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DIVISION OF
OIL, GAS & MINING

Project 8007-23
November 9, 1987

North American Equities, Ltd.
1401 17th Street, Suite 1600
Denver, Colorado 80202

Attn: Alan Smith

Subject: Slope Stability Analyses of Proposed Reconstructed Slopes, Little Snider Canyon Drainage, Blazon Mine, Carbon County, Utah.

Gentlemen:

Presented below are the results of our stability analysis of a proposed slope configuration, representing the north and south walls of the above drainage. This configuration is an estimate of the final slope geometry following removal of coal refuse currently in place within the drainage. Included also is the documentation forming the basis for our analysis. The purpose of our analyses was to determine the approximate, post reclamation slope required to stabilize oversteepened, unstable or potentially unstable slope areas presently occurring at and near the mouth of the above drainage.These slope conditions presumably persist with depth beneath the existing coal refuse fill.

SITE INSPECTION

The general site location is shown on Figure 1, attached. The site plan, Figure 2, is based on topographic coverage of the original, undisturbed drainage and was obtained from a previous mine plan on file at the offices of the Utah State Division of Oil Gas and Mining.

A cross section sketch of the site, made at the time of our site visit on Novermber 3, 1987, is presented on Figure 3. The cross section represents estimated conditions near the mouth of the drainage, along the section labeled North X-section and South X-section of Figure 2 and includes the areas of maximum steepness and slope disturbance due to slough (ravelling). The coal refuse thickness indicated on Figure 3 decreases to zero at roughly 60 feet upstream from the drainage mouth. Bulk samples of the soils exposed in the very steep slopes undergoing ravelling were also taken at that time.

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LABORATORY TESTING

Laboratory testing, consisting of natural moisture, gradation and Atterburg Limit determinations, were conducted on samples representative of the exposed, ravelling soils of concern to our study, to determine their general encineering characteristics. Test results are presented on Figure 4 and summarized on Table I.

SLOPE STABILITY ANALYSIS

The slope geometry analyzed is based on our field measurements of the existing, visible slopes and their assumed projection, underneath the coal refuse, to the original drainage base. A cross section representing the north drainage wall was used in the analysis as this slope exhibited the greatest potential for instability following removal of the coal refuse. The geometry of the opposite or south slope is approximately the same except that the presence of the road cut in the slope will tend to increase the factor of safety against slope failure, in this area, on reconstruction. Subsoil and bedrock conditions are essentially the same on both sides of the drainage. Soil strength characteristics were determined on the basis of laboratory classifications and also by back-calculating the soil strengths required to result in a factor of safety of < 1 for the portions of the slopes presently undergoing ravelling. A piezometric surface was not included in the analysis due to the intermitant nature of the drainage and the predominantly fine grained nature of both the subsoils and potential borrow in the area. Saturated soil units weights were, however, used in the analysis to approximate the long term, worst case condition. The soil parameters used are presented on Figure 5.

The stability analyses were conducted using the STABL2 computer program, developed by Purdue University. One hundred trial failure surfaces were ananlyzed by the program with the ten most critical surfaces indicated by the numerals 1 to 10(0), plotted on Figure 5. The most critical failure surface (lowest factor of safety against failure) is indicated on Figure 5.

A minimum factor of safety of 1.6 against failure, under static conditions, was determined by the analysis, using saturated conditions for both the native undisturbed soils, and the engineered fill. A copy of the computer printout of this result and the next lowest factor of safety determined are shown on Figure 6.

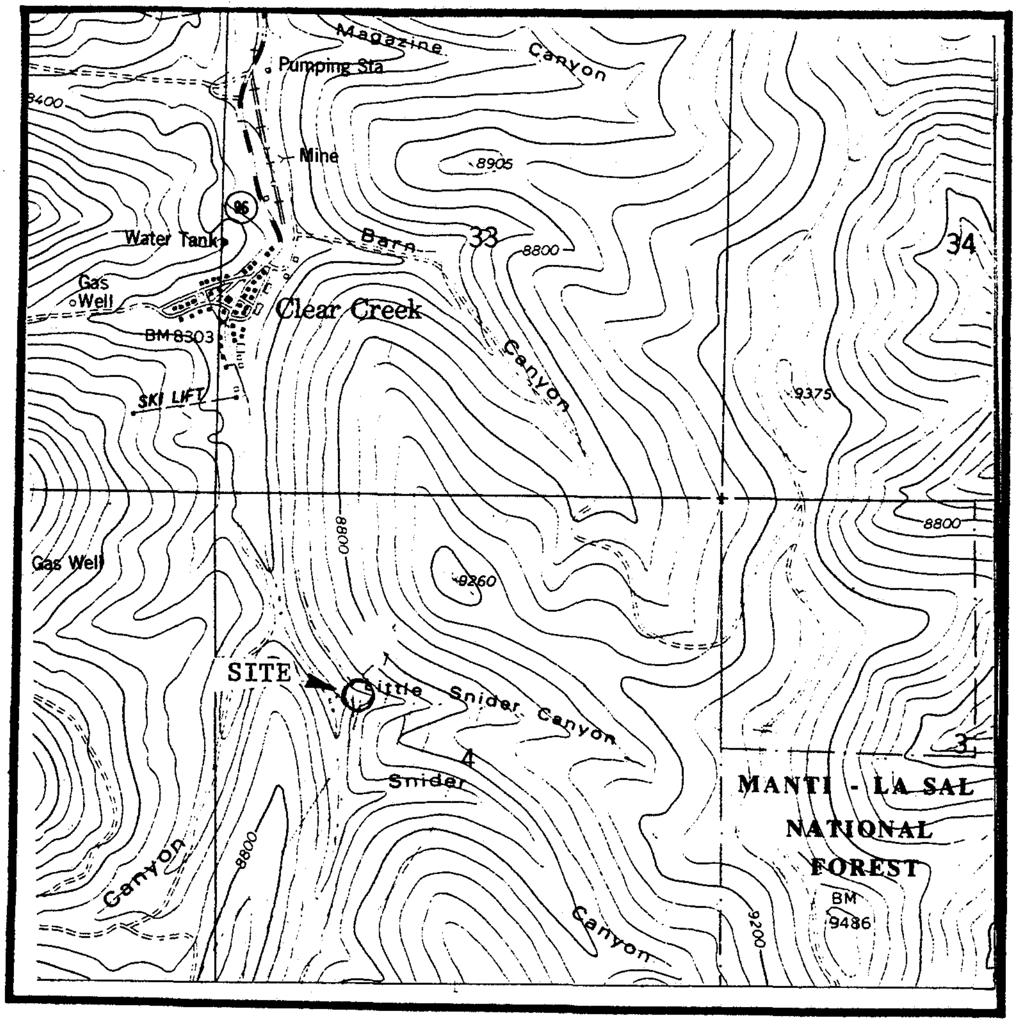
LIMITATIONS

Due to the time constraints of the project requirements, the analyses and data presented in this report are based on our site inspection, estimations concerning elevations and distances and on assumed subsurface conditions below the coal refuse within the drainage. The results of our analyses are thus to be considered preliminary only and subject to review and modification, as required, on inspection of the drainage after the coal refuse has been removed. For this same reason, the soil parameters, soil thicknesses, etc. used in the analyses were conservative, allowing an evaluation of the estimated worst case condition.

We have appreciated the opportunity to provide this service to you. Please contact us if there are any questions on the above.

Respectfully Submitted
LGS & ASSOC'S., INC.

LaMonte G. Sorenson
Principal, Engineering Geologist



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LOCATION MAP

SCALE:1"=2000'

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FIGURE 1

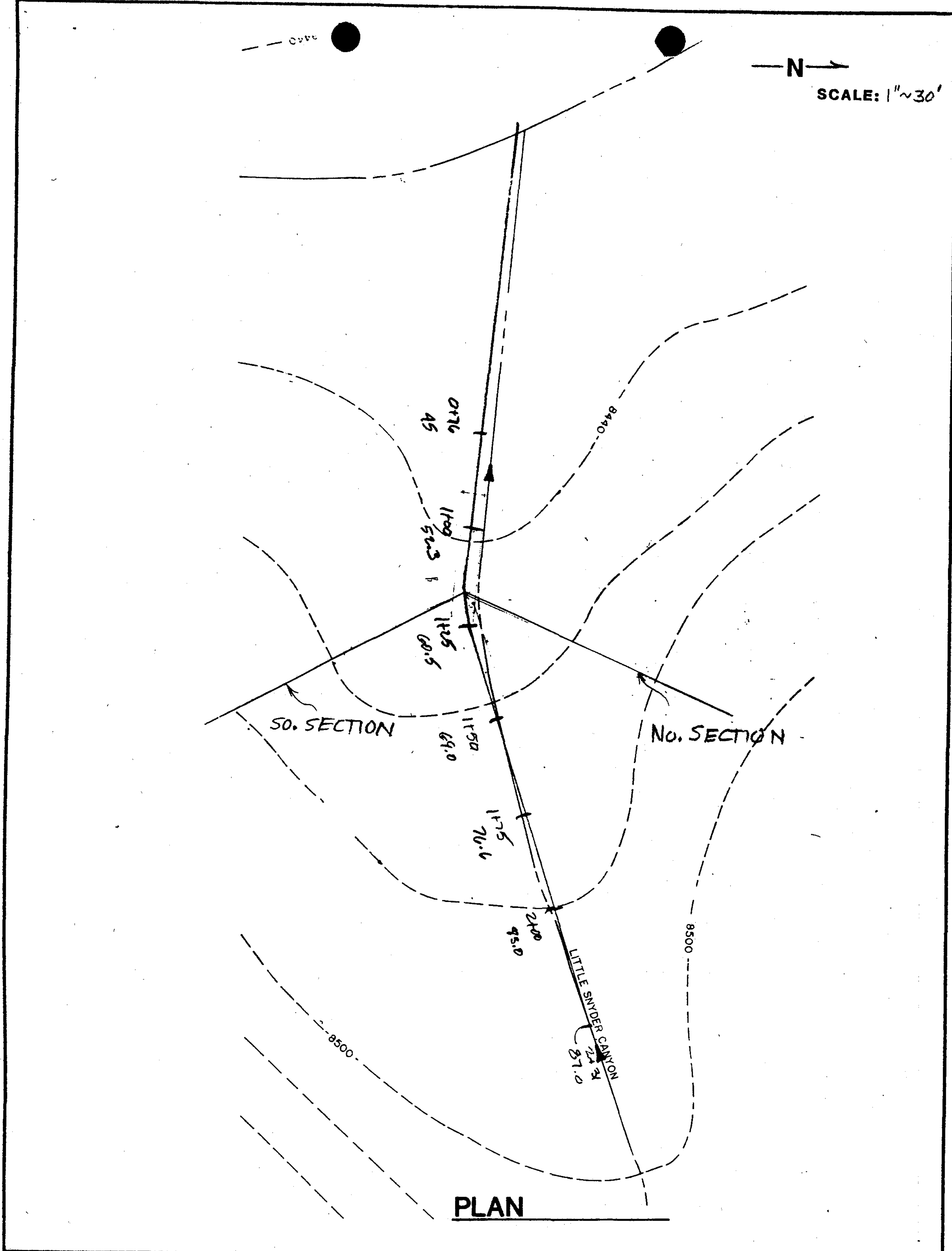

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FIGURE 2

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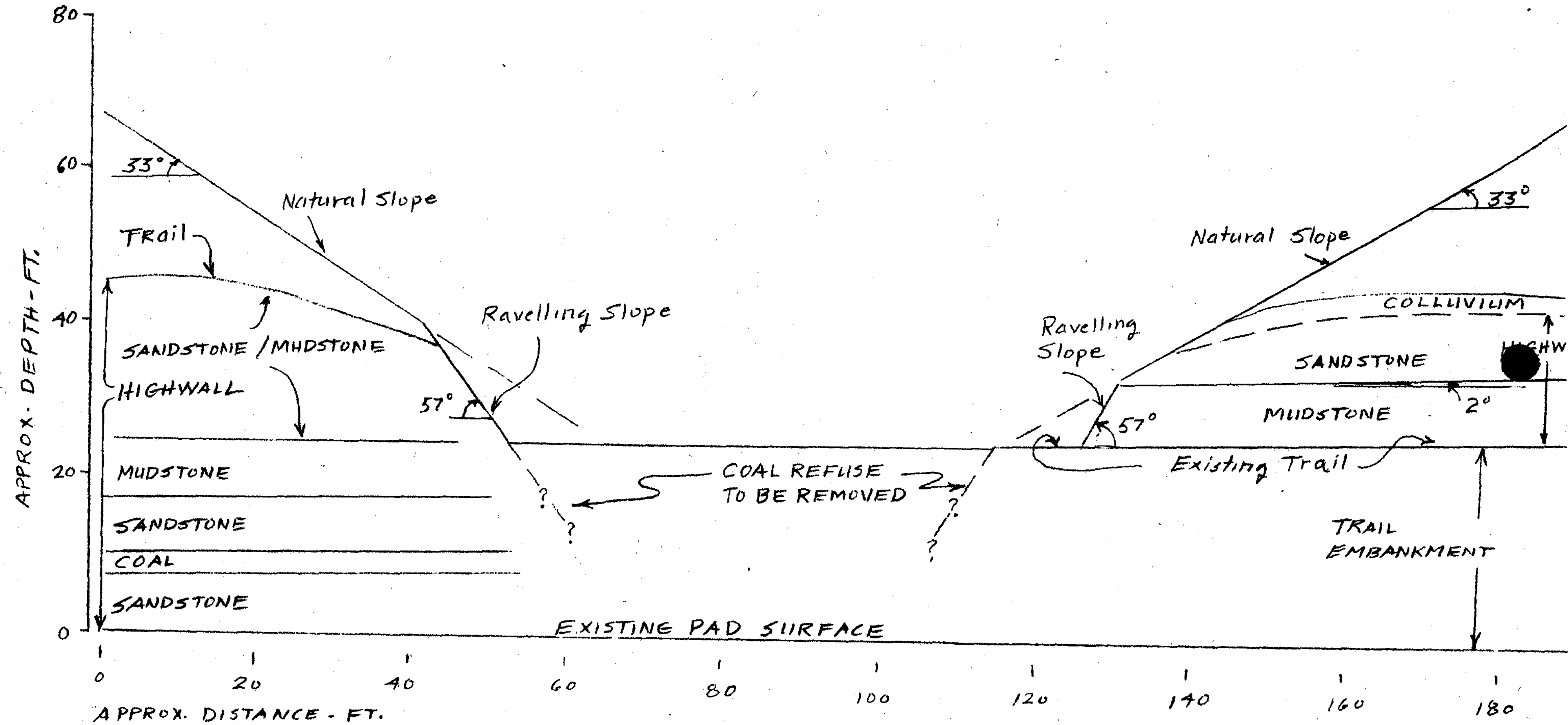
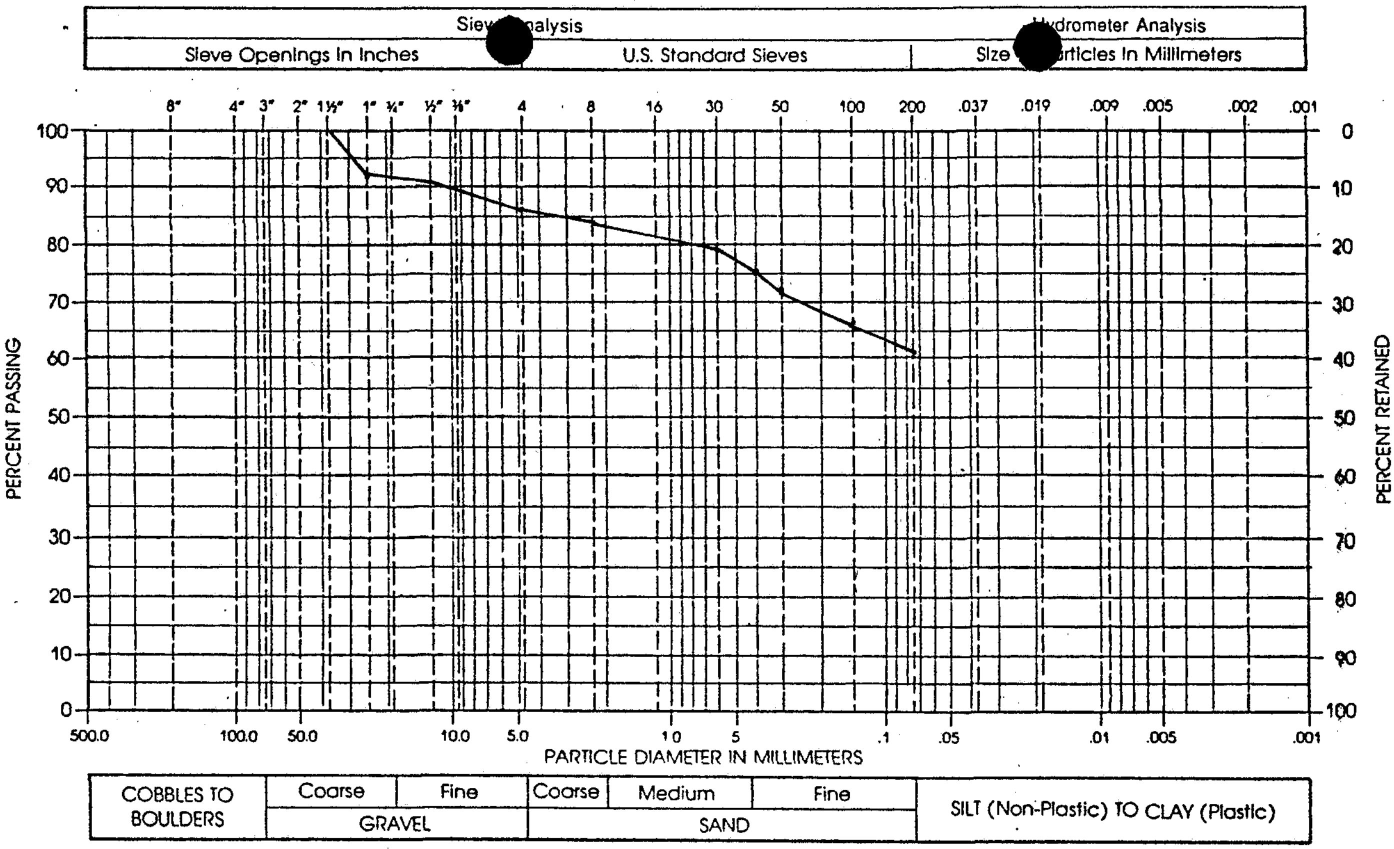


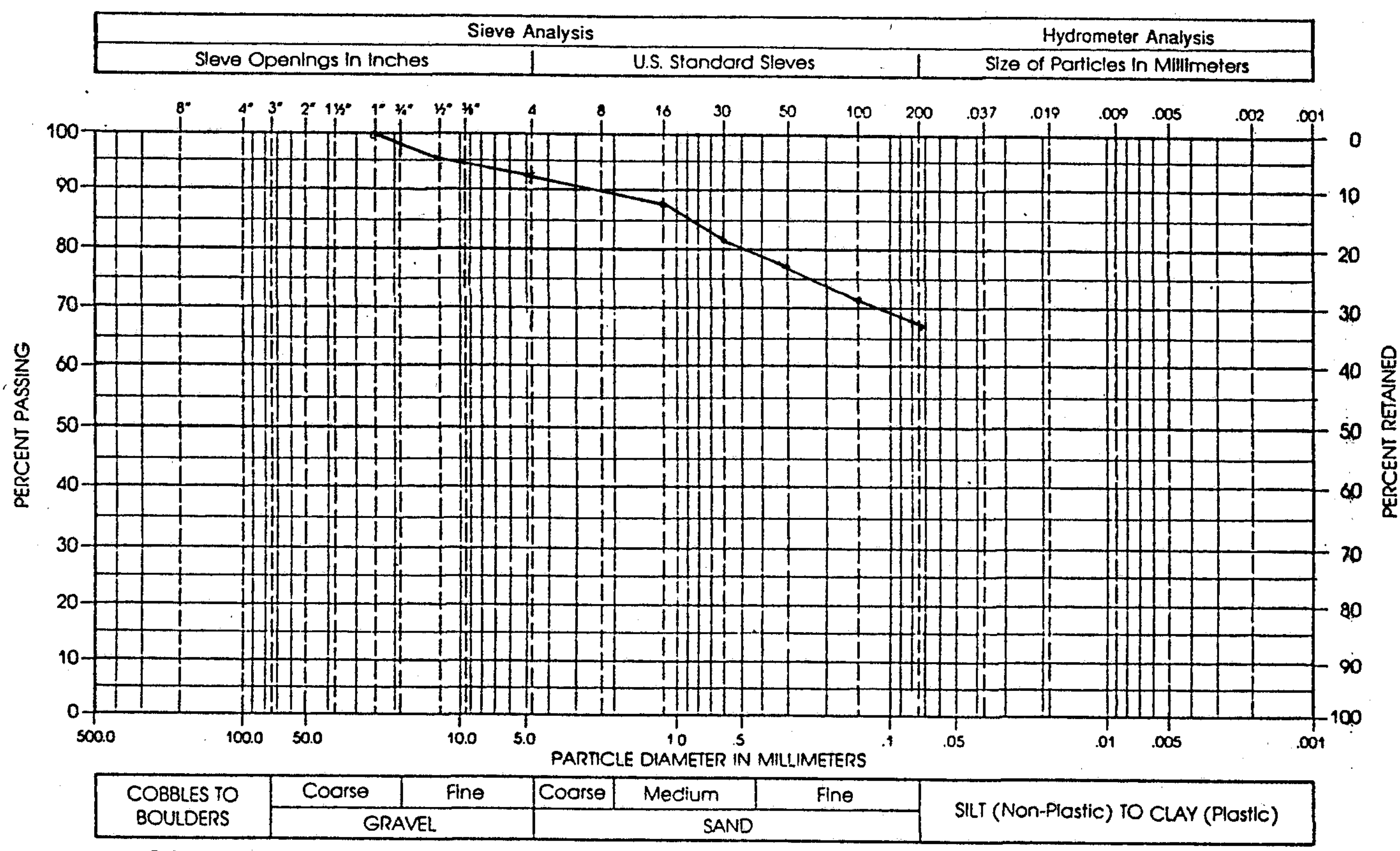
ESTIMATED X-SECTION AT DRAINAGE MOUTH

FIGURE 3



SOIL TYPE: Sandy lean clay
FROM: No. slope

% GRAVEL: 13.9
% SAND: 25.1
% SILT-CLAY: 61.0



SOIL TYPE: Sandy lean clay
FROM: No. slope

% GRAVEL: 7.6
% SAND: 25.2
% SILT-CLAY: 67.2

GRADATION TEST RESULTS

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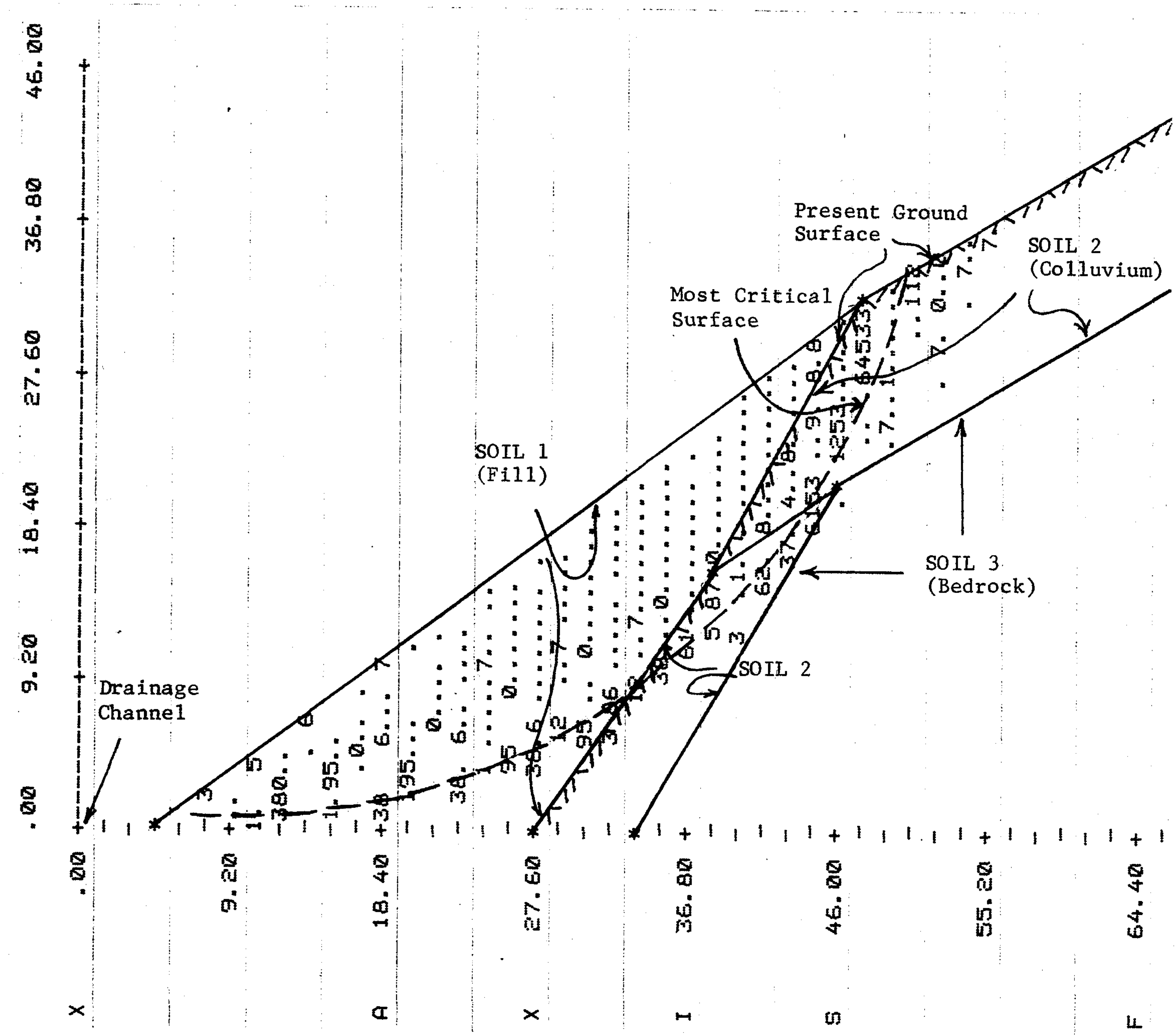
FIGURE 4

ISOTROPIC SOIL PARAMETERS

3 TYPE(S) OF SOIL

SOIL TYPE NO.	TOTAL UNIT WT. (PCF)	SATURATED UNIT WT. (PCF)	COHESION INTERCEPT (PSF)	FRICTION ANGLE (DEG)	PORE PRESSURE PARAMETER	PRESSURE CONSTANT (PSF)	PIEZOMETRIC SURFACE NO.
1	130.0	130.0	500.0	20.0	.00	.0	1
2	130.0	130.0	300.0	20.0	.00	.0	1
3	160.0	160.0	5000.0	30.0	.00	.0	1



TYPICAL SLOPE W/ MOST CRITICAL FAILURE SURFACE
(represents No. & So. sections of Figure 2)

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FIGURE 5

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 BISHOP METHOD.

FAILURE SURFACE SPECIFIED BY 14 COORDINATE POINTS

POINT NO.	X-SURF (FT)	Y-SURF (FT)
1	5.00	.00
2	10.00	.08
3	14.96	.71
4	19.82	1.88
5	24.52	3.58
6	29.01	5.80
7	33.22	8.49
8	37.11	11.63
9	40.63	15.18
10	43.74	19.10
11	46.39	23.34
12	48.56	27.84
13	50.22	32.56
14	50.46	33.56

*** 1.574 ***

FAILURE SURFACE SPECIFIED BY 14 COORDINATE POINTS

POINT NO.	X-SURF (FT)	Y-SURF (FT)
1	5.00	.00
2	10.00	.20
3	14.94	.93
4	19.79	2.18
5	24.47	3.92
6	28.95	6.15
7	33.16	8.84
8	37.07	11.95
9	40.64	15.46
10	43.81	19.33
11	46.56	23.50
12	48.85	27.95
13	50.67	32.61
14	51.03	33.93

*** 1.581 ***

TABLE I

TEST NO.	PIT	DEPTH (ft.)	NAT.UNIT WT.(pcf)	NAT.MOIST. CONTENT(%)	SILT-CLAY (%-#200)	SAND(%-#4, +200)	GRAVEL(%+#4, -3in.)	LIQUID LIMIT	PLASTIC INDEX	UCF COMPR. STRENGTH*	CLASSIFICATION (UNIFIED SYSTEM)
1	No. slope face			18.2	61.0	25.1	13.9	32	19		Sandy lean clay
2	No. slope face			19.5	67.2	25.2	7.6				Sandy lean clay
3	So. slope face			20.0							Sandy lean clay

REMARKS:
* unconfined compressive strength, in psf, by hand penetrometer.