ATTACHMENT 11

SUMP CONNECTION CONSTRUCTION PLAN

May 2016

0120-685-11-03

SUMP CONNECTION CONSTRUCTION PLAN

ATTACHMENT 11

OTTAWA COUNTY FARMS LANDFILL

CONSTRUCTION PERMIT APPLICATION

COOPERSVILLE, MI

PREPARED BY

Weaver Consultants Group

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ATTACHMENTS

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XSTABL Analyses
Proposed Slide Rail System

11 SUMP CONNECTION CONSTRUCTION PLAN

The purpose of this plan is to support the construction planning sequencing for the lateral expansion application prepared for the Ottawa County Farms (OCF) Landfill. More specifically, this plan addresses the connection of the existing leachate collection sumps located on the east end of Phases 1 & 2 to the expansion area Phase 9. Various elements of construction that require specific consideration in order to execute the sump connection construction include, but are not limited to, the following:

1. Waste excavation and handling;
2. Establishment of temporary leachate containment and removal controls
3. Excavation of soil berm;
4. Liner system construction and connection;
5. Fill sequencing after connection; and
6. Health and safety considerations.

It is anticipated that during the construction bidding process, prospective contractors will be asked to provide an implementation plan for the waste excavation and sump connection construction to obtain additional input on specific tasks or activities expected. The implementation plan should include a detailed construction sequencing or development plan and an evaluation of the proposed slope and methodology presented in this Plan.

This construction plan is intended to be flexible with regard to the means and methods by which the waste relocation, sump connection construction, and ancillary support activities are to be completed. The actual sequence or phasing of construction could be impacted by unforeseen site-specific conditions that may not become apparent until construction of the sump connections and/or Phase 9 commences.

11.1 WASTE EXCAVATION AND HANDLING

Waste excavation is necessary in order to expose and construct the bottom liner and leachate collection system tie-in between the existing Phases 1 & 2 and the adjacent Phase 9. Slope stability calculations were performed using XSTABL two-dimensional limit equilibrium slope stability software (Sharma 2011). Results of this preliminary slope stability evaluation indicate that a waste excavation with 2H:1V slope will provide a factor of safety 1.4 for the circular failure through waste when used in conjunction with a trench box system. Initial discussions to assess the feasibility of trench box (or slide rail system) use were conducted with Pro-Tech Equipment. It was concluded that this project could utilize a slide rail system for the last 20 to 30 feet above the sumps. Engineering calculations and preliminary schematic of the proposed slide rail system are provided with this Plan.

Prior to commencing waste excavation activities for the construction of Phase 9, further evaluation of

the waste excavation slope may be conducted to determine if a steeper angle could be acceptable. Additional evaluation may include the use of 3-dimensional analysis or site specific interface friction testing on samples collected from the existing liner components of Phases 1 and 2 if possible.

Waste materials to be excavated are expected to consist of general municipal solid waste, construction & demolition debris and/or special wastes. Prior to excavation commencing, site records will be reviewed to determine if the area may contain disposed asbestos containing materials (ACM). Waste will be excavated by the contractor and hauled to the active working face for final disposal. The existing site conditions are shown on Figure 11-1.Proposed waste excavation contours around the Phase 1 & 2 sumps are indicated on Figure 11-2.

As waste is removed to excavation grades, a minimum of 12 inches of soil cover will be placed over exposed waste.

11.1.1 Landfill Gas and Odor Management

The waste excavation will impact the existing landfill gas collection and control system (GCCS) due to the presence of extraction wells, laterals and headers within the excavation area. Impacts to the existing GCCS will be mitigated appropriately to maintain compliance with the New Source Performance Standards (NSPS). This may include but is not necessarily limited to installing temporary wells and rerouting laterals and headers. Excavation of waste can introduce oxygen into the system which presents a fire risk. Care will be taken to limit vacuum on the gas extraction system until 12 inches of cover is placed.

Odors will be controlled by implementing a multi-faceted approach which may include continued landfill gas collection, placement of soil cover, masking or neutralization sprays and/or managing construction schedules so as to minimize the potential for odors (i.e. limiting excavation to winter months). An odor management plan will be required of the contractor(s) performing the waste excavation. This plan will include the following:

1) The City of Coopersville and Polkton Township will be notified in writing that a waste relocation project is starting at the Ottawa County Farms Landfill and unusual odors may be noticeable. The Ottawa County Farms Landfill requests that any complaints received by the Township and City be forwarded to landfill management at (616) 837-8195.

2) During the excavation, the contractor will, to the extent practical, keep surrounding gas wells connected to vacuum. No gas wells will be abandoned as a result of this project.

3) The contractor will be required to install either daily cover soil, or a foam cover material similar to RusFoam ADC. If needed, odor control granular additive will be added to the foam, which may be used upon the manufacturer's recommendation for this application.

11.1.2 Fugitive Dust Management

Excavation of waste can have inherent challenges with regard to managing fugitive dust, particularly due to the short term increase in truck traffic and construction equipment. Control measures will be implemented such that the construction activities do not contribute nuisance fugitive dust emissions. Control measures to be employed include, but are not limited to, frequent cleaning of paved haul roads, routine maintenance of gravel roads, optimizing of haul routes, spraying the working area with water, tarping loads, etc. Fugitive dust control will be expected as part of the contractor implementation plan for the work.

11.2 LEACHATE CONTAINMENT AND REMOVAL

Once the waste is removed, the existing leachate removal system within the sump area will be removed. This will include the leachate collection sand on the inside face of the east berm, the pumps and sideslope riser, perimeter force main/sewer, and leachate removal piping as indicated on Figures 11-3 and 11-5.

The leachate removal pipes that enter the Phase 1 and 2 sumps will eventually be extended into a dedicated sump within Phase 9. The two northernmost cleanouts in Phase 1 will be extended to the north to provide for long term access. All other leachate collection pipes and their cleanouts will be inspected and/or jetted then fitted with an end cap. Inspection of these pipes will not be possible once they are covered by waste placement.

During construction the exposed sumps will be the collection point for leachate within their respective phases and also surface water that runs off the waste excavation slopes. It is important that temporary containment and leachate removal be installed in order to prevent the uncontrolled discharge to the environment. Temporary sand bags and a geomembrane rain flap (or similar containment) along the slope and floor of the sump connection excavation will provide containment of waste and liquid generated from the waste mass or existing leachate collection system. Detail 2 on Figure 11-6 provides a schematic of the temporary liquid containment berm.

Temporary leachate removal pumps and hoses will be utilized within the excavated sump and containment berm area during construction of liner components connecting Phases 1 & 2 with Phase 9. Continuous pumping and removal of leachate will take place throughout the sump connection construction to convey the liquids from the excavated sump area to the existing leachate forcemain by way of a new lift station to be installed near the northwest corner of the lateral expansion area. If necessary, temporary storage containers such as frac tanks may be used.

11.3 SOIL BERM EXCAVATION

Two sections of the existing liner components and soil berm located between Phases 1 & 2 and lateral expansion Phase 9 will need to be removed. This is necessary in order to connect the bottom liner and leachate collection systems. The soil berm will be excavated to the slopes and grades indicated on Figure 11-3 and extend to the top of the existing sump elevation in Phases 1 & 2. Excavated soil from the berm may be used on site for daily cover needs, compacted soil liner (if suitable), or stockpiled with other excavated soil from the project area.

11.4 LINER SYSTEM CONSTRUCTION AND CONNECTION

After removing the soil berm, the bottom liner system of Phase 9 will be extended to the slopes and bottom of the berm cut slopes. The geosynthetic components will be overlapped and seamed between Phase 9 and Phases 1 and 2 in accordance with the CQA Plan.

The completed leachate collection system shown on Figure 11-4 will not be connected until the Phase 9 construction report is approved and allowed to begin receiving waste. At that time, the temporary rain flaps and sand bag containment berms will be removed and the leachate collection pipes will be connected as shown by Detail 3 on Figure 11-7. The former sump areas will be backfilled with a sand/bentonite mixture.

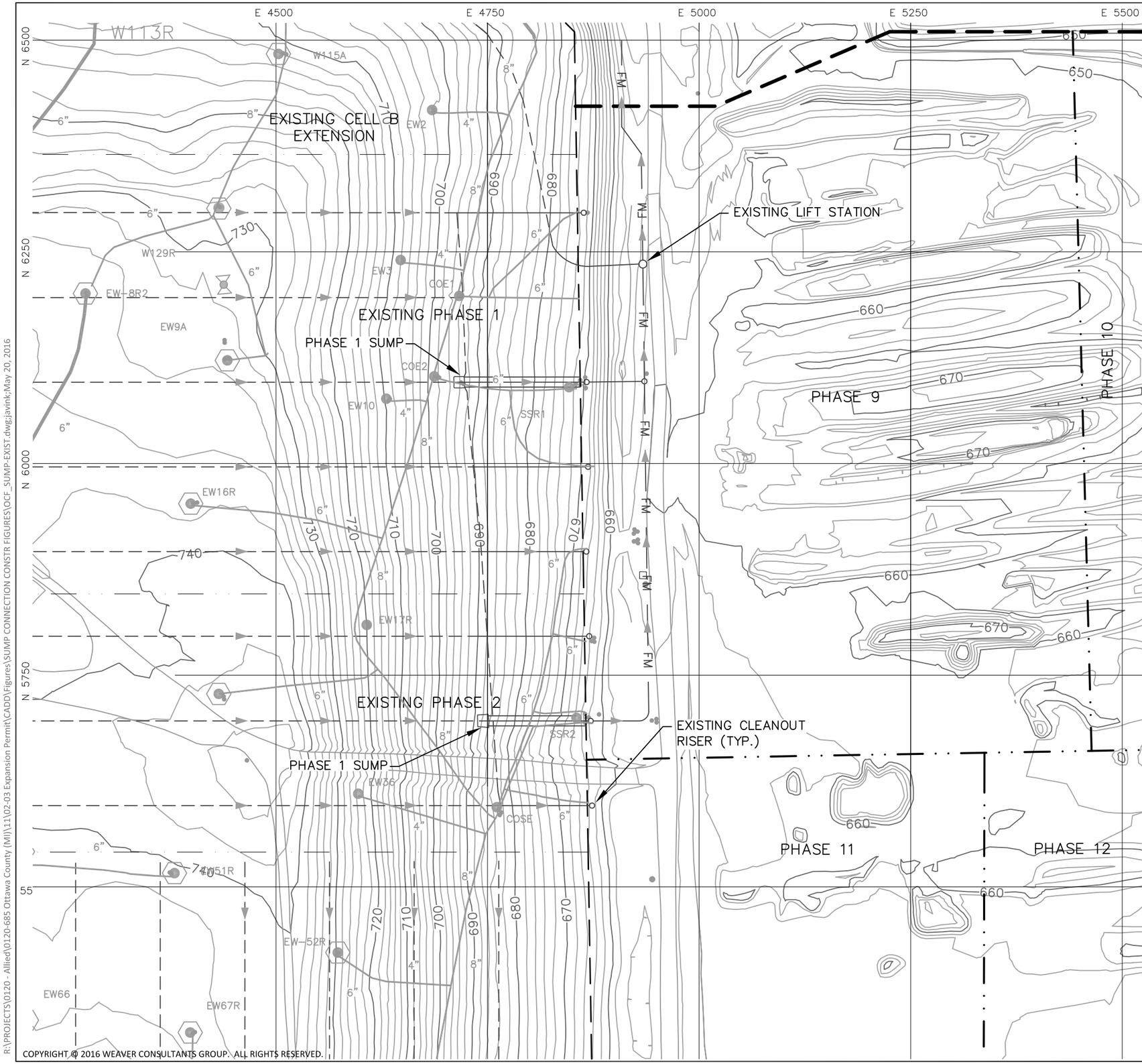
11.5 POST-CONSTRUCTION SEQUENCING

After the final pipe connections are made, the landfill operations will begin filling the sump connection area with incoming waste. Filling of the sump connection area may be performed concurrently or after a layer of select waste is placed across the entire floor of Phase 9, depending on incoming waste receipts and operational considerations.

11.6 HEALTH & SAFETY CONSIDERATIONS

The selected construction contractor will be required to prepare and execute a project specific Health & Safety Plan (HASP). Key elements of the HASP will address regular, ambient air monitoring/screening for explosive gases, hydrogen sulfide and volatile organic compounds, waste material handling, heavy equipment traffic, fugitive dust, and recognition of slope instability. Further, if ACM is previously determined to have been disposed within the area of waste excavation, specific measures for handling exposed or excavated ACM will also be incorporated into the implementation plan as well as the HASP.

FIGURES



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N

SCALE: 1" = 120'

0 60' 120' 240'

LEGEND

- PERMITTED SOLID WASTE BOUNDARY
- EXPANSION SOLID WASTE BOUNDARY
- PHASE BOUNDARY– EXISTING UNIT
- PHASE BOUNDARY– EXPANSION AREA
- 670 — EXISTING CONTOUR (10 FT. INTERVAL)
- EXISTING CONTOUR (2 FT. INTERVAL)
- EXISTING LEACHATE COLLECTION PIPE
- FM — EXISTING FORCEMAIN
- EXISTING GAS HEADER/LATERAL

NOTE:

1. EXISTING TOPOGRAPHICAL INFORMATION FROM AERIAL SURVEY PERFORMED BY COOPER AERIAL SURVEYS, CO., MARCH 30, 2016.

PREPARED FOR:
OTTAWA COUNTY
LANDFILL, INC.
15550 68TH AVE.
COOPERSVILLE, MI

SUMP CONNECTION CONSTRUCTION PLAN
EXISTING CONDITIONS
OTTAWA COUNTY FARMS LANDFILL
OTTAWA COUNTY, MICHIGAN

No.	DATE	REVISION DESCRIPTION

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CAD:OCF_SUMP-EXIST.DWG

FIGURE 11-1

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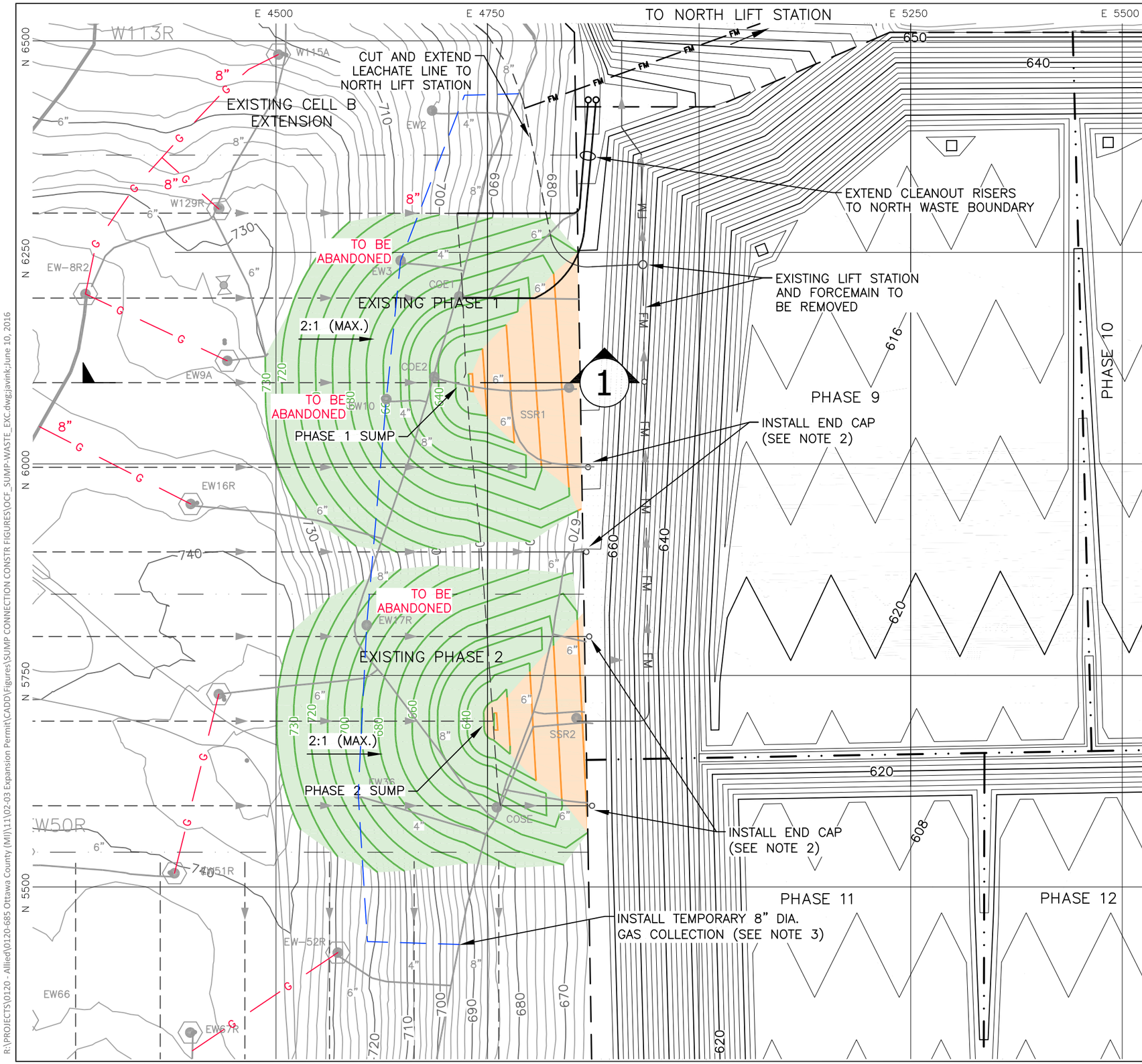

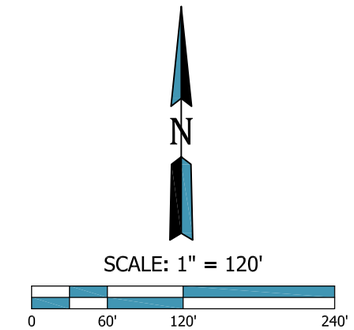

LEGEND

- PROPERTY LINE
- PERMITTED SOLID WASTE BOUNDARY
- EXPANSION SOLID WASTE BOUNDARY
- PHASE BOUNDARY– EXISTING UNIT
- PHASE BOUNDARY– EXPANSION AREA
- 670 — EXISTING CONTOUR (10 FT. INTERVAL)
- EXISTING CONTOUR (2 FT. INTERVAL)
- 670 — EXPANSION TOP OF LINER CONTOUR
- 670 — WASTE EXCAVATION CONTOUR
- 630 — EXPOSED LINER CONTOUR
- FM — EXISTING FORCEMAIN
- EXISTING LEACHATE COLLECTION PIPE
- G — PROPOSED TEMPORARY GAS COLLECTION LATERAL
- PROPOSED HORIZONTAL GAS TRENCH

NOTE:

1. EXISTING TOPOGRAPHICAL INFORMATION FROM AERIAL SURVEY PERFORMED BY COOPER AERIAL SURVEYS, CO., MARCH 30, 2016.
2. LEACHATE COLLECTION CLEANOUTS THAT ARE NOT EXTENDED NORTH OR THROUGH TO PHASE 9 ARE TO BE INSPECTED AND/OR JETTED, THEN CAPPED.
3. INSTALL GAS COLLECTION LATERALS AS NEEDED TO GAS WELLS LOCATED WITHIN WASTE EXCAVATION.

PREPARED FOR:
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15550 68TH AVE.
COOPERSVILLE, MI

SUMP CONNECTION CONSTRUCTION PLAN
WASTE EXCAVATION PLAN
OTTAWA COUNTY FARMS LANDFILL
OTTAWA COUNTY, MICHIGAN

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FIGURE 11-2

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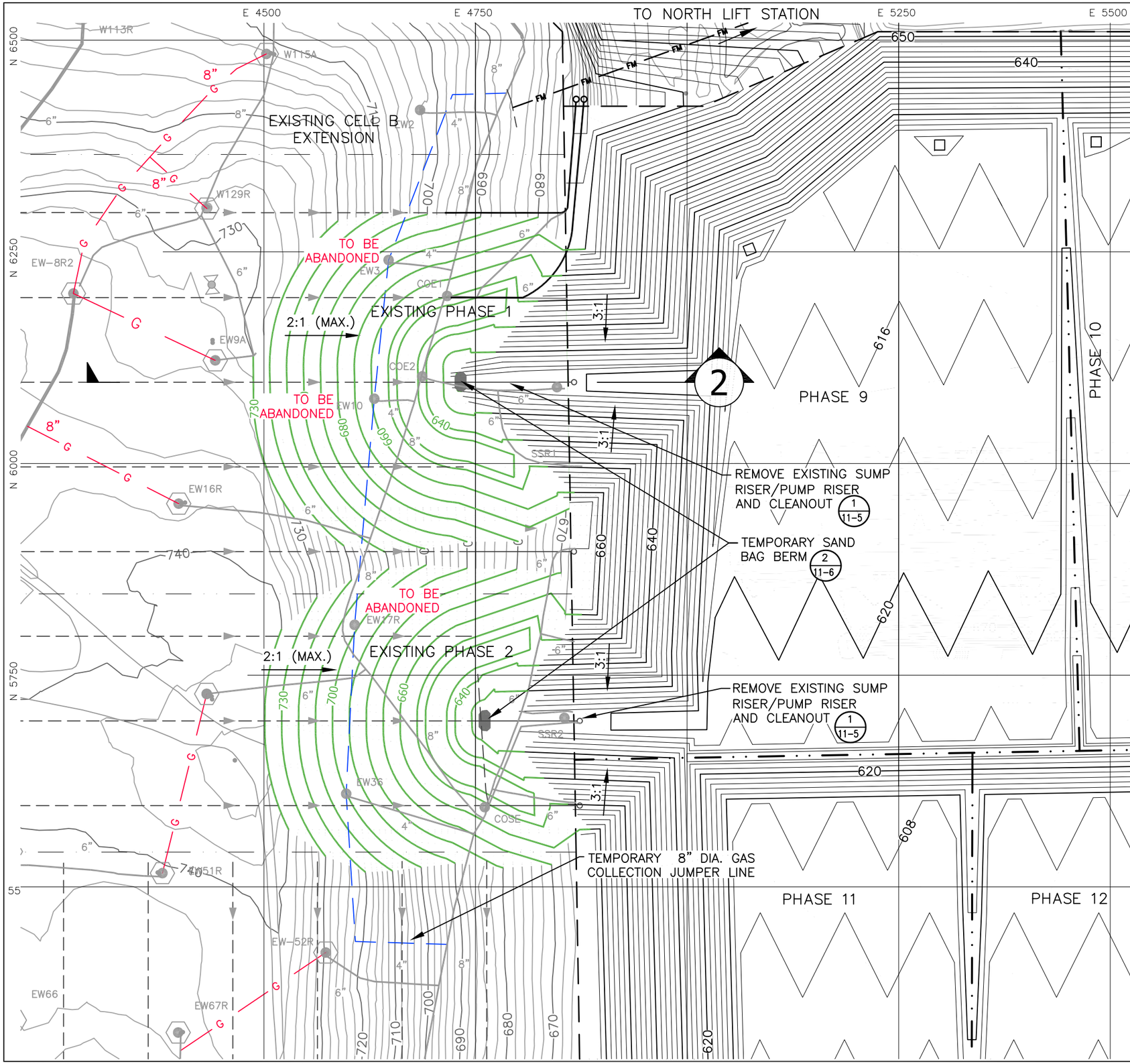

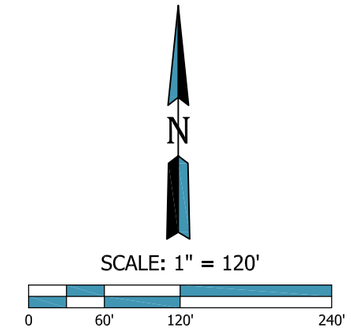

LEGEND

- PERMITTED SOLID WASTE BOUNDARY
- EXPANSION SOLID WASTE BOUNDARY
- PHASE BOUNDARY– EXISTING UNIT
- PHASE BOUNDARY– EXPANSION AREA
- 670 — EXISTING CONTOUR (10 FT. INTERVAL)
- EXISTING CONTOUR (2 FT. INTERVAL)
- 670 — EXPANSION TOP OF LINER CONTOUR
- 670 — WASTE EXCAVATION CONTOUR
- EXISTING LEACHATE COLLECTION PIPE
- G — PROPOSED TEMPORARY GAS COLLECTION LATERAL
- PROPOSED HORIZONTAL GAS TRENCH

NOTE:

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3. INSTALL GAS COLLECTION LATERALS AS NEEDED TO GAS WELLS LOCATED WITHIN WASTE EXCAVATION.

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SUMP CONNECTION CONSTRUCTION PLAN
SIDESLOPE EXCAVATION PLAN
OTTAWA COUNTY FARMS LANDFILL
OTTAWA COUNTY, MICHIGAN

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FIGURE 11-3

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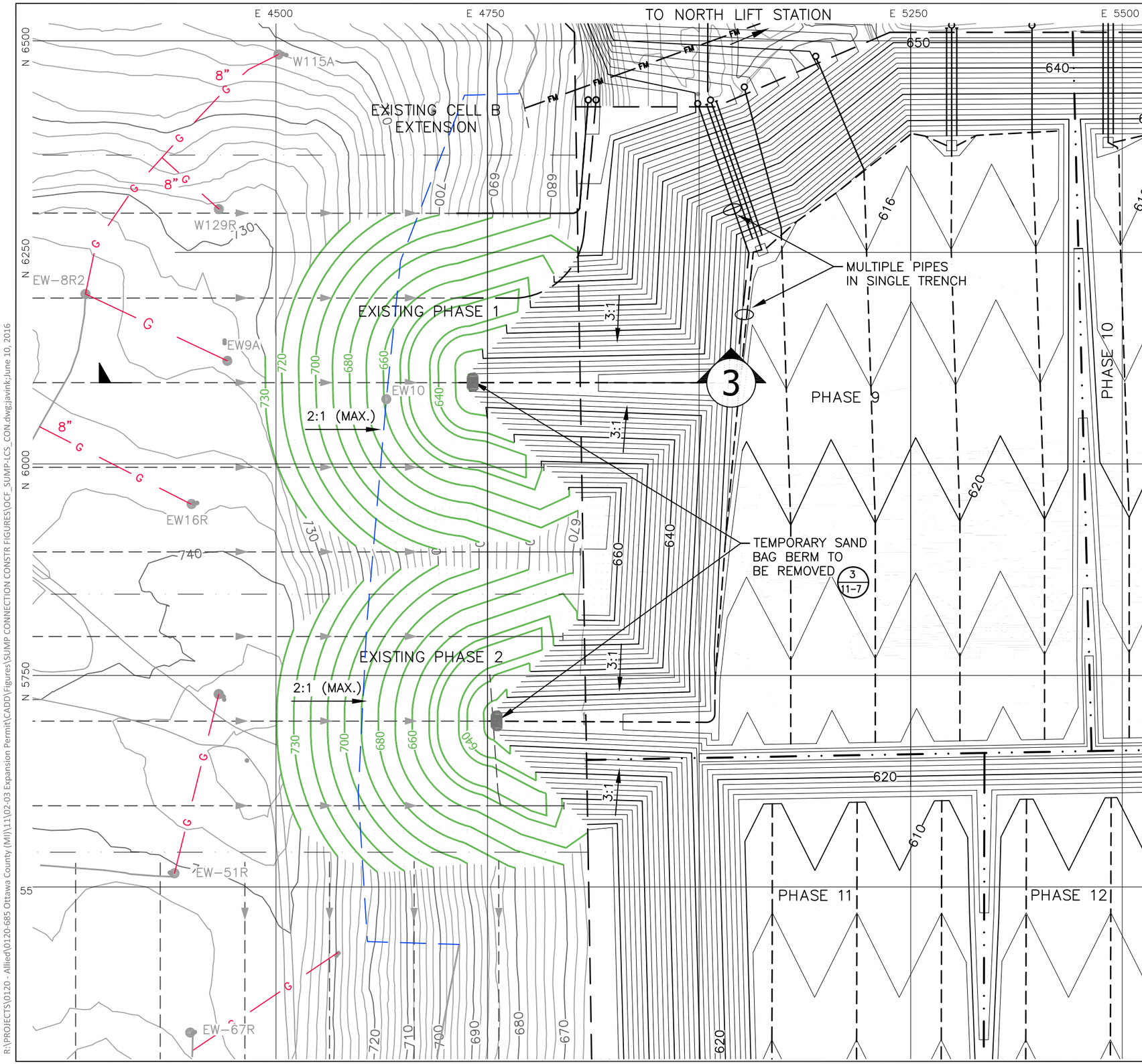

SCALE: 1" = 120'

0 60 120' 240'

LEGEND

- PERMITTED SOLID WASTE BOUNDARY
- EXPANSION SOLID WASTE BOUNDARY
- PHASE BOUNDARY– EXISTING UNIT
- PHASE BOUNDARY– EXPANSION AREA
- 670 — EXISTING CONTOUR (10 FT. INTERVAL)
- EXISTING CONTOUR (2 FT. INTERVAL)
- 670 — EXPANSION TOP OF LCS CONTOUR
- 670 — WASTE EXCAVATION CONTOUR
- LCS PIPE CLEANOUT RISER
- EXISTING LEACHATE COLLECTION PIPE
- EXPANSION LEACHATE COLLECTION PIPE
- G — PROPOSED TEMPORARY GAS COLLECTION LATERAL
- PROPOSED HORIZONTAL GAS TRENCH

NOTE:

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3. INSTALL GAS COLLECTION LATERALS AS NEEDED TO GAS WELLS LOCATED WITIN WASTE EXCAVATION.

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SUMP CONNECTION CONSTRUCTION PLAN
LEACHATE COLLECTION SYSTEM CONNECTION
OTTAWA COUNTY FARMS LANDFILL
OTTAWA COUNTY, MICHIGAN

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FIGURE 11-4

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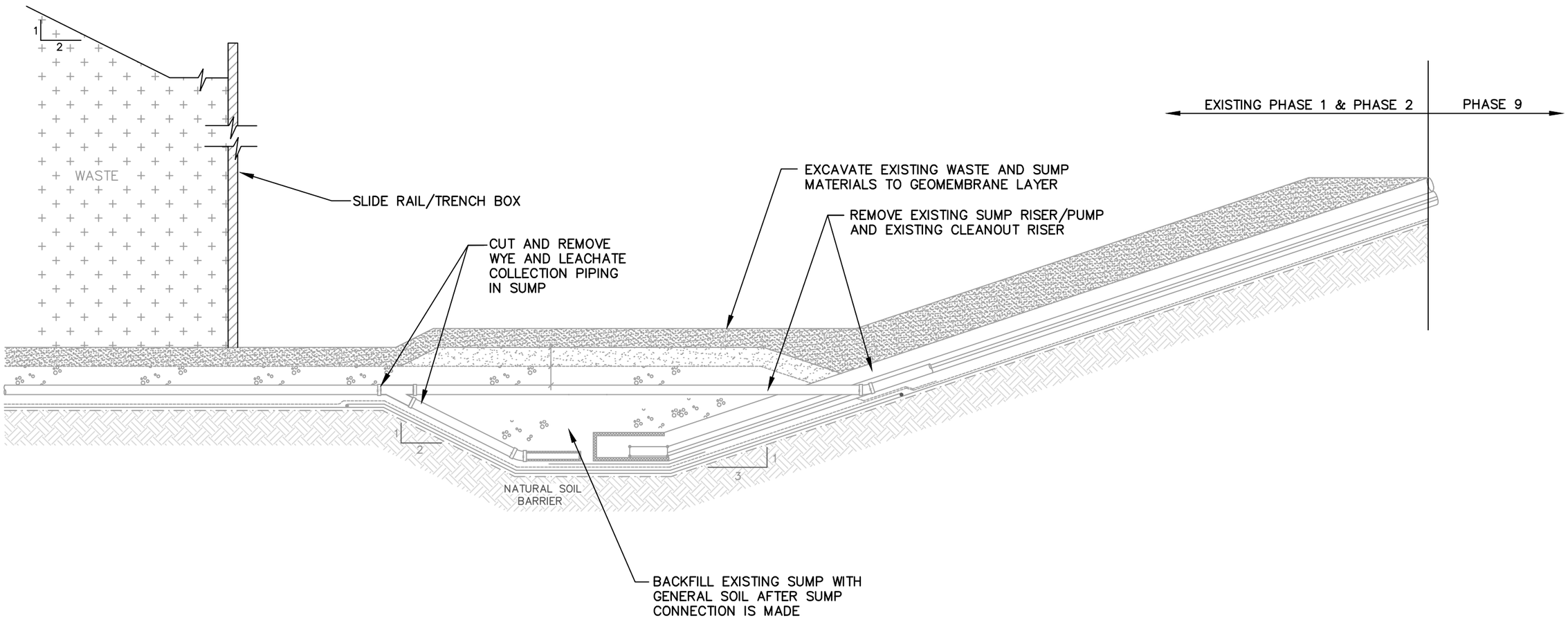

1 / 11-5 X-SECTION AT SUMP AFTER WASTE EXCAVATION

NO SCALE

NOTES:

1. AT PHASE 1 AND PHASE 2 SUMP LOCATIONS, EXCAVATE EXISTING WASTE AT 2:1 SLOPES AND ABANDON EXISTING SUMP RISERS AND PUMP. TIE–IN TO PHASE 9 LEACHATE COLLECTION SYSTEM.

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SUMP CONNECTION CONSTRUCTION PLAN
DETAILS - SHEET 1
OTTAWA COUNTY FARMS LANDFILL
OTTAWA COUNTY, MICHIGAN

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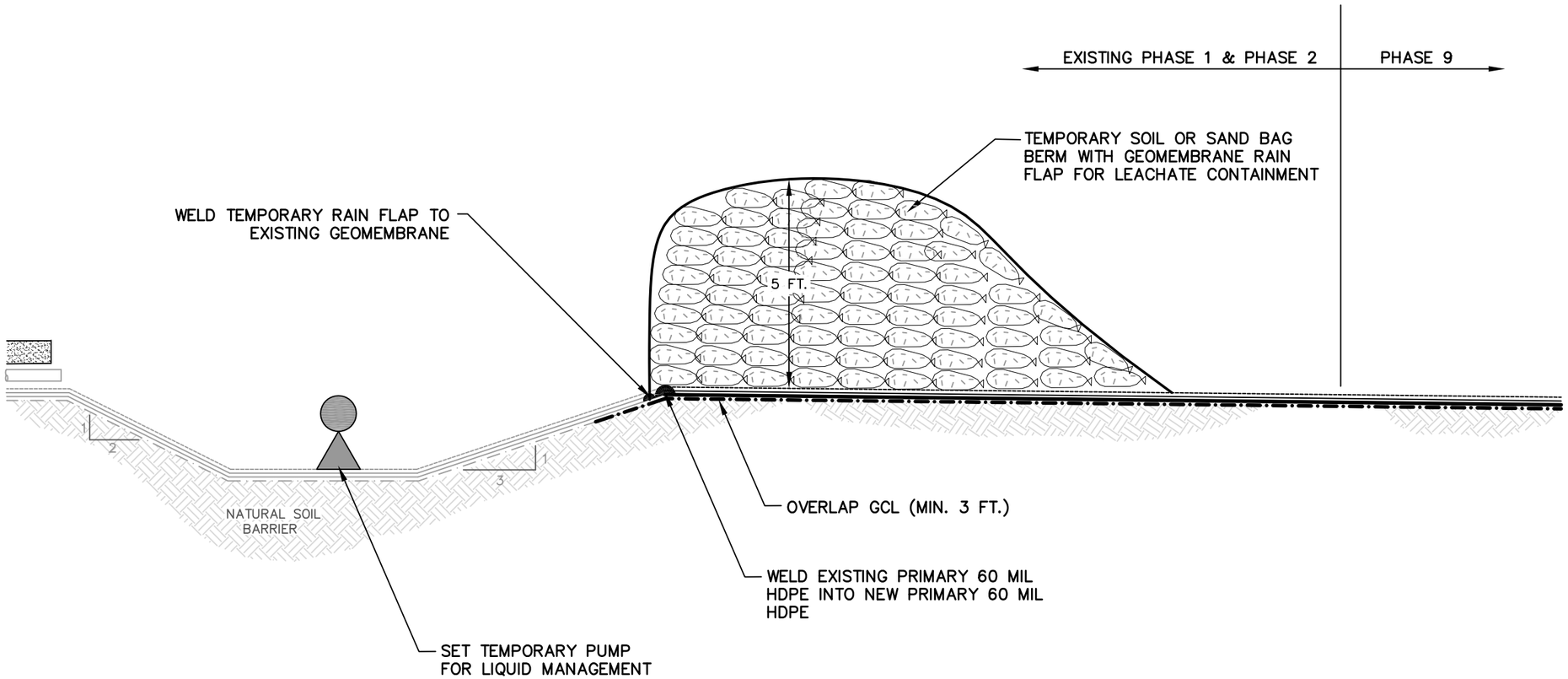
FIGURE 11-5



2
11-6

X-SECTION AT SUMP AFTER LINER INSTALLATION

NO SCALE

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SUMP CONNECTION CONSTRUCTION PLAN
DETAILS - SHEET 2
OTTAWA COUNTY FARMS LANDFILL
OTTAWA COUNTY, MICHIGAN

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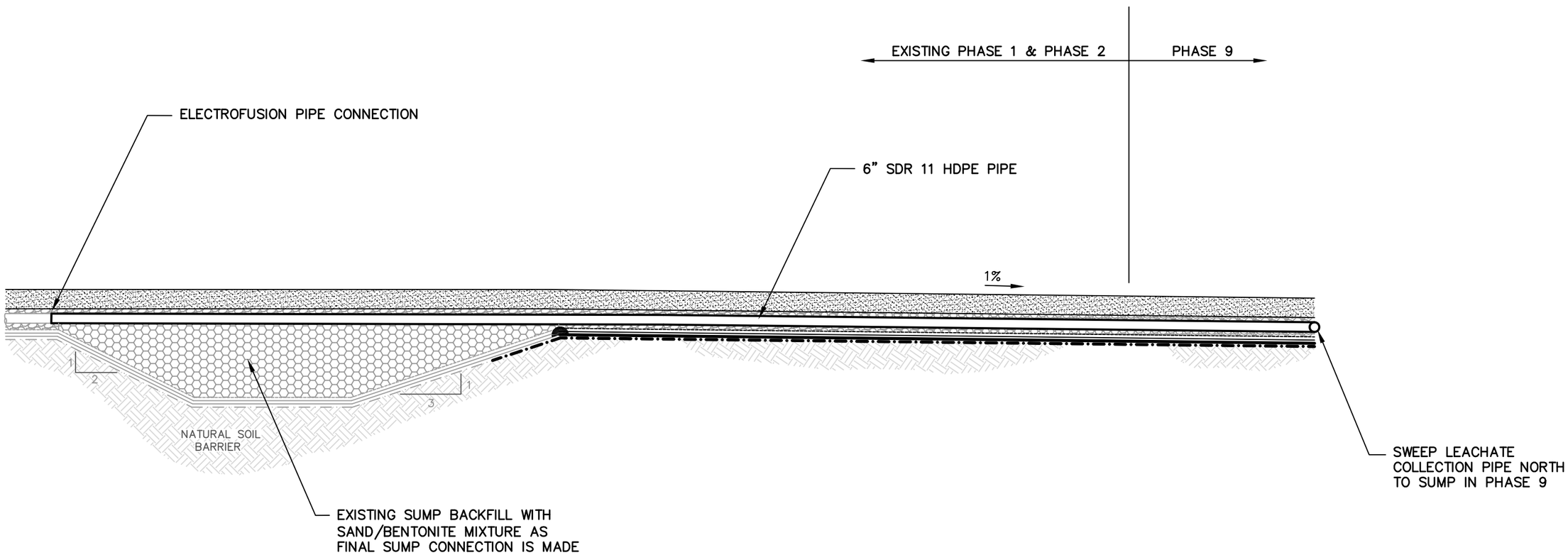
FIGURE 11-6



3
11-7

X-SECTION AT SUMP AFTER LEACHATE COLLECTION CONNECTION

NO SCALE

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SUMP CONNECTION CONSTRUCTION PLAN
DETAILS - SHEET 3
OTTAWA COUNTY FARMS LANDFILL
OTTAWA COUNTY, MICHIGAN

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FIGURE 11-7

CALCULATIONS

Weaver Consultants Group	Project	Ottawa County Farms Expansion CPA			Project Number: 0120-685-11-03
	Subject	Sump Access Stability			Scale: NA
	Designed By: PEB	Date 6/10/16	Checked by:	Date	Sheet No: 1 of 5

Objective

1. Determine the Factor of Safety against slope failure in a 2:1 excavation in waste. Waste will be removed to the point where a slide rail structure can be installed to support further excavation in the waste and expose the leachate collection sump and tie-in areas.
2. Determine the reactive force that must be generated by the slide rail structure in order to maintain a FOS of 1.4.

2:1 Waste Excavation Stability

The stability program XSTABL was used to determine the Factor of Safety (FOS) against slope failure for the stage of construction where waste is excavated at a 2:1 slope to approximately 26 feet above the base of liner grades (cut to elevation 650)

Two cases were analyzed:

1. Circular failure through waste above excavation
2. Block failure along liner system

The parameters utilized for waste and liner strength are the same as utilized for stability analyses included in 7-III of the Construction Permit Application.

XSTABL runs are attached with the following results:

1. Circular failure through waste above excavation = 1.4
2. Block failure along liner system = 1.2

The circular failure is considered long term since this case will exist until waste is placed within notch after cell completion. The block failure is short-term until the slide rail system is in place, and therefore ok.

The XSTABL runs and supporting figures are attached.

Forces against Slide Rail Structure

XSTABL was utilized to determine the resultant force along an open cut that would be needed to maintain a FOS of 1.4.

XSTABL indicates that a total force of 172 kips/foot will be required to support the excavation and provide a FOS of 1.4. The XSTABL analyses are attached.

This total force will be a combination of the lateral support provided by the sliding rail support structure and the shear resistance on the sides of the failure wedge. This is illustrated schematically on Sheet 2.

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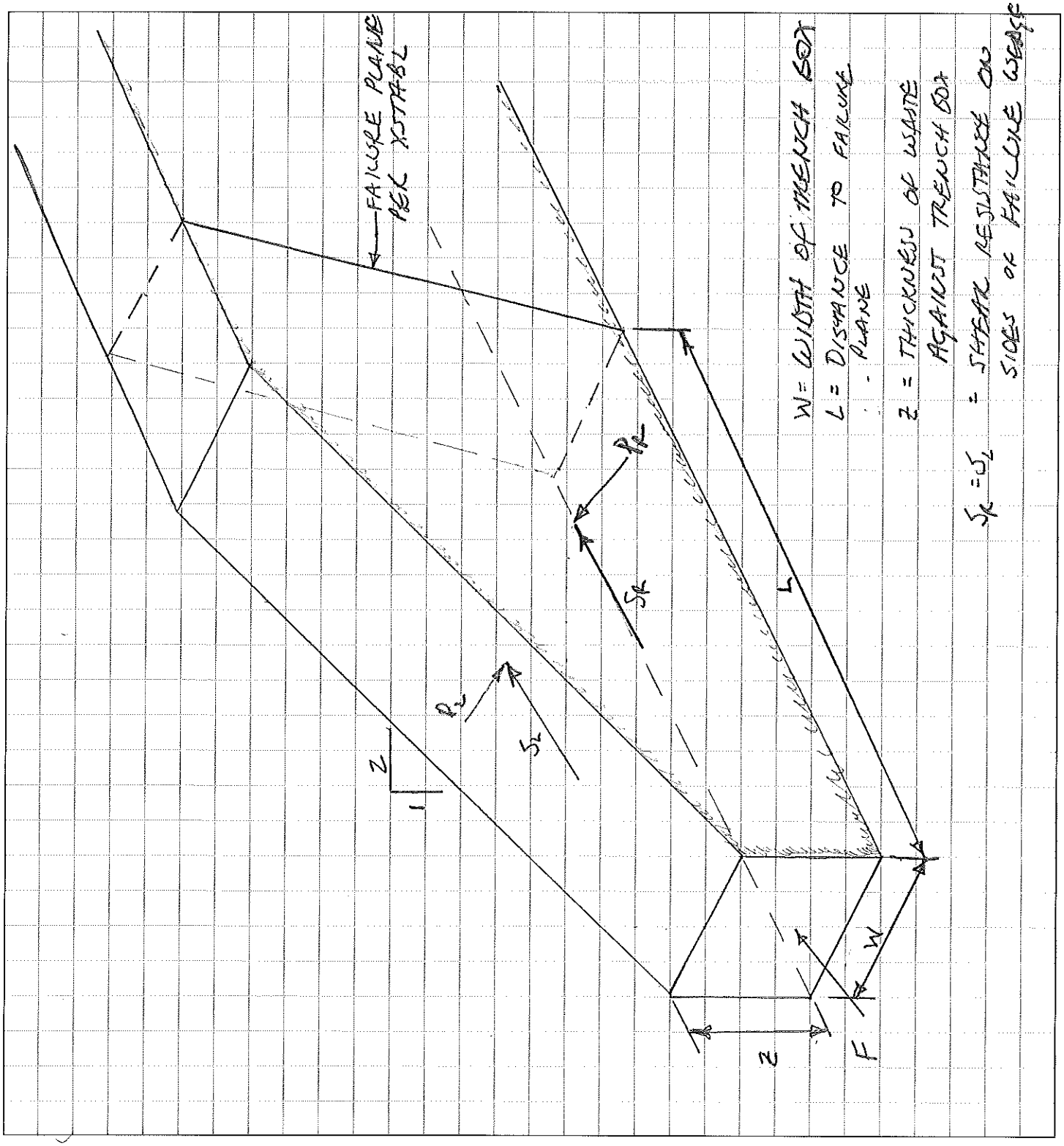
By PEB Date 6/10/16 Subject OTTAWA CO. FARMS Sheet 2 of 5

Ckd By _____ Date _____ SUMP ACCESS STABILITY File No. _____



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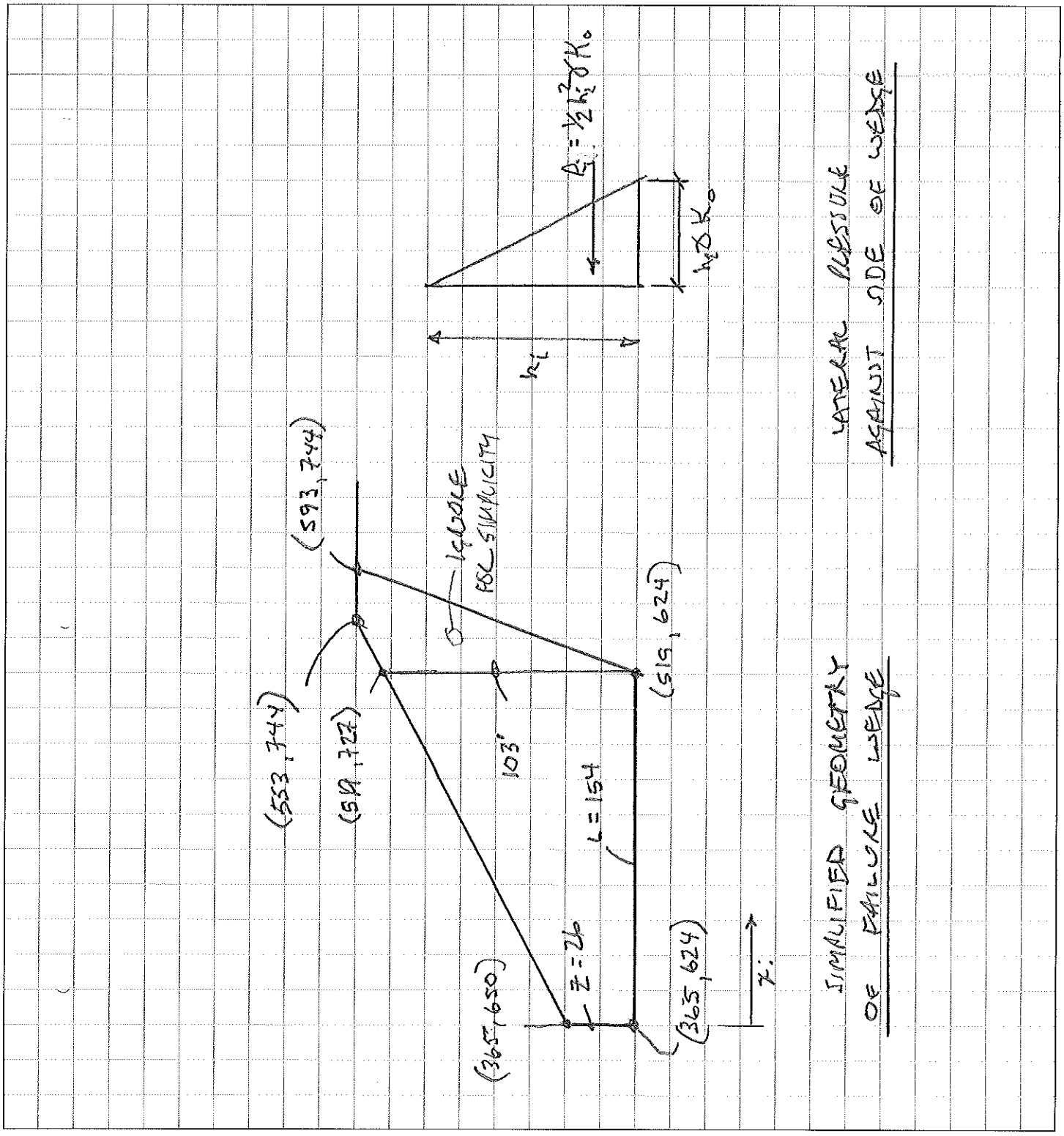
By PEB Date 6/10/16 Subject Ottawa County Farms Sheet 4 of 5

Ckd By _____ Date _____ Slope Access Stability File No. _____



Weaver Consultants Group	Project	Ottawa County Farms Expansion CPA			Project Number: 0120-685-11-03
	Subject	Sump Access Stability			Scale: NA
	Designed By: PEB	Date 6/10/16	Checked by:	Date	Sheet No: 3 of 5

From the previous sheet, the following terms are used:

W = width of failure wedge = 24.25 feet

L = distance from structure to failure plane (feet)

Z = depth of waste against side of slide rail system = 26 feet

F = total force against side of slide rail system

$P_R = P_L$ = lateral pressure against side of failure wedge due to waste density

Sheet 4 shows a simplified, conservative geometry of the side face of the failure wedge and lateral pressure against the side face.

At any point x_i along the side face:

$$P_i = \frac{1}{2} * h_i^2 * \gamma_{WASTE} * K_O$$

$$K_O = 1 - \sin \phi_{WASTE}$$

Utilizing the relationship that $h_i = 26 + x_i/2$

$$P_i = \frac{1}{2} * (26 + x_i/2)^2 * \gamma_{WASTE} * K_O$$

In order to calculate P_R and P_L, integrate the previous equation from $x_i = 0$ to $x_i = 154$.

Then:

$$S_R = S_L = P * \tan \phi_{WASTE}$$

Sheet 5 shows the integration and solution to the analysis.

In summary, the calculated shear resistance on the side of the failure wedge is greater than the force needed to support the wedge and provide a FOS > 1.4.

The analysis is for theoretical material without consideration of shear-induced strain. In reality, the "intact" waste that we are relying on for shearing resistance must undergo strain in order to mobilize the entire shearing resistance. This mobilization of strain may induce some loading on the slide rail structure. However, this loading will be relatively minor

Weaver Consultants Group

By [illegible] Date 6/10/16 Subject Ottawa County Farm Sheet 5 of 5

Ckd By _____ Date _____ File No. _____

$h_i = 26 + \frac{x_i}{2}$

$\therefore P_i = \frac{1}{2}\left(26 + \frac{x_i}{2}\right)^2 \gamma K_o$

$S_i = P_i \tan \phi_{WASTE}$

$K_o = 1 - \sin \phi_{WASTE} = 1 - \sin(25°) = 0.577$

$\gamma_{WASTE} = 50$ pcf

$$S_A = S_i = \int_{x=0}^{x=154} \frac{1}{2}\left(26 + \frac{x}{2}\right)^2 \gamma K_o \tan 25°$$

$$= \int 10.75\left(26 + \frac{x}{2}\right)^2$$

$$= \int_0^{154} 10.75\left(676 + 26x + \frac{x^2}{4}\right)$$

$$= \left[676x + 13x^2 + \frac{1}{12}x^3\right] \times 10.75$$

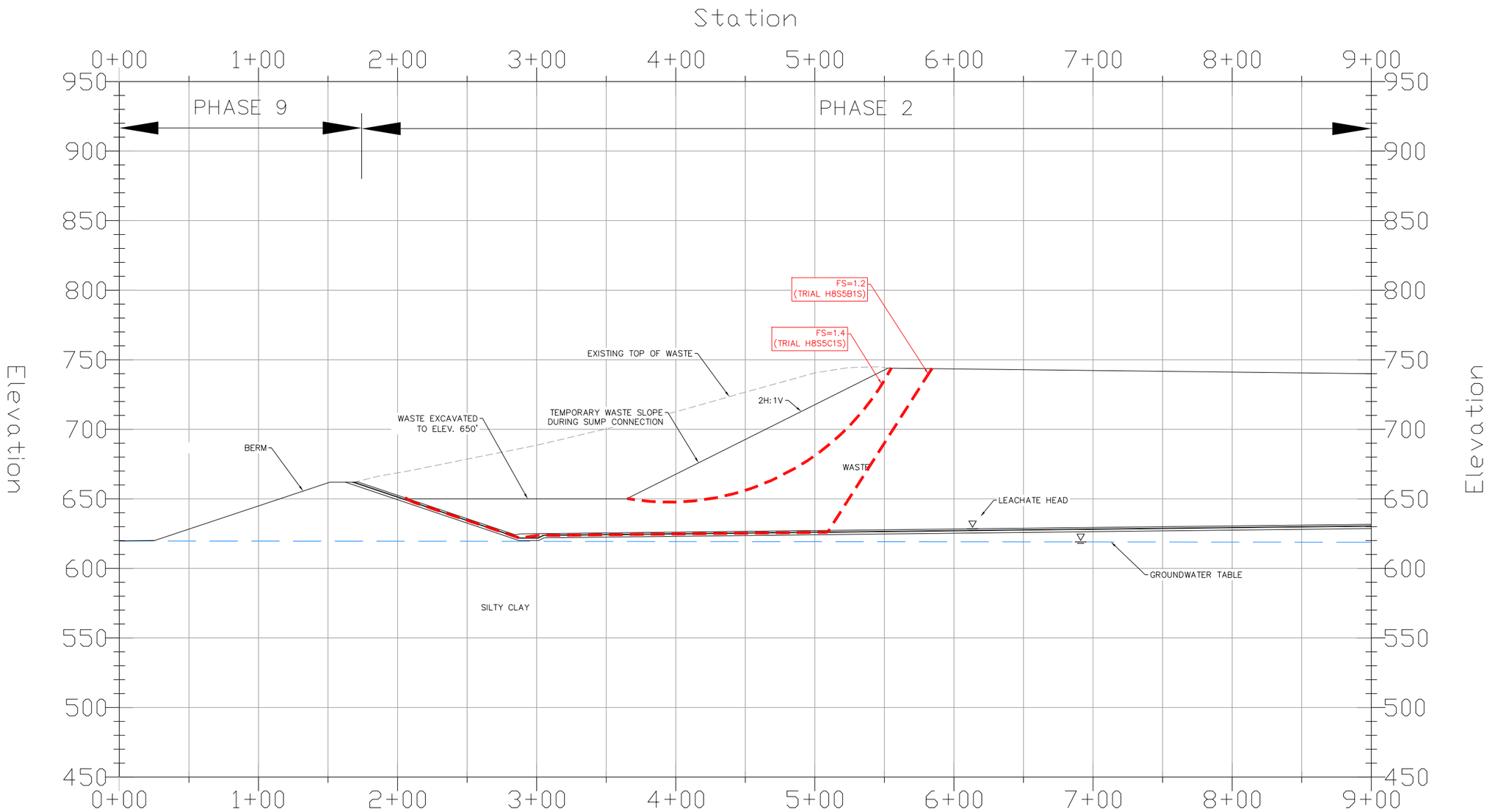
@ $x = 154 = 7{,}705{,}249$ #

$F = 172000 \times 24.25' - 2(7705249) = -11{,}239{,}500$ #

$\therefore$ THEREFORE SHEAR RESISTANCE PROVIDED FOS > 1.4

XSTABL ANALYSES

Alignment - HH' PROFILE



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PREPARED FOR:
REPUBLIC SERVICES
OTTAWA COUNTY LANDFILL, INC.
15550 68TH AVE.
COOPERSVILLE, MI

SECTION HH'
(INTERIMEDIATE CONFIGURATION)
SLOPE STABILITY ANALYSES
OTTAWA COUNTY FARMS LANDFILL
OTTAWA COUNTY, MICHIGAN

No.	DATE	REVISION DESCRIPTION

Weaver Consultants Group

WEAVER CONSULTANTS GROUP
1316 BOND STREET
SUITE 108
NAPERVILLE, ILLINOIS 60563
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www.wcgrp.com

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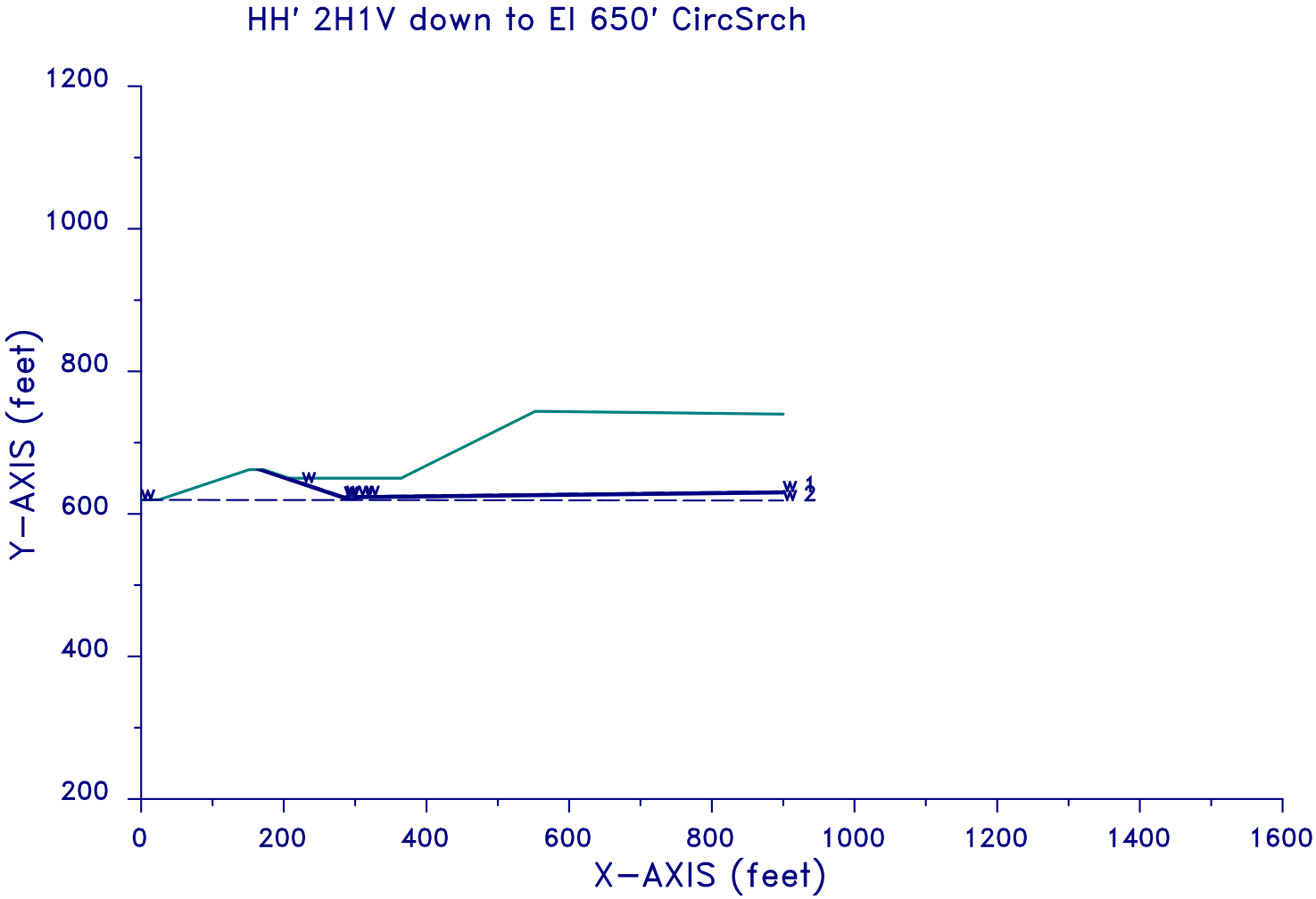
REVIEWED BY: --
DATE: 06/10/2016
FILE: 0120-685-11-03
CAD: OCF00006A.dwg

FIGURE 1

H8S5C1S 6-10-16 13:33



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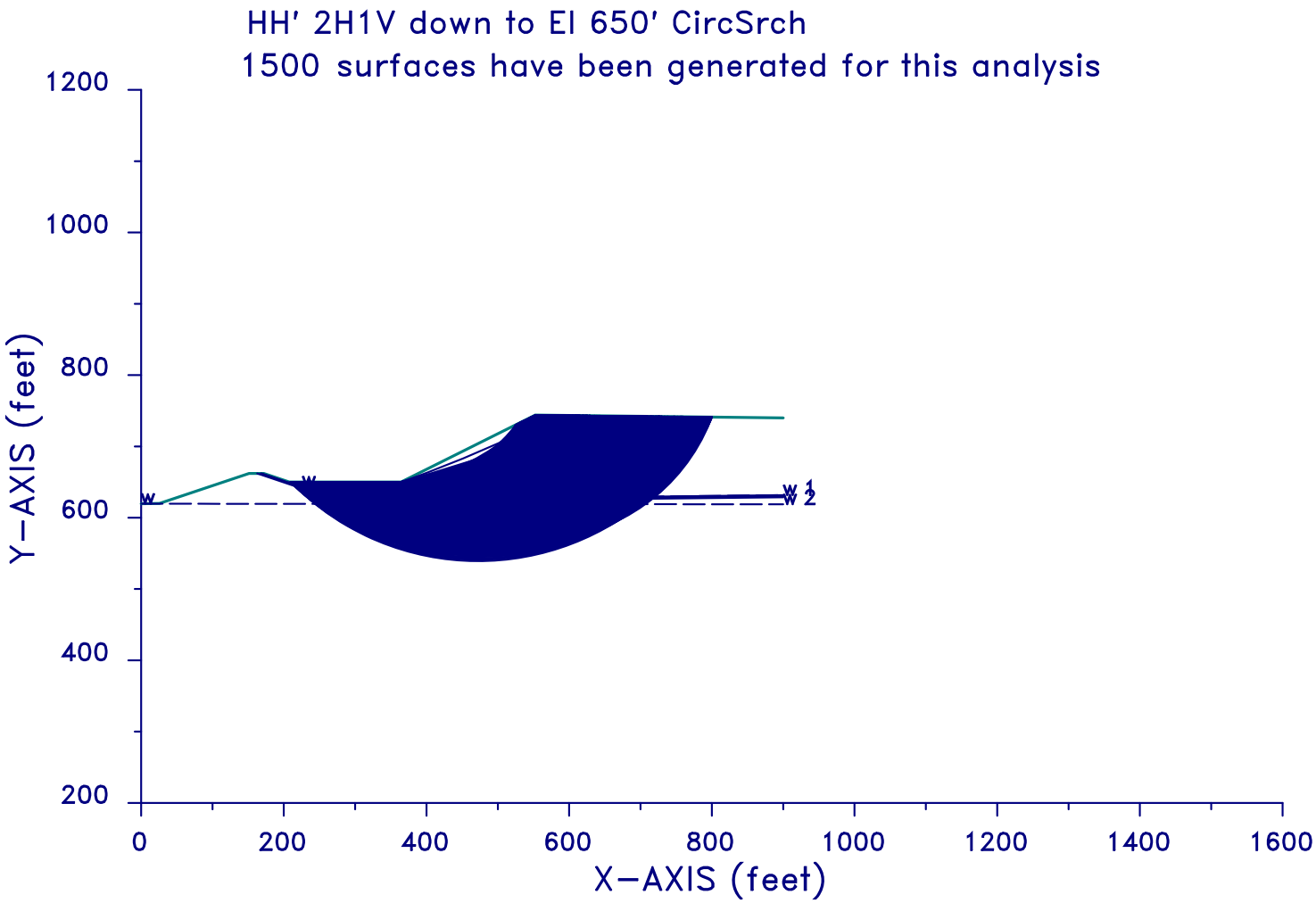

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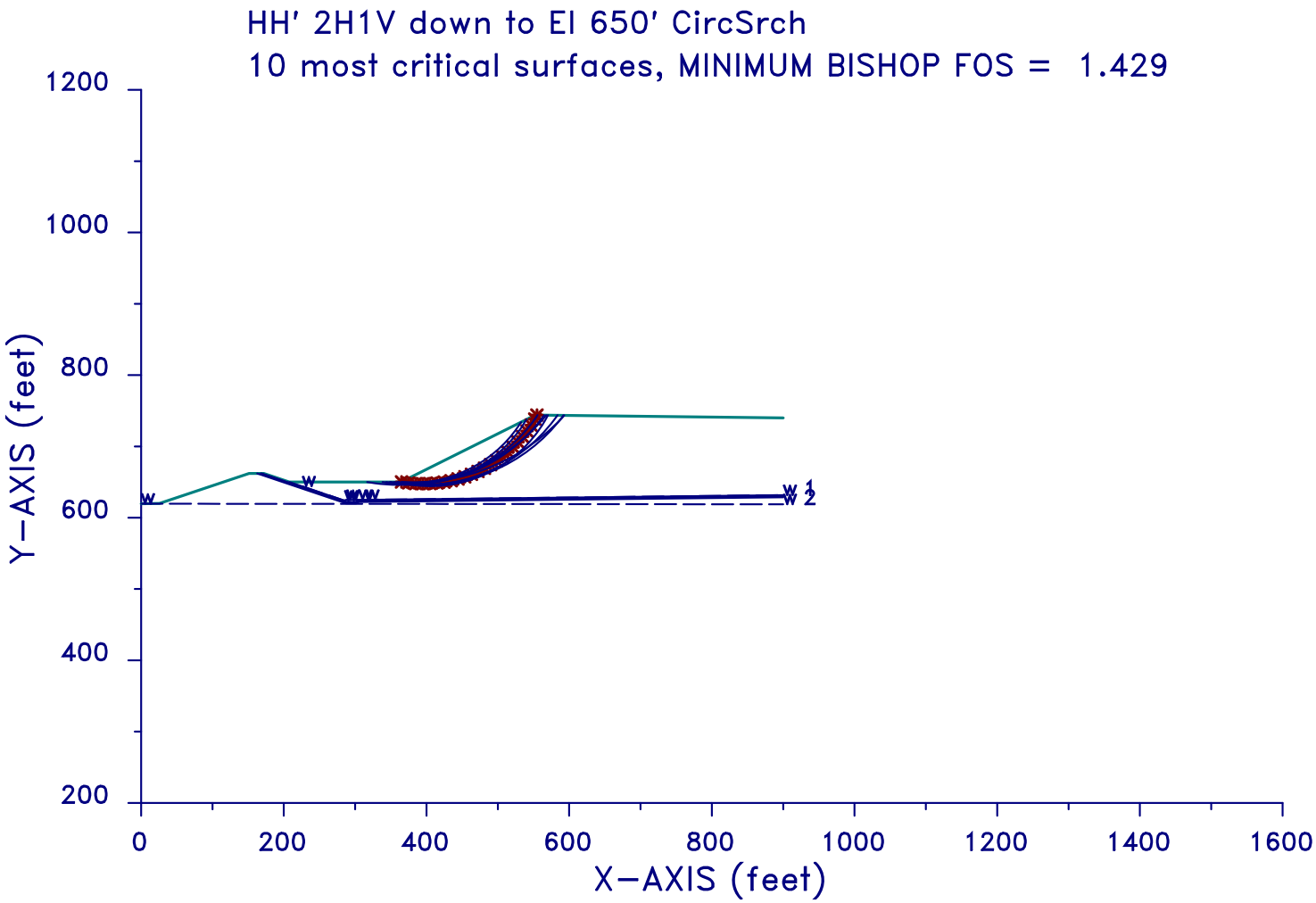

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*****************************************
```

Problem Description : HH' 2H1V down to El 650' CircSrch

SEGMENT BOUNDARY COORDINATES
---

9 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	619.7	25.6	620.1	11
2	25.6	620.1	151.3	662.0	11
3	151.3	662.0	162.6	662.0	10
4	162.6	662.0	168.8	662.0	4
5	168.8	662.0	172.0	662.0	3
6	172.0	662.0	207.7	650.0	3
7	207.7	650.0	364.6	650.0	2
8	364.6	650.0	552.6	744.0	2
9	552.6	744.0	900.0	740.0	2

17 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	207.7	650.0	284.8	624.1	3
2	284.8	624.1	287.7	624.8	3
3	287.7	624.8	304.8	625.0	3
4	304.8	625.0	314.9	625.1	3
5	314.9	625.1	900.0	631.7	3
6	168.8	662.0	287.7	622.0	4
7	287.7	622.0	300.9	622.0	4
8	300.9	622.0	304.9	624.0	4
9	304.9	624.0	900.0	630.7	4
10	167.6	662.0	287.7	621.6	10
11	287.7	621.6	301.0	621.6	10

12	301.0	621.6	305.0	623.6	10
13	305.0	623.6	900.0	630.3	10
14	162.6	662.0	287.4	620.0	11
15	287.4	620.0	301.4	620.0	11
16	301.4	620.0	305.4	622.0	11
17	305.4	622.0	900.0	628.7	11

ISOTROPIC Soil Parameters
---

12 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	128.0	130.0	.0	24.00	.000	.0	1
2	80.0	85.0	210.0	25.00	.000	.0	1
3	125.0	130.0	.0	32.00	.000	.0	1
4	65.0	65.0	.0	11.00	.000	.0	1
5	65.0	65.0	.0	8.00	.000	.0	1
6	65.0	65.0	.0	18.00	.000	.0	1
7	65.0	65.0	.0	8.00	.000	.0	1
8	65.0	65.0	.0	20.00	.000	.0	1
9	65.0	65.0	.0	8.40	.000	.0	1
10	128.0	130.0	180.0	24.00	.000	.0	2
11	128.0	130.0	180.0	24.00	.000	.0	2
12	125.0	130.0	.0	34.00	.000	.0	2

2 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 6 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	225.70	644.00
2	284.80	624.10
3	287.70	624.80
4	304.80	625.00
5	314.90	625.10
6	900.00	631.70

Water Surface No. 2 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	619.70
2	900.00	618.80

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

1500 trial surfaces will be generated and analyzed.

50 Surfaces initiate from each of 30 points equally spaced along the ground surface between x = 210.0 ft
and x = 365.0 ft

Each surface terminates between x = 525.0 ft
and x = 800.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = 460.0 ft

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

10.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 24 coordinate points

Point	x-surf	y-surf

No.	(ft)	(ft)
1	365.00	650.20
2	374.90	648.79
3	384.86	647.92
4	394.86	647.61
5	404.85	647.86
6	414.82	648.66
7	424.73	650.01
8	434.55	651.91
9	444.25	654.36
10	453.79	657.33
11	463.16	660.83
12	472.32	664.85
13	481.24	669.37
14	489.90	674.37
15	498.26	679.85
16	506.31	685.78
17	514.02	692.15
18	521.36	698.94
19	528.32	706.13
20	534.86	713.69
21	540.98	721.60
22	546.65	729.84
23	551.85	738.38
24	554.84	743.97

**** Simplified BISHOP FOS = 1.429 ****

The following is a summary of the TEN most critical surfaces

Problem Description : HH' 2H1V down to El 650' CircSrch

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.429	395.42	827.78	180.16	365.00	554.84	4.117E+07
2.	1.429	375.84	880.32	233.37	338.28	565.11	5.534E+07
3.	1.437	375.72	863.83	216.23	343.62	555.62	4.514E+07
4.	1.442	381.60	935.56	285.84	365.00	593.25	8.200E+07
5.	1.446	394.19	877.63	232.08	348.97	583.63	7.268E+07
6.	1.452	405.47	830.78	186.50	359.66	570.42	5.653E+07
7.	1.463	399.74	885.60	238.98	359.66	591.86	7.894E+07
8.	1.466	381.58	830.99	183.91	348.97	539.97	3.492E+07
9.	1.474	377.09	833.10	184.51	354.31	532.68	3.001E+07
10.	1.474	362.47	910.83	264.78	316.90	567.91	6.341E+07

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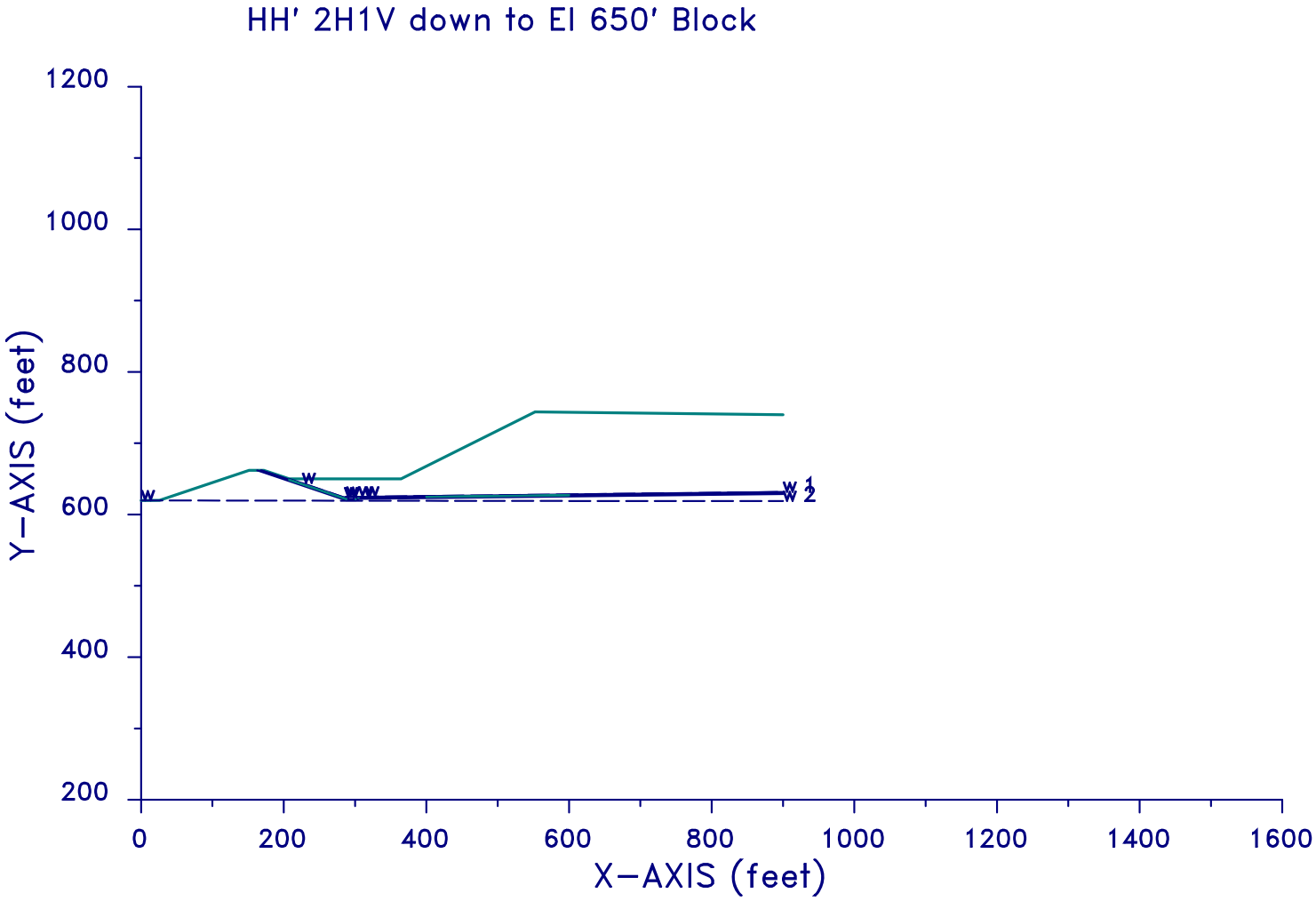

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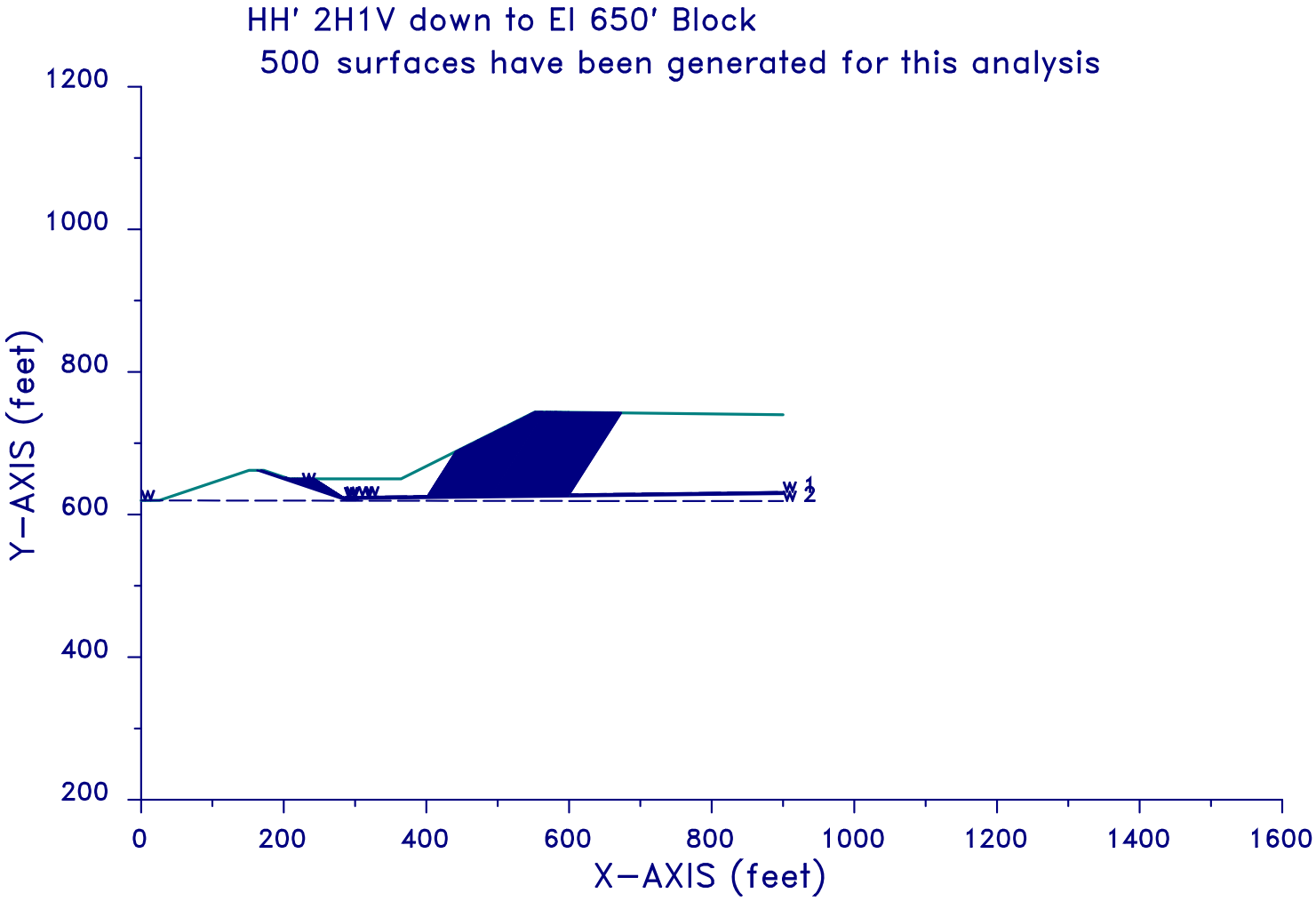

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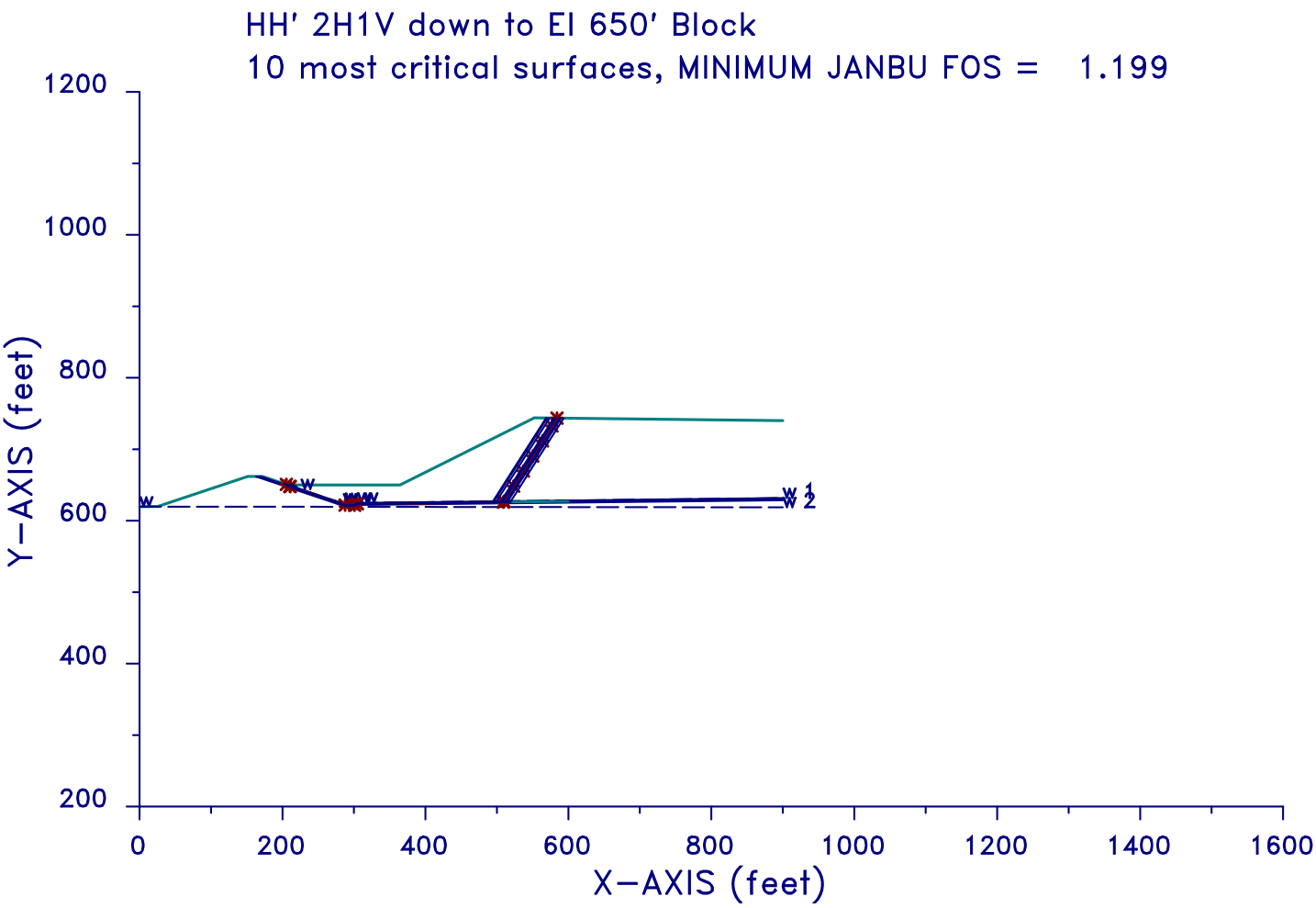

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*  Ver. 5.208                 96 - 2046 *
*****************************************
```

Problem Description : HH' 2H1V down to El 650' Block

SEGMENT BOUNDARY COORDINATES
---

9 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	619.7	25.6	620.1	11
2	25.6	620.1	151.3	662.0	11
3	151.3	662.0	162.6	662.0	10
4	162.6	662.0	168.8	662.0	4
5	168.8	662.0	172.0	662.0	3
6	172.0	662.0	207.7	650.0	3
7	207.7	650.0	364.6	650.0	2
8	364.6	650.0	552.6	744.0	2
9	552.6	744.0	900.0	740.0	2

17 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	207.7	650.0	284.8	624.1	3
2	284.8	624.1	287.7	624.8	3
3	287.7	624.8	304.8	625.0	3
4	304.8	625.0	314.9	625.1	3
5	314.9	625.1	900.0	631.7	3
6	168.8	662.0	287.7	622.0	4
7	287.7	622.0	300.9	622.0	4
8	300.9	622.0	304.9	624.0	4
9	304.9	624.0	900.0	630.7	4

10	167.6	662.0	287.7	621.6	10
11	287.7	621.6	301.0	621.6	10
12	301.0	621.6	305.0	623.6	10
13	305.0	623.6	900.0	630.3	10
14	162.6	662.0	287.4	620.0	11
15	287.4	620.0	301.4	620.0	11
16	301.4	620.0	305.4	622.0	11
17	305.4	622.0	900.0	628.7	11

ISOTROPIC Soil Parameters
---

12 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	128.0	130.0	.0	24.00	.000	.0	1
2	80.0	85.0	210.0	25.00	.000	.0	1
3	125.0	130.0	.0	32.00	.000	.0	1
4	65.0	65.0	.0	11.00	.000	.0	1
5	65.0	65.0	.0	8.00	.000	.0	1
6	65.0	65.0	.0	18.00	.000	.0	1
7	65.0	65.0	.0	8.00	.000	.0	1
8	65.0	65.0	.0	20.00	.000	.0	1
9	65.0	65.0	.0	8.40	.000	.0	1
10	128.0	130.0	180.0	24.00	.000	.0	2
11	128.0	130.0	180.0	24.00	.000	.0	2
12	125.0	130.0	.0	34.00	.000	.0	2

2 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 6 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	225.70	644.00
2	284.80	624.10
3	287.70	624.80
4	304.80	625.00
5	314.90	625.10
6	900.00	631.70

Water Surface No. 2 specified by 2 coordinate points

****

PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	619.70
2	900.00	618.80

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

500 trial surfaces will be generated and analyzed.

5 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 25.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	207.7	648.7	286.6	622.2	.4
2	287.7	621.8	287.7	621.8	.4
3	300.9	621.8	300.9	621.8	.4
4	304.9	623.8	304.9	623.8	.4
5	400.0	624.9	600.0	627.1	.4

****
ERROR # 38
****
The program calculated a point for the PASSIVE wedge that is outside the defined slope geometry. The analysis will continue, but the user should adjust the search box or slope geometry to allow a passive wedge to be formed from all points within first box.
****

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined
are displayed below - the most critical first

Failure surface No. 1 specified by 15 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	205.45	650.76
2	210.44	647.99
3	210.68	647.79
4	287.70	621.88
5	300.90	621.63
6	304.90	623.62
7	509.17	625.98
8	509.44	626.30
9	509.99	627.30
10	523.42	648.39
11	536.86	669.47
12	550.29	690.55
13	563.72	711.64
14	577.15	732.72
15	584.11	743.64

** Corrected JANBU FOS = 1.199 ** (Fo factor = 1.081)

Failure surface No. 2 specified by 15 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	206.66	650.35
2	211.65	647.58
3	211.93	647.36
4	287.70	621.88
5	300.90	621.96
6	304.90	623.66
7	504.93	626.12
8	505.03	626.25
9	505.59	627.25
10	519.02	648.34
11	532.45	669.42
12	545.89	690.51
13	559.32	711.59
14	572.75	732.67
15	579.77	743.69

** Corrected JANBU FOS = 1.200 ** (Fo factor = 1.081)

Failure surface No. 3 specified by 15 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	202.83	651.64
2	207.81	648.87
3	209.10	648.04

4	287.70	621.78
5	300.90	621.79
6	304.90	623.88
7	512.58	626.33
8	512.59	626.34
9	513.15	627.34
10	526.58	648.42
11	540.01	669.51
12	553.44	690.59
13	566.88	711.68
14	580.31	732.76
15	587.21	743.60

** Corrected JANBU FOS = 1.204 ** (Fo factor = 1.080)

Failure surface No. 4 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	208.92	650.00
2	210.29	649.13
3	215.28	646.36
4	215.41	646.26
5	287.70	621.79
6	300.90	621.92
7	304.90	623.64
8	498.94	626.14
9	498.98	626.18
10	499.53	627.18
11	512.96	648.27
12	526.39	669.35
13	539.83	690.44
14	553.26	711.52
15	566.69	732.61
16	573.79	743.76

** Corrected JANBU FOS = 1.208 ** (Fo factor = 1.082)

Failure surface No. 5 specified by 15 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	202.74	651.67
2	207.72	648.91
3	208.15	648.56
4	287.70	621.91
5	300.90	621.69
6	304.90	623.89
7	495.34	625.95
8	495.51	626.15
9	496.06	627.14
10	509.49	648.23
11	522.92	669.31
12	536.36	690.40
13	549.79	711.48
14	563.22	732.57

15	570.38	743.80

** Corrected JANBU FOS = 1.209 ** (Fo factor = 1.082)

Failure surface No. 6 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	208.49	650.00
2	209.37	649.44
3	214.36	646.67
4	214.46	646.59
5	287.70	621.85
6	300.90	621.90
7	304.90	623.79
8	518.76	626.16
9	518.97	626.41
10	519.52	627.41
11	532.95	648.49
12	546.38	669.58
13	559.82	690.66
14	573.25	711.75
15	586.68	732.83
16	593.50	743.53

** Corrected JANBU FOS = 1.209 ** (Fo factor = 1.080)

Failure surface No. 7 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	212.12	650.00
2	217.05	646.86
3	222.06	644.08
4	222.44	643.77
5	287.70	621.97
6	300.90	621.97
7	304.90	623.64
8	513.07	626.08
9	513.29	626.35
10	513.85	627.34
11	527.28	648.43
12	540.71	669.51
13	554.14	690.60
14	567.58	711.68
15	581.01	732.77
16	587.90	743.59

** Corrected JANBU FOS = 1.210 ** (Fo factor = 1.081)

Failure surface No. 8 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)

1	210.35	650.00
2	213.31	648.12
3	218.31	645.34
4	218.76	644.97
5	287.70	621.61
6	300.90	621.82
7	304.90	623.82
8	514.85	626.35
9	514.86	626.36
10	515.41	627.36
11	528.85	648.45
12	542.28	669.53
13	555.71	690.62
14	569.14	711.70
15	582.58	732.79
16	589.45	743.58

** Corrected JANBU FOS = 1.211 ** (Fo factor = 1.081)

Failure surface No. 9 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	208.42	650.00
2	209.22	649.49
3	214.21	646.72
4	214.88	646.17
5	287.70	621.63
6	300.90	621.83
7	304.90	623.70
8	493.90	626.13
9	493.90	626.13
10	494.46	627.13
11	507.89	648.21
12	521.32	669.29
13	534.75	690.38
14	548.19	711.46
15	561.62	732.55
16	568.80	743.81

** Corrected JANBU FOS = 1.214 ** (Fo factor = 1.082)

Failure surface No.10 specified by 16 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	214.49	650.00
2	222.07	645.17
3	227.09	642.39
4	227.54	642.02
5	287.70	621.98
6	300.90	621.81
7	304.90	623.74
8	507.46	625.90
9	507.78	626.28
10	508.33	627.28

11	521.76	648.37
12	535.20	669.45
13	548.63	690.54
14	562.06	711.62
15	575.49	732.71
16	582.47	743.66

** Corrected JANBU FOS = 1.214 ** (Fo factor = 1.082)

The following is a summary of the TEN most critical surfaces

Problem Description : HH' 2H1V down to El 650' Block

	Modified JANBU FOS	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	1.199	1.081	205.45	584.11	3.705E+05
2.	1.200	1.081	206.66	579.77	3.600E+05
3.	1.204	1.080	202.83	587.21	3.781E+05
4.	1.208	1.082	208.92	573.79	3.463E+05
5.	1.209	1.082	202.74	570.38	3.371E+05
6.	1.209	1.080	208.49	593.50	3.934E+05
7.	1.210	1.081	212.12	587.90	3.828E+05
8.	1.211	1.081	210.35	589.45	3.853E+05
9.	1.214	1.082	208.42	568.80	3.336E+05
10.	1.214	1.082	214.49	582.47	3.717E+05

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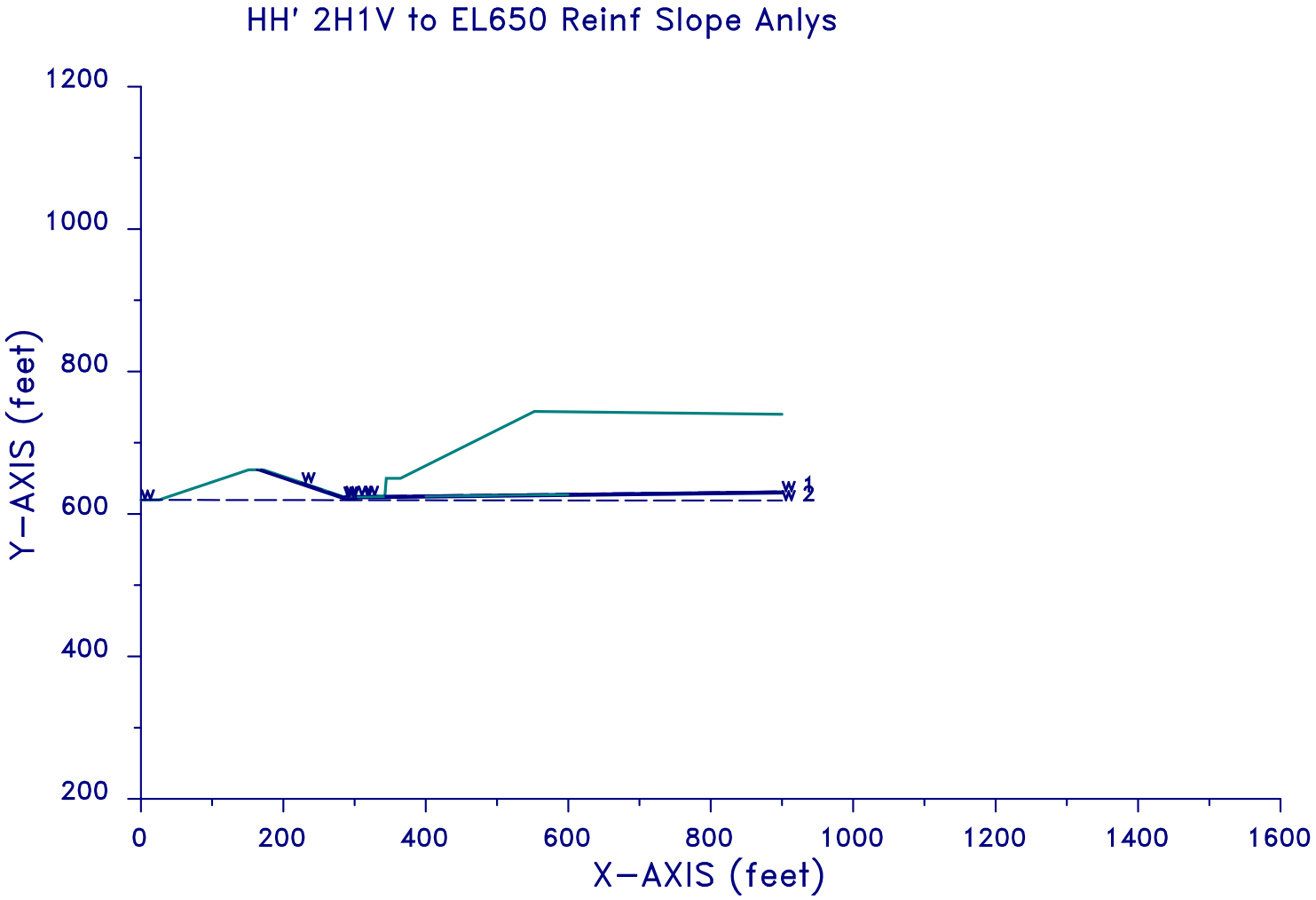

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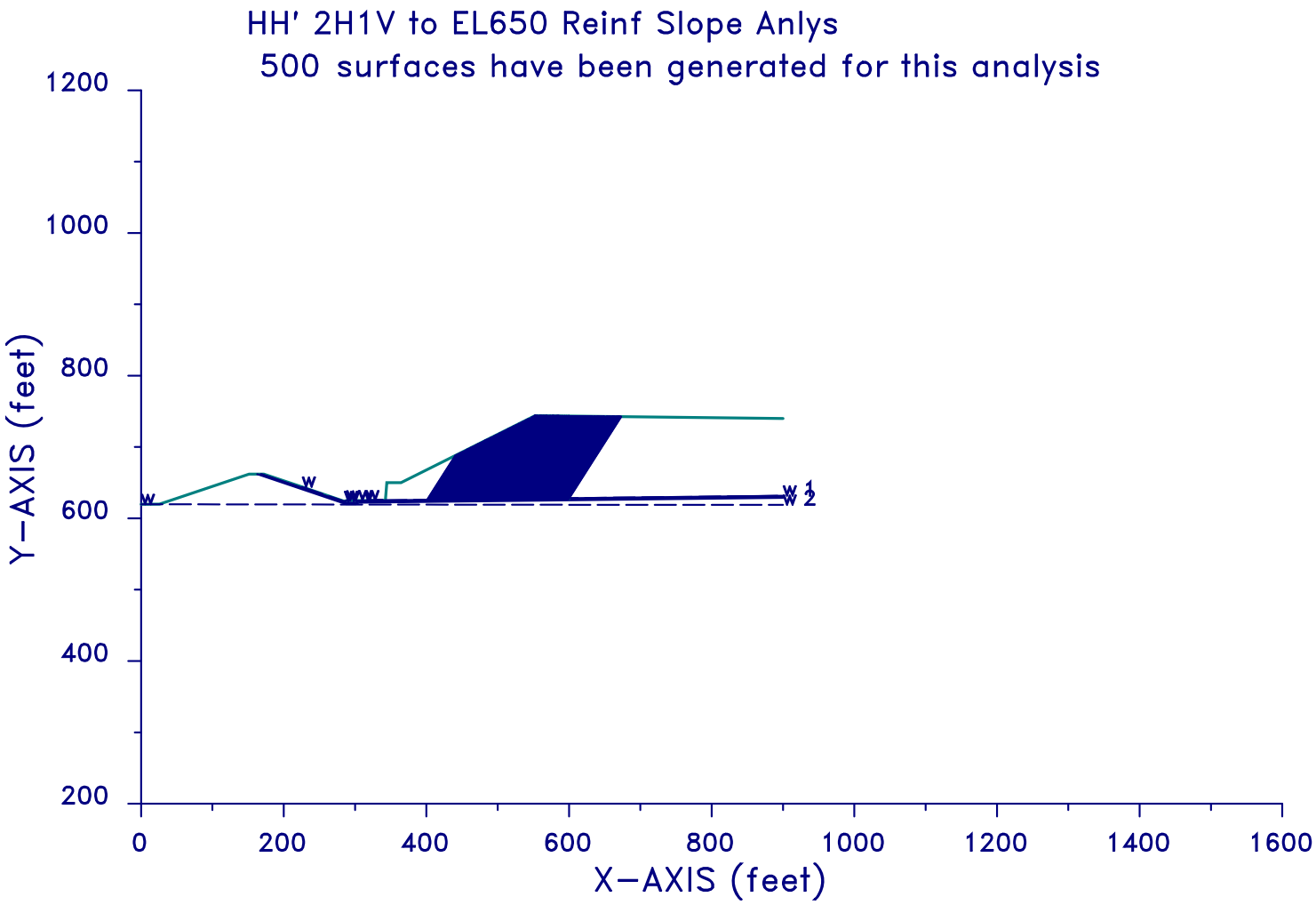

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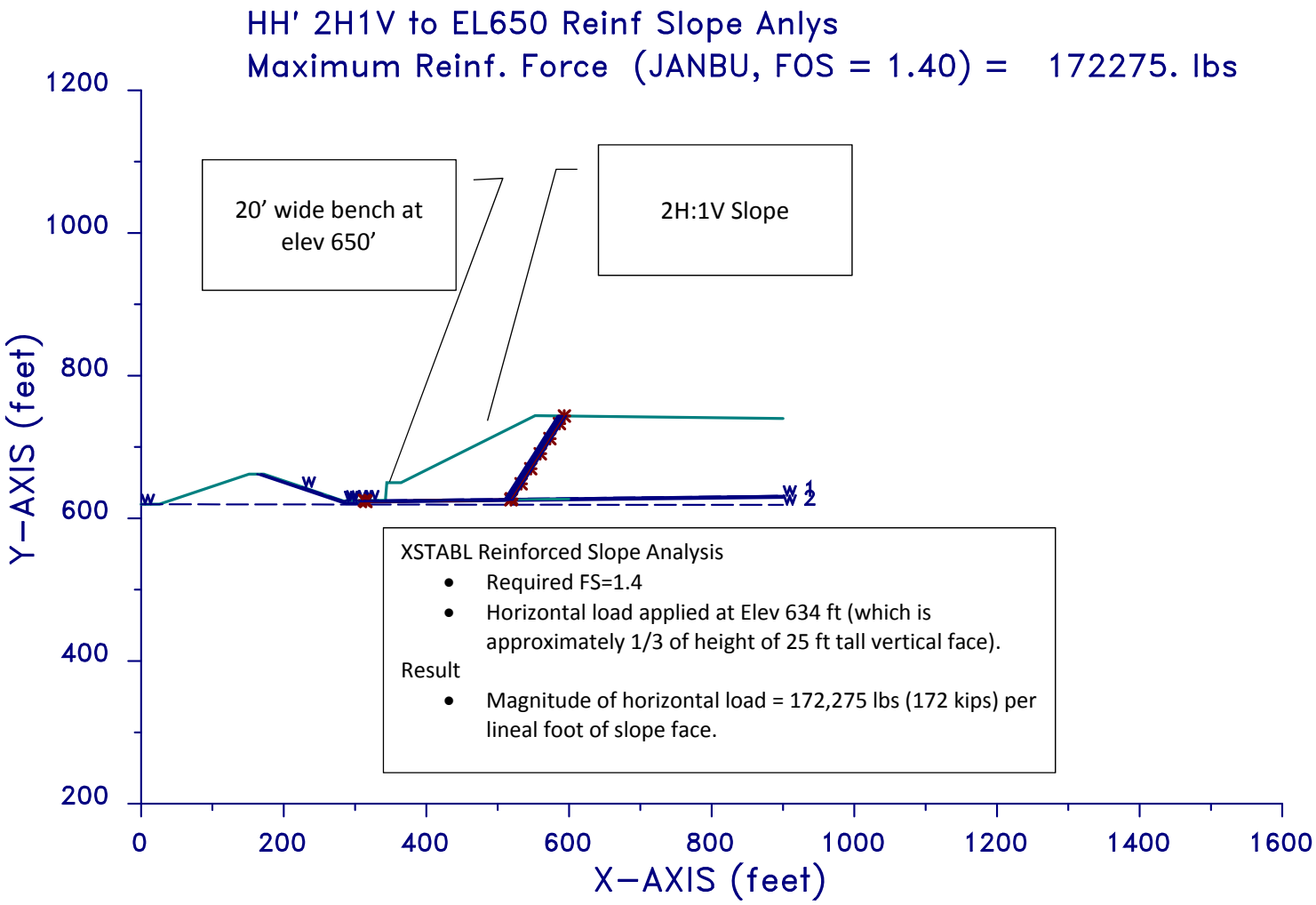

XSTABL Reinforced Slope Analysis

- Required FS=1.4
- Horizontal load applied at Elev 634 ft (which is approximately 1/3 of height of 25 ft tall vertical face).

Result

- Magnitude of horizontal load = 172,275 lbs (172 kips) per lineal foot of slope face.

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*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*                using the              *
*            Method of Slices           *
*                                       *
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```

Problem Description : HH' 2H1V to EL650 Reinf Slope Anlys

SEGMENT BOUNDARY COORDINATES
---

15 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	619.7	25.6	620.1	11
2	25.6	620.1	151.3	662.0	11
3	151.3	662.0	162.6	662.0	10
4	162.6	662.0	168.8	662.0	4
5	168.8	662.0	172.0	662.0	3
6	172.0	662.0	225.7	644.0	3
7	225.7	644.0	284.8	624.1	3
8	284.8	624.1	287.7	624.8	3
9	287.7	624.8	304.8	625.0	3
10	304.8	625.0	314.9	625.1	3
11	314.9	625.1	342.6	625.4	3
12	342.6	625.4	344.6	650.0	2
13	344.6	650.0	364.6	650.0	2
14	364.6	650.0	552.6	744.0	2
15	552.6	744.0	900.0	740.0	2

13 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	342.6	625.4	900.0	631.7	3
2	168.8	662.0	287.7	622.0	4
3	287.7	622.0	300.9	622.0	4
4	300.9	622.0	304.9	624.0	4
5	304.9	624.0	900.0	630.7	4

6	167.6	662.0	287.7	621.6	10
7	287.7	621.6	301.0	621.6	10
8	301.0	621.6	305.0	623.6	10
9	305.0	623.6	900.0	630.3	10
10	162.6	662.0	287.4	620.0	11
11	287.4	620.0	301.4	620.0	11
12	301.4	620.0	305.4	622.0	11
13	305.4	622.0	900.0	628.7	11

ISOTROPIC Soil Parameters
---

12 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	128.0	130.0	.0	24.00	.000	.0	1
2	80.0	85.0	210.0	25.00	.000	.0	1
3	125.0	130.0	.0	32.00	.000	.0	1
4	65.0	65.0	.0	11.00	.000	.0	1
5	65.0	65.0	.0	8.00	.000	.0	1
6	65.0	65.0	.0	18.00	.000	.0	1
7	65.0	65.0	.0	8.00	.000	.0	1
8	65.0	65.0	.0	20.00	.000	.0	1
9	65.0	65.0	.0	8.40	.000	.0	1
10	128.0	130.0	180.0	24.00	.000	.0	2
11	128.0	130.0	180.0	24.00	.000	.0	2
12	125.0	130.0	.0	34.00	.000	.0	2

REINFORCED SLOPE ANALYSIS

The analysis will be performed to determine the critical surface that requires the largest amount of reinforcing force to satisfy:

Minimum (required) FOS = 1.400
Resultant at Elevation = 634.00 feet

2 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 6 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	225.70	644.00
2	284.80	624.10
3	287.70	624.80
4	304.80	625.00
5	314.90	625.10
6	900.00	631.70

Water Surface No. 2 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	619.70
2	900.00	618.80

A critical failure surface searching method, using a random technique for generating sliding BLOCK surfaces, has been specified.

The active and passive portions of the sliding surfaces are generated according to the Rankine theory.

500 trial surfaces will be generated and analyzed.

2 boxes specified for generation of central block base

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

Length of line segments for active and passive portions of sliding block is 25.0 ft

Box no.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Width (ft)
1	304.9	623.8	340.9	624.2	.4
2	400.0	624.9	600.0	627.1	.4

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined
are displayed below - the most critical first

Failure surface No. 1 specified by 12 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	312.98	625.08
2	314.73	624.11
3	315.19	623.73
4	518.61	626.08
5	518.88	626.41
6	519.43	627.40
7	532.86	648.48
8	546.29	669.57
9	559.73	690.65
10	573.16	711.74
11	586.59	732.82
12	593.41	743.53

```
*******************************************************************
**  Maximum Required Reinforcement Force = 1.7228E+05  (lb)     **
**  Corrected JANBU FOS =  1.400   (for above reinforcement)    **
*******************************************************************
```

Failure surface No. 2 specified by 12 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	303.27	624.98
2	305.04	624.00
3	305.50	623.62
4	513.30	626.16
5	513.45	626.35
6	514.00	627.34
7	527.43	648.42
8	540.87	669.51
9	554.30	690.59
10	567.73	711.68
11	581.16	732.76
12	588.06	743.59

```
*******************************************************************
**  Maximum Required Reinforcement Force = 1.7168E+05  (lb)     **
**  Corrected JANBU FOS =  1.400   (for above reinforcement)    **
*******************************************************************
```

Failure surface No. 3 specified by 12 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	327.87	625.24
2	329.61	624.28
3	329.96	623.99
4	514.70	626.15
5	514.88	626.36

6	515.43	627.35
7	528.86	648.44
8	542.29	669.52
9	555.72	690.61
10	569.16	711.69
11	582.59	732.78
12	589.47	743.58

```
*******************************************************************
**  Maximum Required Reinforcement Force = 1.7152E+05  (lb)     **
**  Corrected JANBU FOS =  1.400   (for above reinforcement)    **
*******************************************************************
```

Failure surface No. 4 specified by 12 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	325.35	625.21
2	327.09	624.25
3	327.40	624.00
4	515.31	626.17
5	515.48	626.37
6	516.03	627.36
7	529.46	648.45
8	542.89	669.53
9	556.33	690.61
10	569.76	711.70
11	583.19	732.78
12	590.06	743.57

```
*******************************************************************
**  Maximum Required Reinforcement Force = 1.7129E+05  (lb)     **
**  Corrected JANBU FOS =  1.400   (for above reinforcement)    **
*******************************************************************
```

Failure surface No. 5 specified by 12 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	307.41	625.03
2	309.17	624.05
3	309.63	623.67
4	509.17	625.98
5	509.44	626.30
6	509.99	627.29
7	523.42	648.38
8	536.85	669.46
9	550.28	690.55
10	563.72	711.63
11	577.15	732.72
12	584.11	743.64

```
*******************************************************************
**  Maximum Required Reinforcement Force = 1.7123E+05  (lb)     **
**  Corrected JANBU FOS =  1.400   (for above reinforcement)    **
*******************************************************************
```

Failure surface No. 6 specified by 12 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	331.22	625.28
2	332.95	624.32
3	333.37	623.97
4	511.09	626.18
5	511.21	626.32
6	511.76	627.31
7	525.19	648.40
8	538.62	669.48
9	552.06	690.57
10	565.49	711.65
11	578.92	732.74
12	585.85	743.62

```
*******************************************************************
**  Maximum Required Reinforcement Force = 1.7111E+05  (lb)     **
**  Corrected JANBU FOS =  1.400   (for above reinforcement)    **
*******************************************************************
```

Failure surface No. 7 specified by 12 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	313.56	625.09
2	315.31	624.12
3	315.66	623.83
4	511.19	626.08
5	511.40	626.32
6	511.95	627.31
7	525.38	648.40
8	538.81	669.48
9	552.24	690.57
10	565.68	711.65
11	579.11	732.74
12	586.04	743.61

```
*******************************************************************
**  Maximum Required Reinforcement Force = 1.7107E+05  (lb)     **
**  Corrected JANBU FOS =  1.400   (for above reinforcement)    **
*******************************************************************
```

Failure surface No. 8 specified by 12 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	312.78	625.08
2	314.53	624.11
3	314.78	623.91
4	515.93	626.15
5	516.12	626.38
6	516.67	627.37
7	530.10	648.45
8	543.53	669.54
9	556.96	690.62
10	570.40	711.71

11	583.83	732.79
12	590.69	743.56

```
*******************************************************************
**  Maximum Required Reinforcement Force = 1.7107E+05  (lb)     **
**  Corrected JANBU FOS =  1.400   (for above reinforcement)    **
*******************************************************************
```

Failure surface No. 9 specified by 12 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	332.65	625.29
2	334.38	624.33
3	334.83	623.96
4	511.43	626.27
5	511.48	626.33
6	512.02	627.31
7	525.46	648.40
8	538.89	669.48
9	552.32	690.57
10	565.75	711.65
11	579.19	732.74
12	586.11	743.61

```
*******************************************************************
**  Maximum Required Reinforcement Force = 1.7104E+05  (lb)     **
**  Corrected JANBU FOS =  1.400   (for above reinforcement)    **
*******************************************************************
```

Failure surface No.10 specified by 12 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	307.55	625.03
2	309.32	624.05
3	309.56	623.85
4	521.01	626.05
5	521.34	626.44
6	521.88	627.43
7	535.32	648.51
8	548.75	669.60
9	562.18	690.68
10	575.61	711.77
11	589.05	732.85
12	595.83	743.50

```
*******************************************************************
**  Maximum Required Reinforcement Force = 1.7099E+05  (lb)     **
**  Corrected JANBU FOS =  1.400   (for above reinforcement)    **
*******************************************************************
```

The following is a summary of the TEN most critical surfaces

Problem Description : HH' 2H1V to EL650 Reinf Slope Anlys

REINFORCING FORCES calculated for minimum FOS = 1.400 and
reinforcing force resultant at elevation = 634.00 feet

	Reinforcing Force (lb)	Correction Factor	Initial x-coord (ft)	Terminal x-coord (ft)	Available Strength (lb)
1.	172275.	1.083	312.98	593.41	4.647E+05
2.	171684.	1.082	303.27	588.06	4.527E+05
3.	171519.	1.083	327.87	589.47	4.554E+05
4.	171289.	1.083	325.35	590.06	4.565E+05
5.	171227.	1.083	307.41	584.11	4.437E+05
6.	171110.	1.084	331.22	585.85	4.472E+05
7.	171066.	1.083	313.56	586.04	4.477E+05
8.	171065.	1.083	312.78	590.69	4.577E+05
9.	171035.	1.084	332.65	586.11	4.477E+05
10.	170991.	1.082	307.55	595.83	4.685E+05

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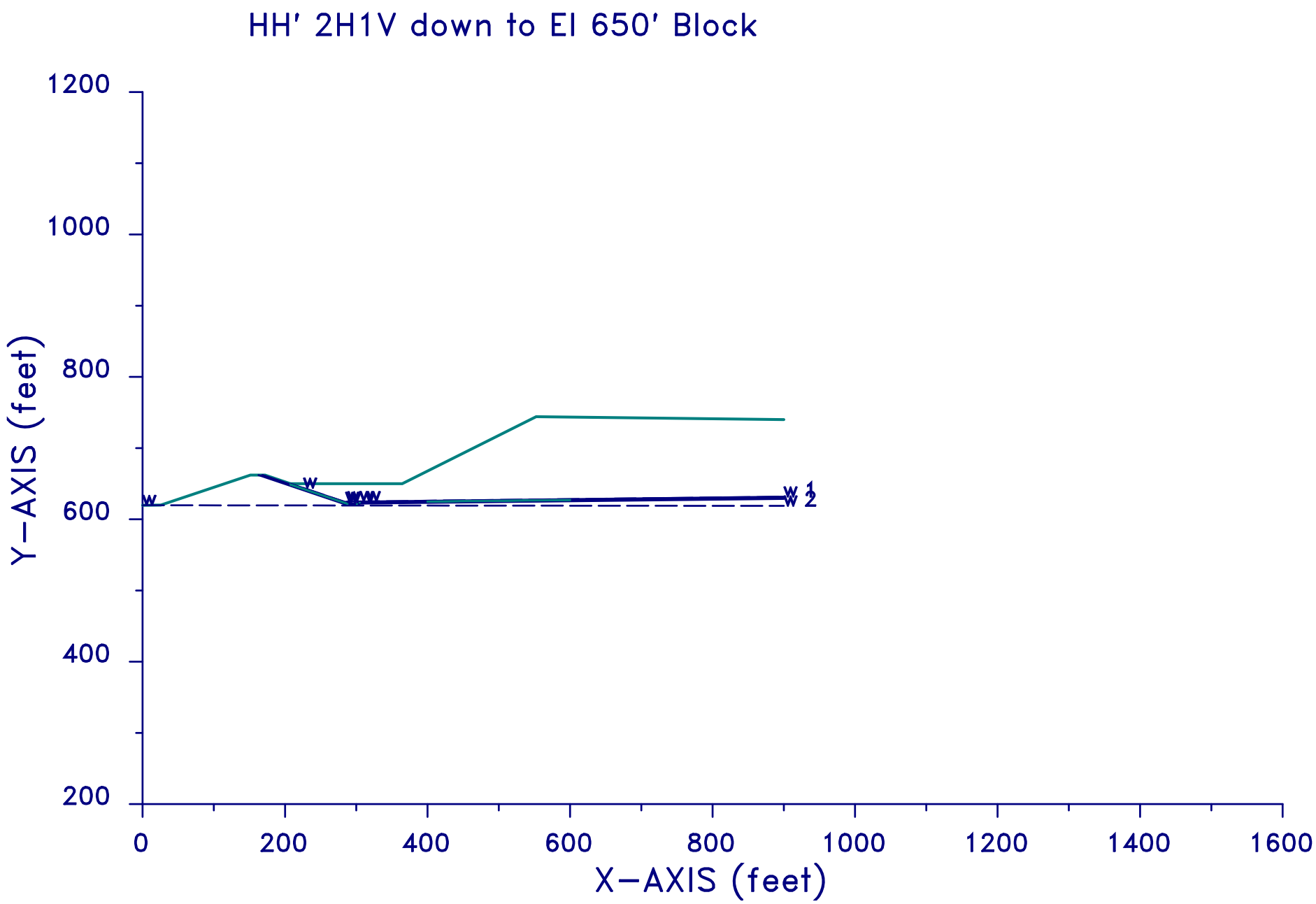

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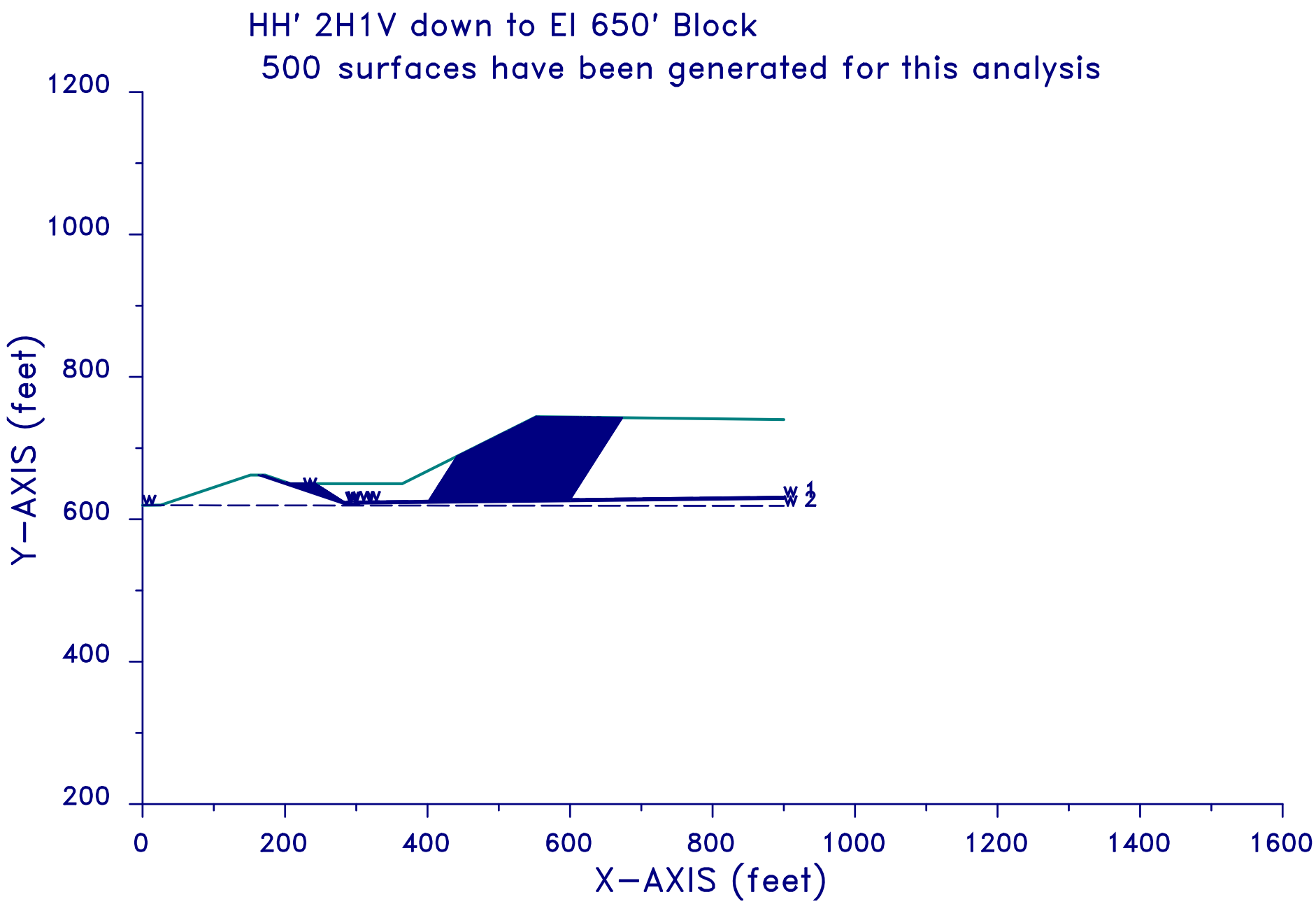

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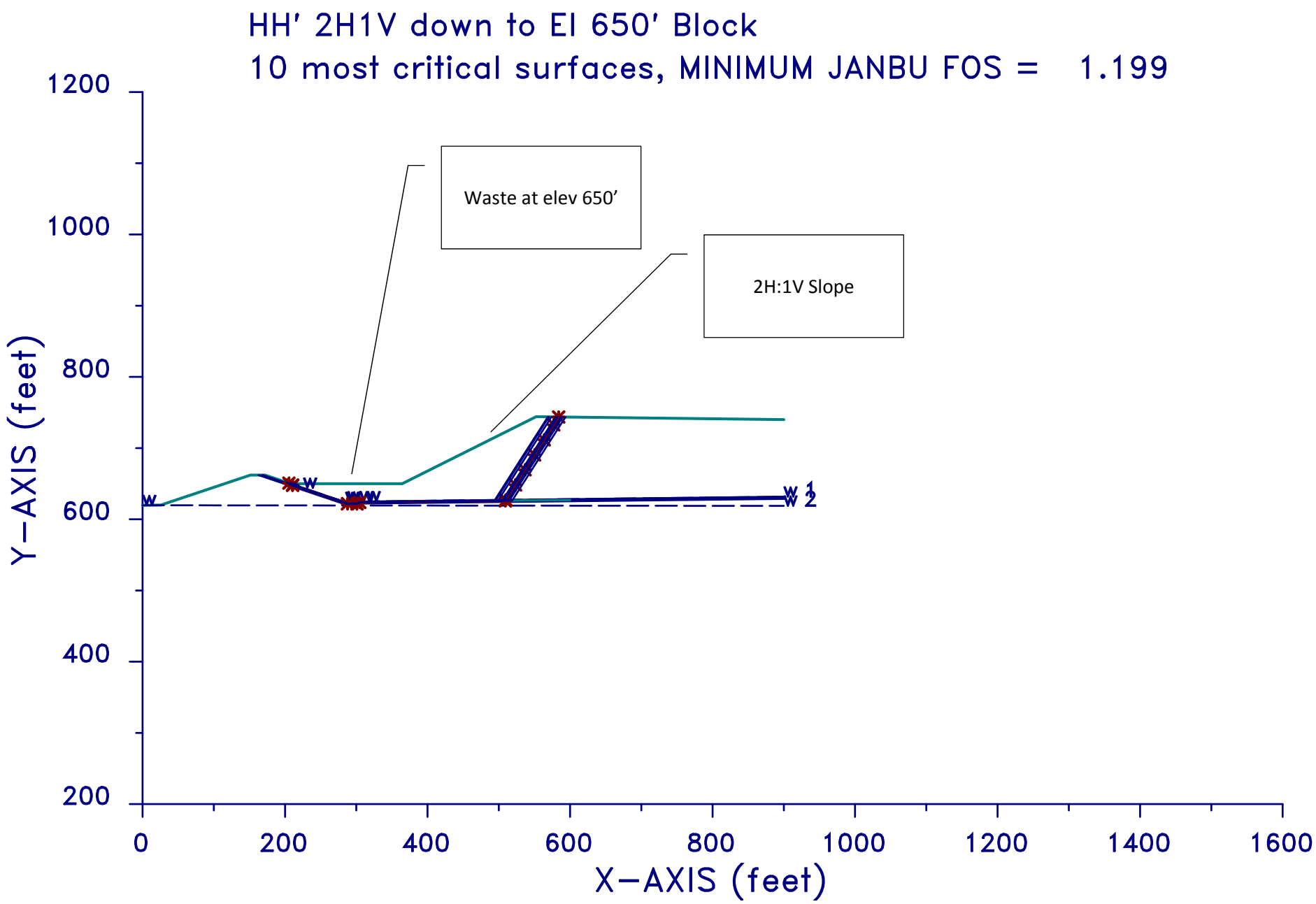

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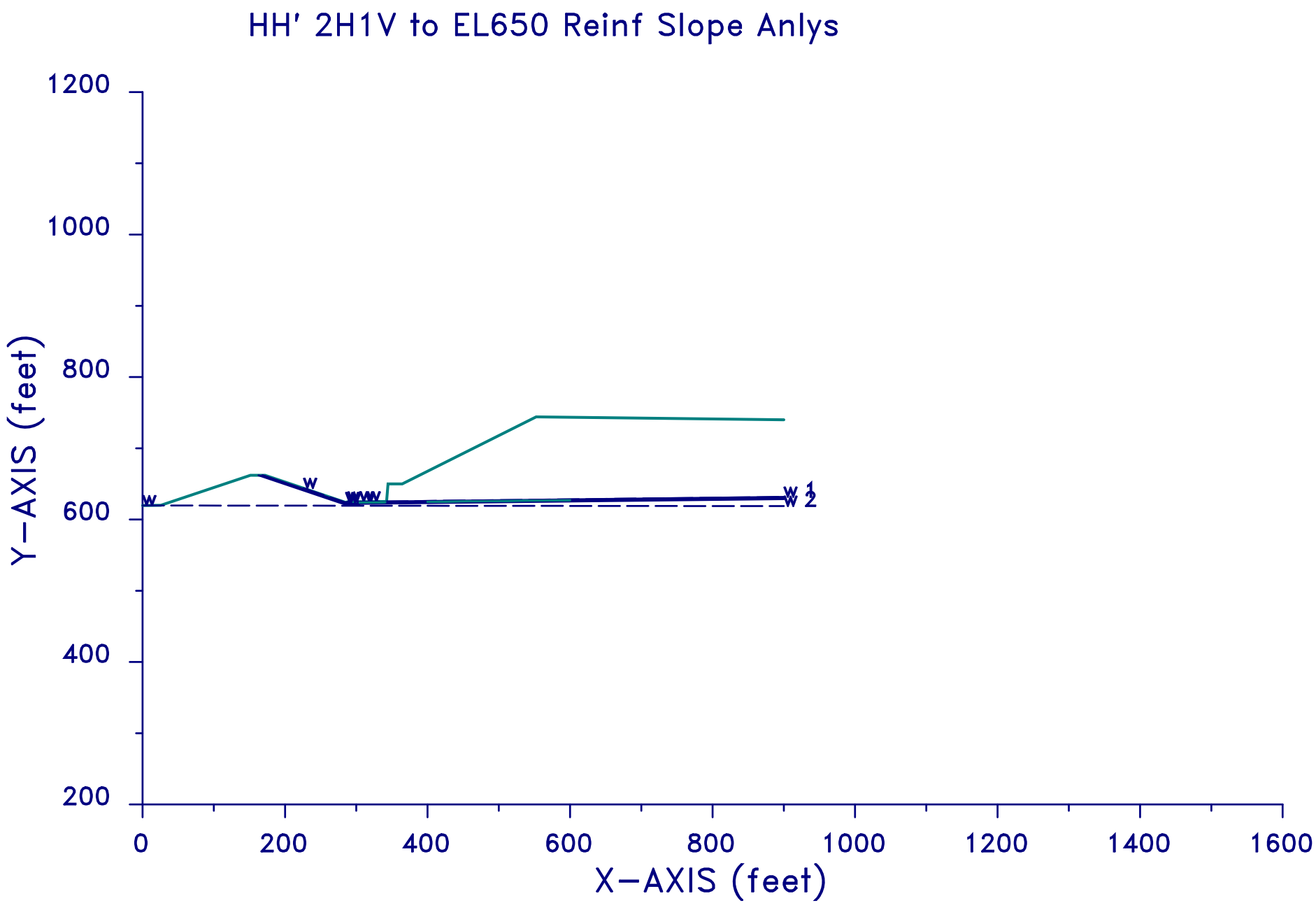

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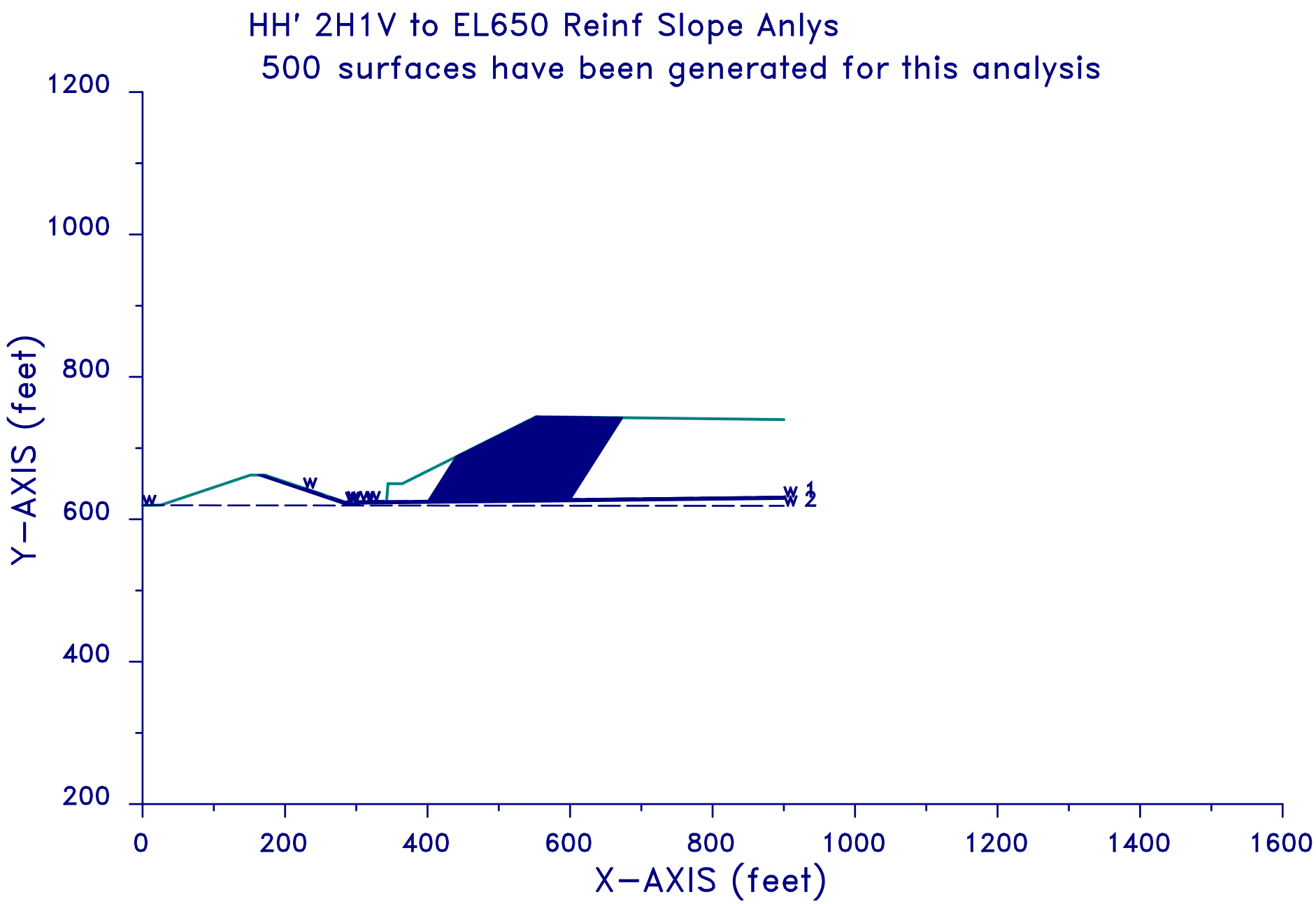

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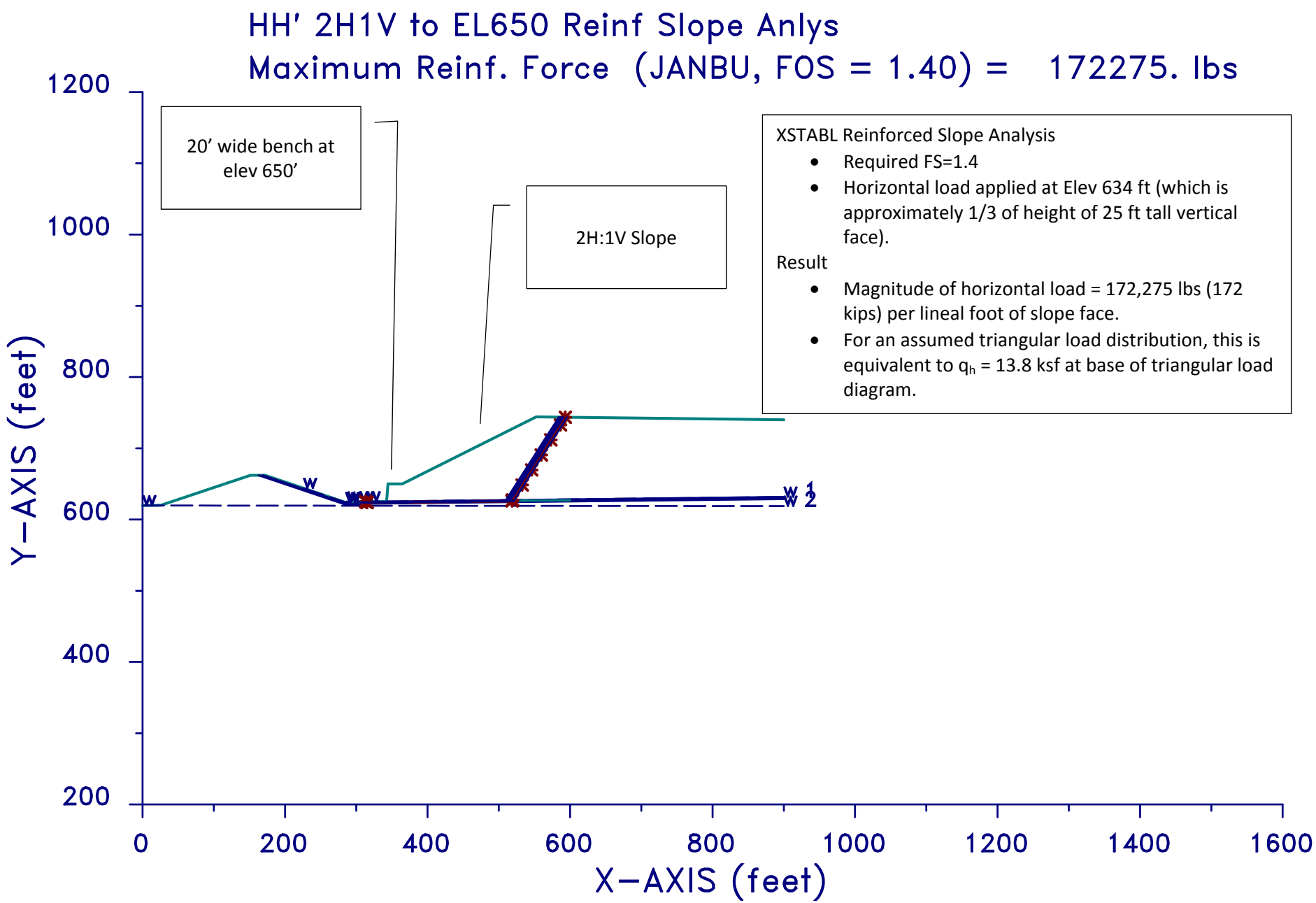


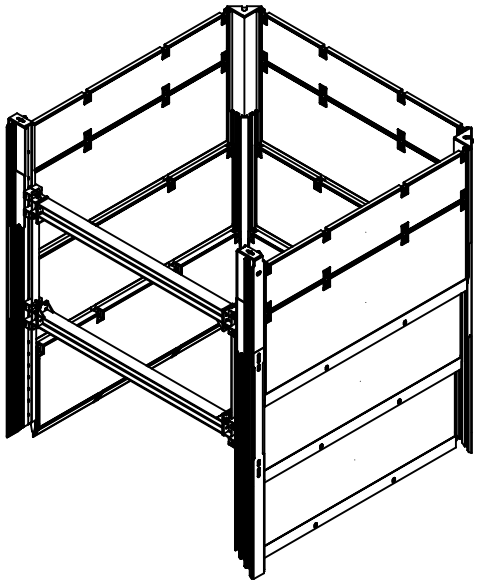
XSTABL Reinforced Slope Analysis

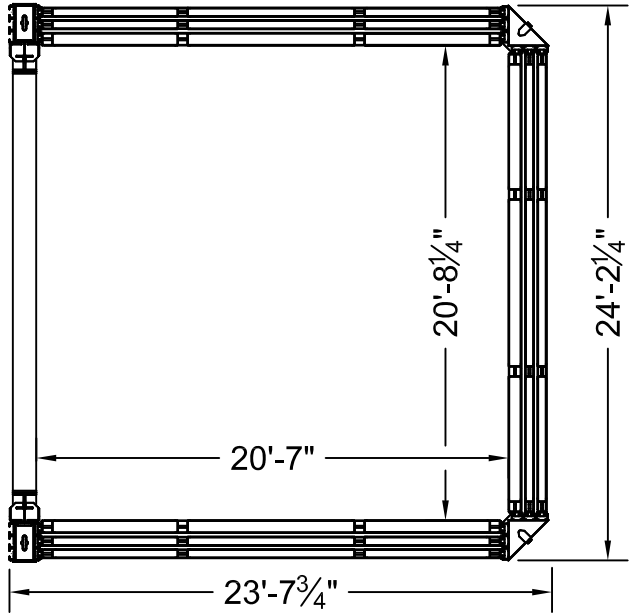
- Required FS=1.4
- Horizontal load applied at Elev 634 ft (which is approximately 1/3 of height of 25 ft tall vertical face).

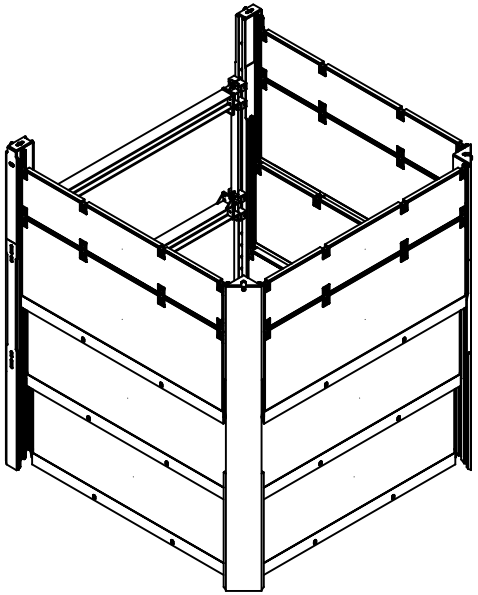
Result

- Magnitude of horizontal load = 172,275 lbs (172 kips) per lineal foot of slope face.
- For an assumed triangular load distribution, this is equivalent to q_h = 13.8 ksf at base of triangular load diagram.

PROPOSED SLIDE RAIL SYSTEM

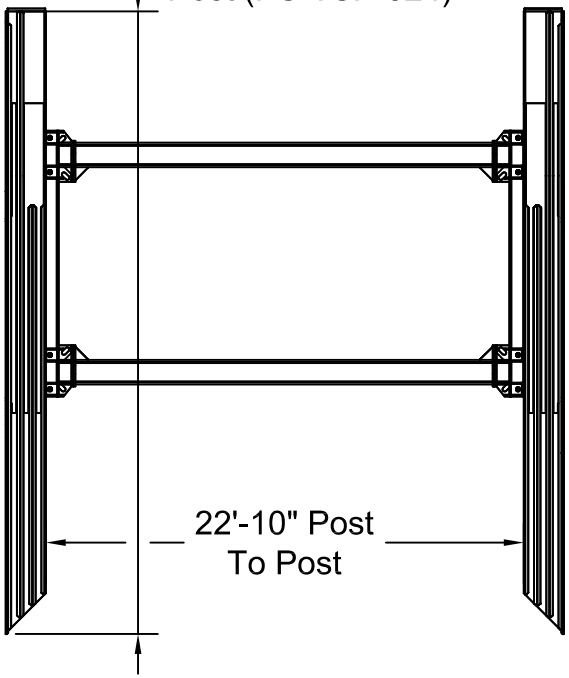


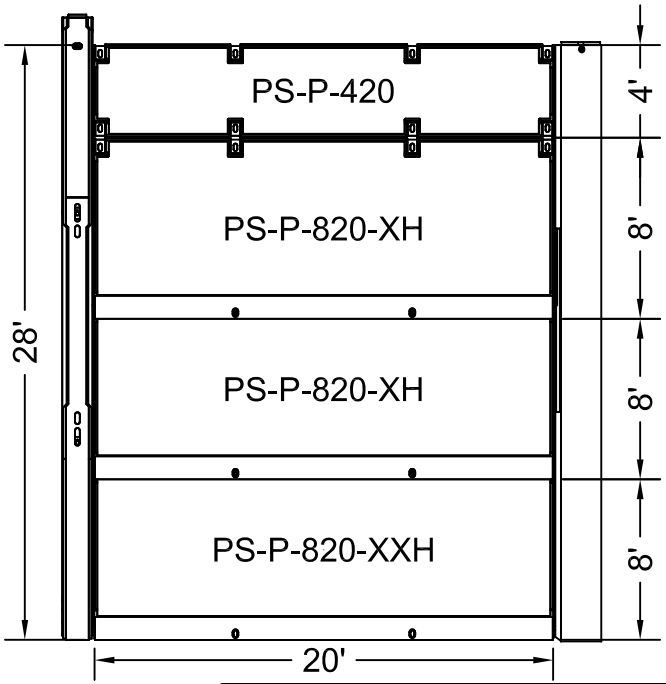


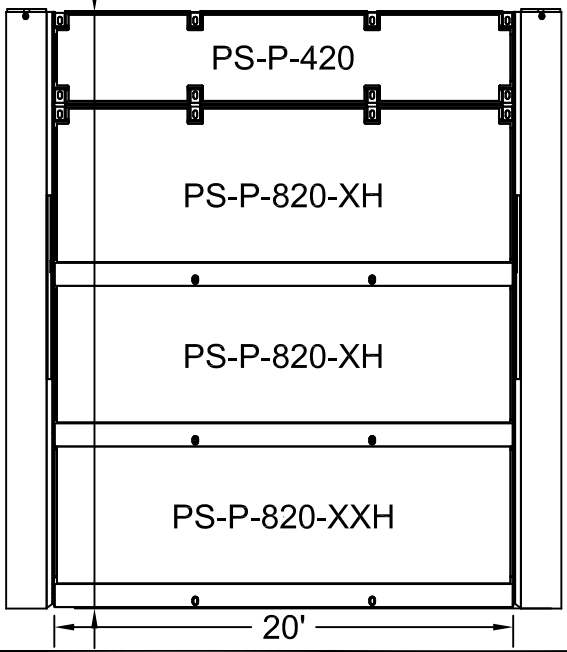


27' Triple Spreader Post (PS-TSP-324)

26' Triple Corner Post (PS-TCP-312)







Subject To Engineering Approval.

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Customer: ~	Page 1 Of 1
Dwg. # Q-SR-T-28Hx20Wx20L-3S	Triple Slide Rail Three Sided
Date: 02-June-2016	By: FM