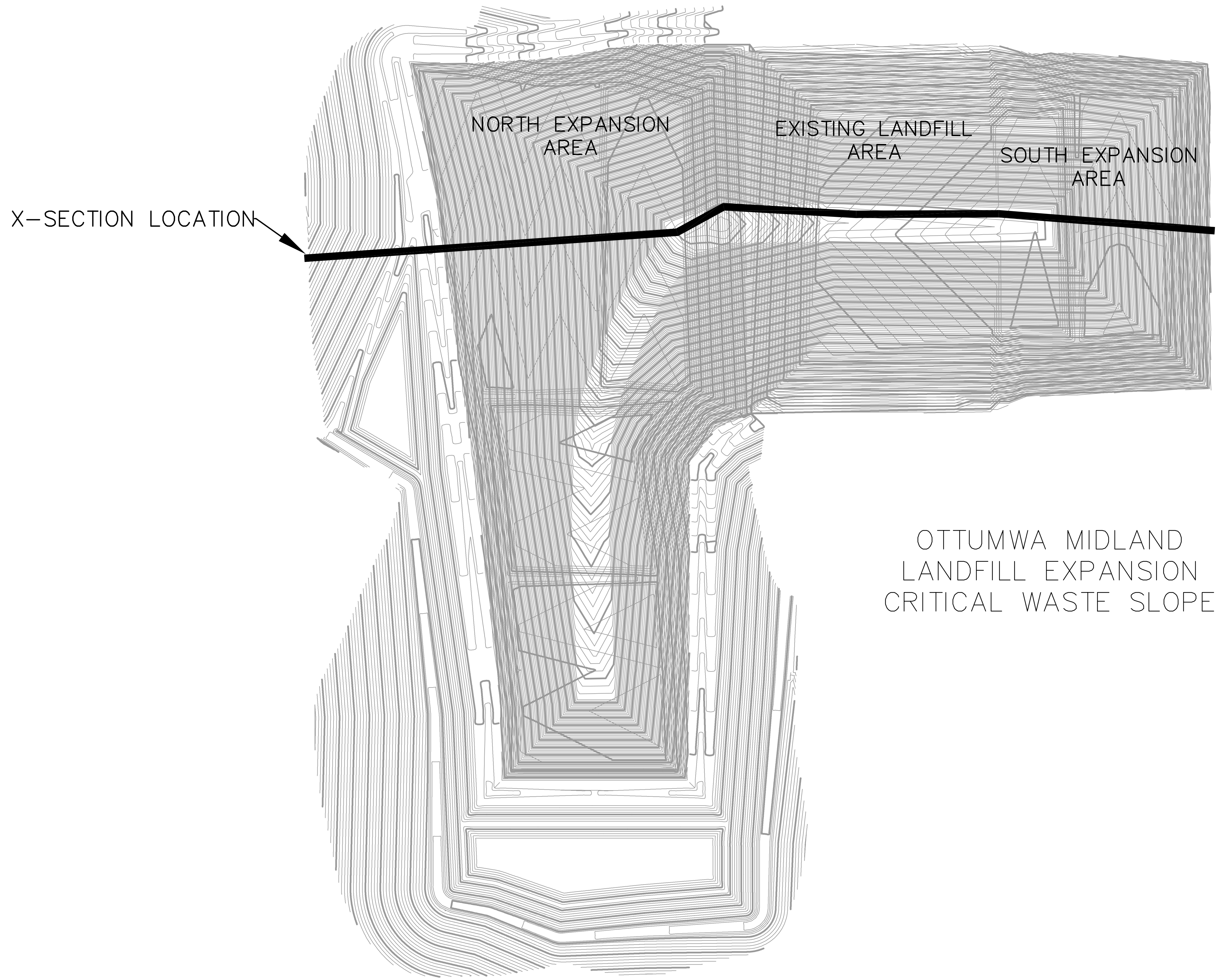


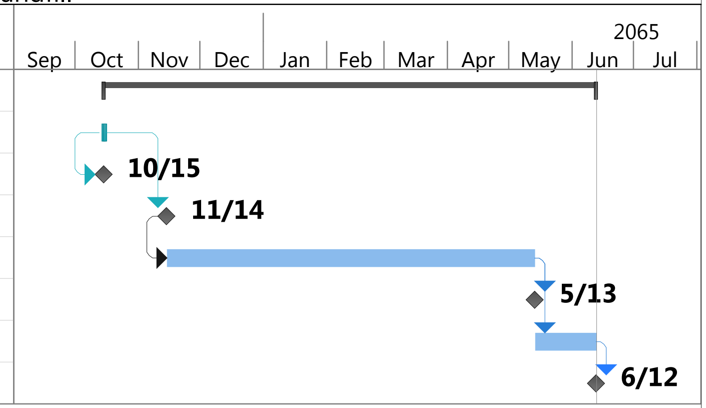
OTTUMWA MIDLAND
LANDFILL EXPANSION
CRITICAL WASTE SLOPE

APPENDIX B

Closure Schedule

Initial Closure Plan Schedule - Ottumwa Midland Landfill

ID	Task Name	Duration	Start	Finish
1	**Phase 1 and Existing Site Closure**	**241 days**	**Wed 10/15/64**	**Fri 6/12/65**
2	Ash Filling Ceases	1 day	Wed 10/15/64	Wed 10/15/64
3	Other Regulatory Permits - None	0 days	Wed 10/15/64	Wed 10/15/64
4	Notification of Intent to Close	0 days	Fri 11/14/64	Fri 11/14/64
5	Construction Activities	180 days	Sat 11/15/64	Wed 5/13/65
6	Notification of Closure Completion	0 days	Wed 5/13/65	Wed 5/13/65
7	Documentation of Closure	30 days	Thu 5/14/65	Fri 6/12/65
8	State Submittal of Documentation Report	0 days	Fri 6/12/65	Fri 6/12/65



Project: Appendix B Schedule_r
Date: Thu 9/8/16

Task		Inactive Summary		External Tasks	
Split		Manual Task		External Milestone	
Milestone		Duration-only		Deadline	
Summary		Manual Summary Rollup		Progress	
Project Summary		Manual Summary		Manual Progress	
Inactive Task		Start-only			
Inactive Milestone		Finish-only			