



TerraMatrix

Engineering & Environmental Services
165 South Union Boulevard
Suite 460
Lakewood, Colorado 80228

#5

OFFICE - (303) 763-5140 / FAX - (303) 763-8003

To: **BOB SWEENEY**

Fax Telephone No:
505-827-1544

From: **JOHN KENDALL**

Office Telephone No:
(303) 763-5140

TOTAL NUMBER OF PAGES (Including This Cover Sheet): _____

DATE 2/12/96 CHARGE NUMBER 602 CHARGED AMOUNT _____

Comments/Notes: RE = GANDY/MARLEY TRINSSIC PARK

BOB,

DALE GANDY ASKED ME TO SEND THE RESULTS
OF THE HELP MODELING TO YOU. WE
WILL BE SENDING THE COMPLETE PACKAGE
LATER THIS WEEK.

John

**TerraMatrix**

February 12, 1996

Mr. Bob Sweeney
Environment Department
Hazardous & Radioactive Materials Bureau
525 Camino De Los Marquez
P.O Box 26110
Santa Fe, NM 87502

Re: HELP Analysis Results for Alternative Landfill Liner Systems

Dear Bob:

We are sending for your review the preliminary results of the HELP program analysis which we conducted for the EPA minimum technology alternative and 5 alternative liner designs for the Triassic Park Waste Disposal Facility Landfill. The attached figures illustrate these alternatives. Our intention is to prepare a complete package of the HELP analyses along with the data input sheets you requested for NMED and EPA review. We are currently making refinements to that document and hope to submit it to you by Wednesday or Thursday of this week.

Our approach to the HELP analyses followed the recommendations outlined in NMED's letter dated January 24, 1996. In addition, we prepared a second set of HELP runs with modified inputs which we feel better illustrate the differences in liner system performance.

NMED commented in their letter that the initial moisture contents of the lateral drainage layers (and presumably the waste layer) used in the waiver report analyses were too high. These moisture contents were set high in order to establish conservative leakage rates to be used subsequently as inputs for the hydrogeologic modeling of the surrounding Upper and Lower Dockum units necessary for the waiver justification. In evaluating the alternate liner systems for the current effort, we have changed soil types, "textures", and initial moisture contents for the waste to points which we feel are commensurate with likely climatic conditions and with the materials likely to be used. It should be noted that the 6 inches of prepared subgrade shown on Alternatives 1, 2, 4, and 5 was not included in the HELP model. Including this layer in an HELP runs would decrease the leakage rate from the overall liner system. We then followed the protocols suggested by NMED in running the HELP model. The results of these HELP runs are summarized on Table 1.

Engineering & Environmental Services
165 South Union Boulevard, Suite 400
Lakewood, Colorado 80128
Phone 303.763.5140 Fax 303.763.8003

Steamboat Springs Denver Fort Collins Seattle Santiago



Mr Bob Sweeney
February 12, 1996
Page 2

The results of the HELP runs at the lower initial moisture contents for waste and soil components which followed the NMED recommended protocol indicated the following:

- There is little difference between the alternatives in terms of percolation rates through the bottom liner. This is due mainly to the high waste storage capacity and evapotranspiration effects.
- The cover system effectively reduces precipitation infiltration which allows the waste to drain once the cover is in place. The cover system clay component, although effective from a HELP modeling standpoint, may be susceptible to deteriorating effects of frost heave and heat desiccation. Use of a GCL as a substitute for the 3 foot thick clay layer may be advisable from a performance standpoint.

Since the initial HELP runs did not indicate any liner leakage, the relative performance of each liner system could not be determined. Therefore, a second set of HELP runs were conducted to evaluate the liner system alternatives under higher moisture conditions. These analyses were conducted with a cover to artificially increase the flow through the liner system and reduce the modeling effects of precipitation, evapotranspiration, and water storage volume. The leakage rates for these runs, although artificially high, reveal the differences in liner performance and provide a general indication of the magnitude of those differences. It should be emphasized that the magnitude of these leakage rates do not represent conditions which are likely to occur. (In this case the 6 inches of prepared subgrade was included in the HELP model for Alternatives 4 and 5). The results of this analysis are summarized on Table 2.

The results of the HELP runs at the high moisture content conditions indicated the following:

- Liner alternates could be ranked by performance in the following groups:

Group Ranking	Alternatives	Floor Leakage (g/a/d)	Slope Leakage (g/a/d)
1	Alternate 3	0.000184	0.000000
	Alternate 2	0.000184	0.000020
	Alternate 4 with 6 inches prepared subgrade	0.000287	0.000002
2	Alternate 1	0.010493	0.000225
	Alternate 5 with 6 inches prepared subgrade	0.054516	0.112515
	MTR	0.062242	0.000943
3	Alternate 4 without prepared subgrade	47.497920	5.627380
	Alternate 5 without prepared subgrade	48.139032	69.762756



Mr Bob Sweeney
February 12, 1996
Page 3

- In order to make a final recommendation for the linc system, other factors such as constructability, long term performance, etc, will be evaluated.

We hope this information meets your needs. Please call me at (303) 763-5140 if you have any questions. I will be available all this week except for Thursday (February 15).

Sincerely,

TerraMatrix Inc.

John J. Kendall
Senior Engineer

Attachments

cc: Dale Gandy
Alan Krause
Pat Corser

TABLE 1

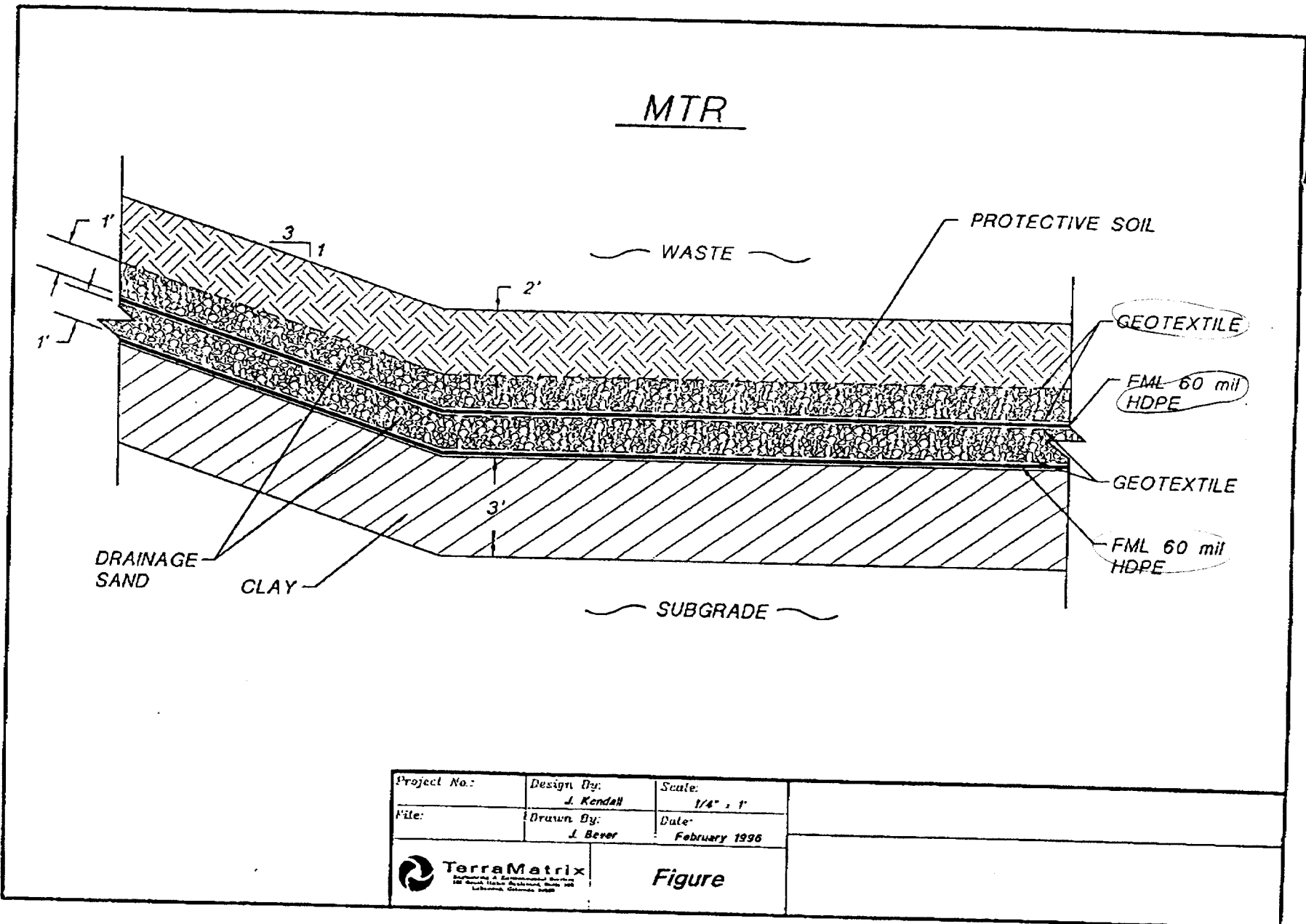
YEARS	LINER SECTION	PRIMARY LATERAL DRAINAGE (gal/acre/day)(1)	PRIMARY LINER LEAKAGE (gal/acre/day)(1)	SECONDARY LATERAL DRAINAGE (gal/acre/day)(1)	SECONDARY LINER LEAKAGE (gal/acre/day)(1)	COMMENTS
FLOOR						
	MTR	0.000000	0.000000	0.000000	0.000000	
	1	0.000000	0.000000	0.000000	0.000000	
	2	0.000000	0.000000	0.000000	0.000000	
0-1	3	0.000000	0.000000	0.000000	0.000000	
	4	0.000000	0.000000	0.000000	0.000000	
	5	0.000000	0.000000	0.000000	0.000000	
	MTR	0.084028	0.585530	0.582927	0.000902	
	1	0.084028	0.585530	0.583563	0.000246	
2-5	2	1.239286	11.050946	11.055676	0.000184	
	3	12.294983	0.000184	0.000000	0.000184	
	4	1.239286	11.056946	1.992483	9.064464	
	5	0.084028	0.585530	0.070358	0.515172	
	MTR	0.000000	0.000000	0.000000	0.000000	
	1	0.000000	0.000000	0.000000	0.000000	
6-10	2	10.902438	22.420307	22.408092	0.000164	
	3	33.310510	0.000164	0.000000	0.000164	
	4	10.902438	22.420307	5.805642	16.611140	
	5	0.000000	0.000000	0.000000	0.000000	
	MTR	0.000000	0.000000	0.000000	0.000000	
	1	0.000000	0.000000	0.000000	0.000000	
11	2	50.885120	71.702075	71.670903	0.000164	
	3	122.556024	0.000184	0.000020	0.000164	
	4	50.885120	71.702075	23.602721	48.084844	
	5	0.000000	0.000000	0.000000	0.000000	
	MTR	0.000000	0.000000	0.000000	0.000000	


	1	0.000000	0.000000	0.000000	0.000000	
12-31	2	12.279714	19.880619	19.885333	0.000123	
	3	32.165047	0.000123	0.000000	0.000123	
	4	12.279714	19.880619	5.927994	13.954264	
	5	0.000000	0.000000	0.000000	0.000000	
	MTR	0.000000	0.000000	0.000000	0.000000	
	1	0.000000	0.000000	0.000000	0.000000	
32-40	2	0.000000	0.000000	0.000000	0.000000	
	3	0.000000	0.000000	0.000000	0.000000	
	4	0.000000	0.000000	0.000000	0.000000	
	5	0.000000	0.000000	0.000000	0.000000	
SLOPE						
	MTR	0.000000	0.000000	0.000000	0.000000	
	1	0.000000	0.000000	0.000000	0.000000	
	2	0.000000	0.000000	0.000000	0.000000	
0-1	3	0.000000	0.000000	0.000000	0.000000	
	4	0.000000	0.000000	NA	NA	
	5	0.000000	0.000000	NA	NA	
	MTR	0.467215	0.202343	0.202240	0.000123	
	1	0.467215	0.202343	0.202261	0.000102	
2-5	2	6.574209	5.722065	5.770240	0.000041	
	3	12.296048	0.000184	0.000164	0.000020	
	4	6.574209	5.722065	NA	NA	
	5	0.467215	0.202343	NA	NA	
	MTR	0.000000	0.000000	0.000000	0.000000	
	1	0.000000	0.000000	0.000000	0.000000	
6-10	2	25.495047	7.833662	7.833642	0.000041	
	3	33.328381	0.000143	0.000123	0.000000	
	4	25.495047	7.833662	NA	NA	
	5	0.000000	0.000000	NA	NA	

	MTR	0.000000	0.000000	0.000000	0.000000
	1	0.000000	0.000000	0.000000	0.000000
11	2	116.866483	5.764161	5.764161	0.000020
	3	122.632079	0.000200	0.000000	0.000000
	4	118.226299	5.770248	NA	NA
	5	0.000000	0.000000	NA	NA
	MTR	0.000000	0.000000	0.000000	0.000000
	1	0.000000	0.000000	0.000000	0.000000
12-31	2	30.262782	1.893904	1.893883	0.000000
	3	122.632079	0.000020	0.000000	0.000000
	4	30.262782	1.893904	NA	NA
	5	0.000000	0.000000	NA	NA
	MTR	0.000000	0.000000	0.000000	0.000000
	1	0.000000	0.000000	0.000000	0.000000
32-40	2	0.000000	0.000000	0.000000	0.000000
	3	0.000000	0.000000	0.000000	0.000000
	4	0.000000	0.000000	NA	NA
	5	0.000000	0.000000	NA	NA

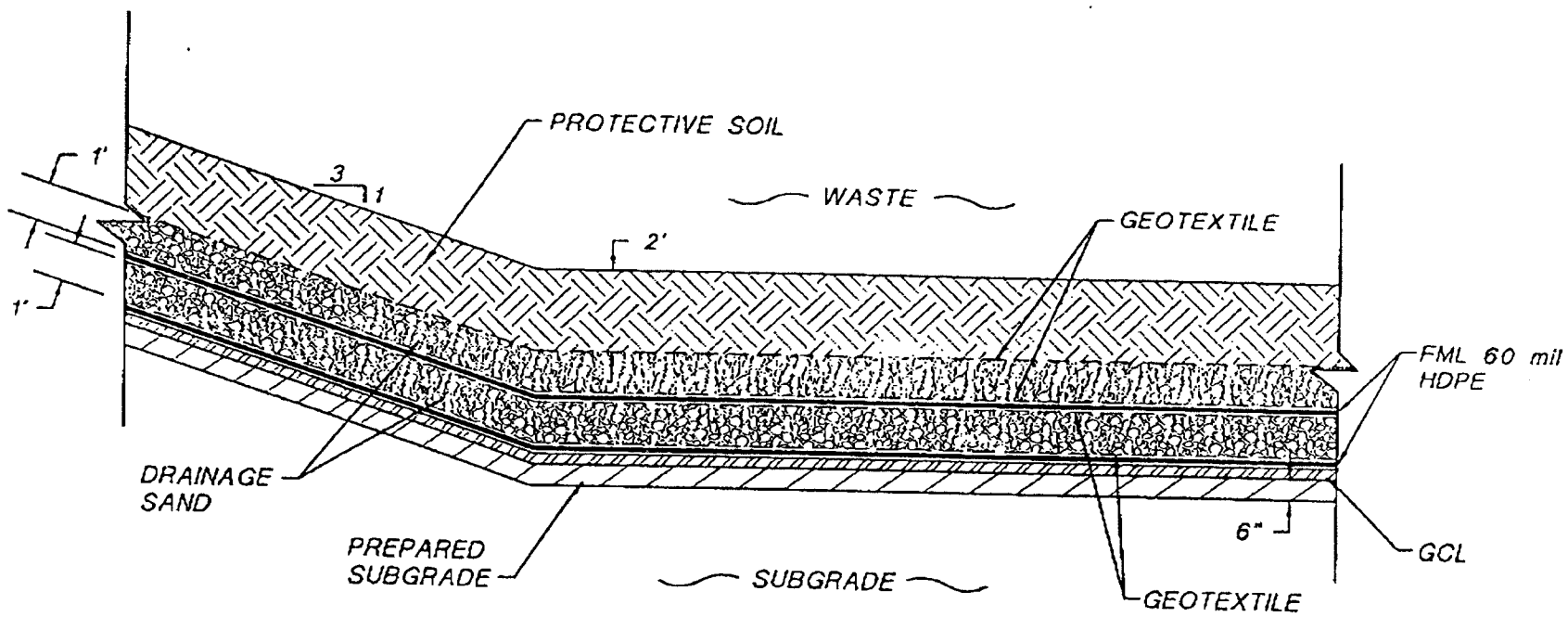
Notes: (1) Values based on average annual totals


TABLE 2						
YEARS	LINER SECTION	PRIMARY LATERAL DRAINAGE (gal/acre/day)(1)	PRIMARY LINER LEAKAGE (gal/acre/day)(1)	SECONDARY LATERAL DRAINAGE (gal/acre/day)(1)	SECONDARY LINER LEAKAGE (gal/acre/day)(1)	COMMENTS
FLOOR						
	MTR	34.770215	69.762756	68.786743	0.062242	
	1	34.770215	69.762756	68.837794	0.010493	
	2	38.263331	66.639139	66.636821	0.000184	
0-20	3	104.900152	0.000184	0.000020	0.000184	
	4	38.263331	66.639136	19.139699	47.497920	
	4A	38.263331	66.639136	66.636718	0.000287	Includes 6" of subgrade
	5	34.770215	69.762756	21.377707	48.139032	
	5A	29.116541	60.796953	60.008977	0.054516	Includes 6" of subgrade
SLOPE						
	MTR	91.307494	13.548042	13.538737	0.000943	
	1	91.307494	13.548042	13.539454	0.000225	
	2	99.275784	5.627380	5.627380	0.000020	
0-20	3	104.901156	0.000020	0.000000	0.000000	
	4	99.275723	5.627380	NA	NA	
	4A	104.901156	0.000020	NA	NA	Includes 6" of subgrade
	5	34.770133	69.762756	NA	NA	
	5A	103.506992	0.112515	NA	NA	Includes 6" of subgrade
(1) Values based on average annual values						



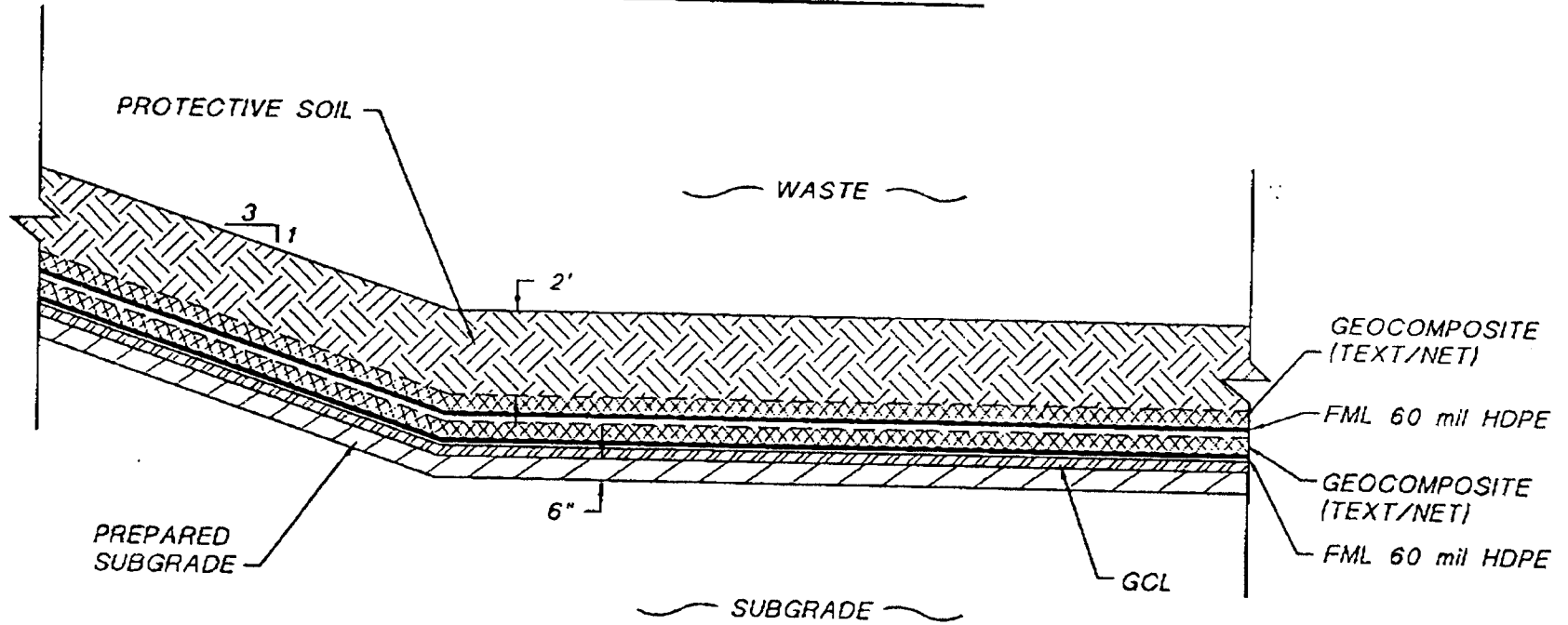
Project No.:	Design By: J. Kendall	Scale: 1/4" = 1'
File:	Drawn By: J. Bever	Date: February 1996
 TerraMatrix <small>Engineering & Environmental Services 200 South Union Boulevard, Suite 100 Lakeland, Colorado 80026</small>		<p>Figure</p>


ALTERNATE 1



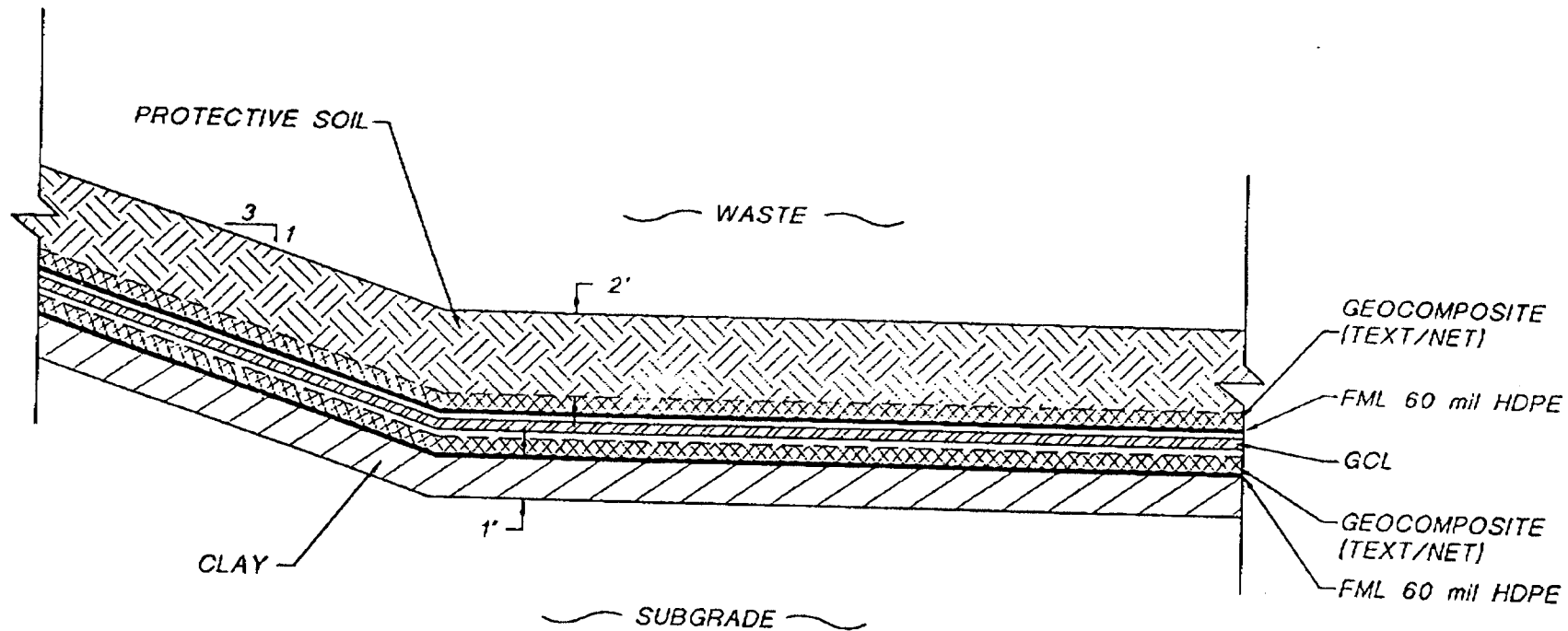
Project No.:	Design By: <i>J. Kendall</i>	Scale: <i>1/4" = 1'</i>	
File:	Drawn By: <i>J. Bever</i>	Date: <i>February 1996</i>	
 TerraMatrix <small>Engineering & Environmental Services 100 South Lake Street, Suite 200 Libertyville, Illinois 60088</small>		<h2 style="margin: 0;">Figure</h2>	


ALTERNATE 2



Project No.:	Design By: <i>J. Kendall</i>	Scale: <i>1/4" = 1'</i>	
File:	Drawn By: <i>J. Bever</i>	Date: <i>February 1996</i>	
 TerraMatrix <small>Specialized Geotechnical Services 100 Street, Miami, Oklahoma, Suite 100 Lawton, Oklahoma 73844</small>		Figure	

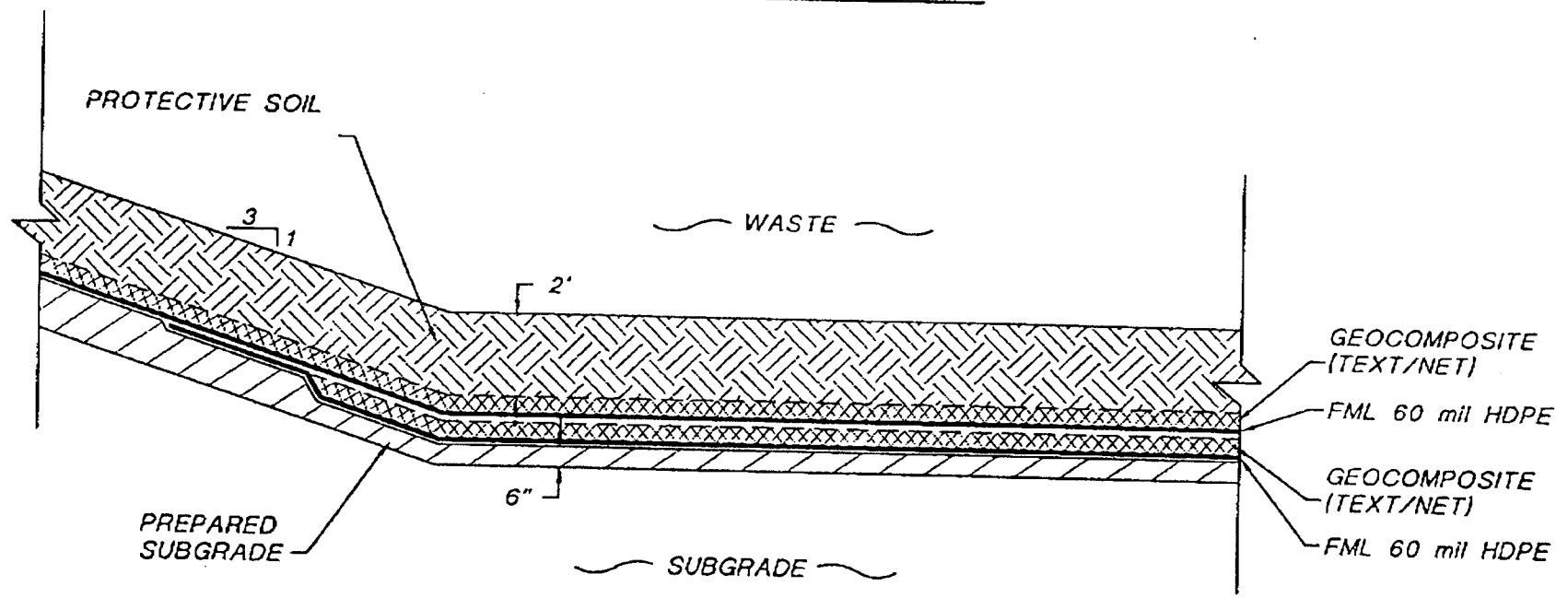
ALTERNATE 3




Project No.:	Design By: <i>J. Kendall</i>	Scale: <i>1/4" = 1'</i>	
File:	Drawn By: <i>J. Bever</i>	Date: <i>February 1996</i>	
 TerraMatrix <small>Engineering & Environmental Services 200 South Union Street, Suite 100 Salt Lake City, Utah 84111</small>		<h2 style="margin: 0;">Figure</h2>	

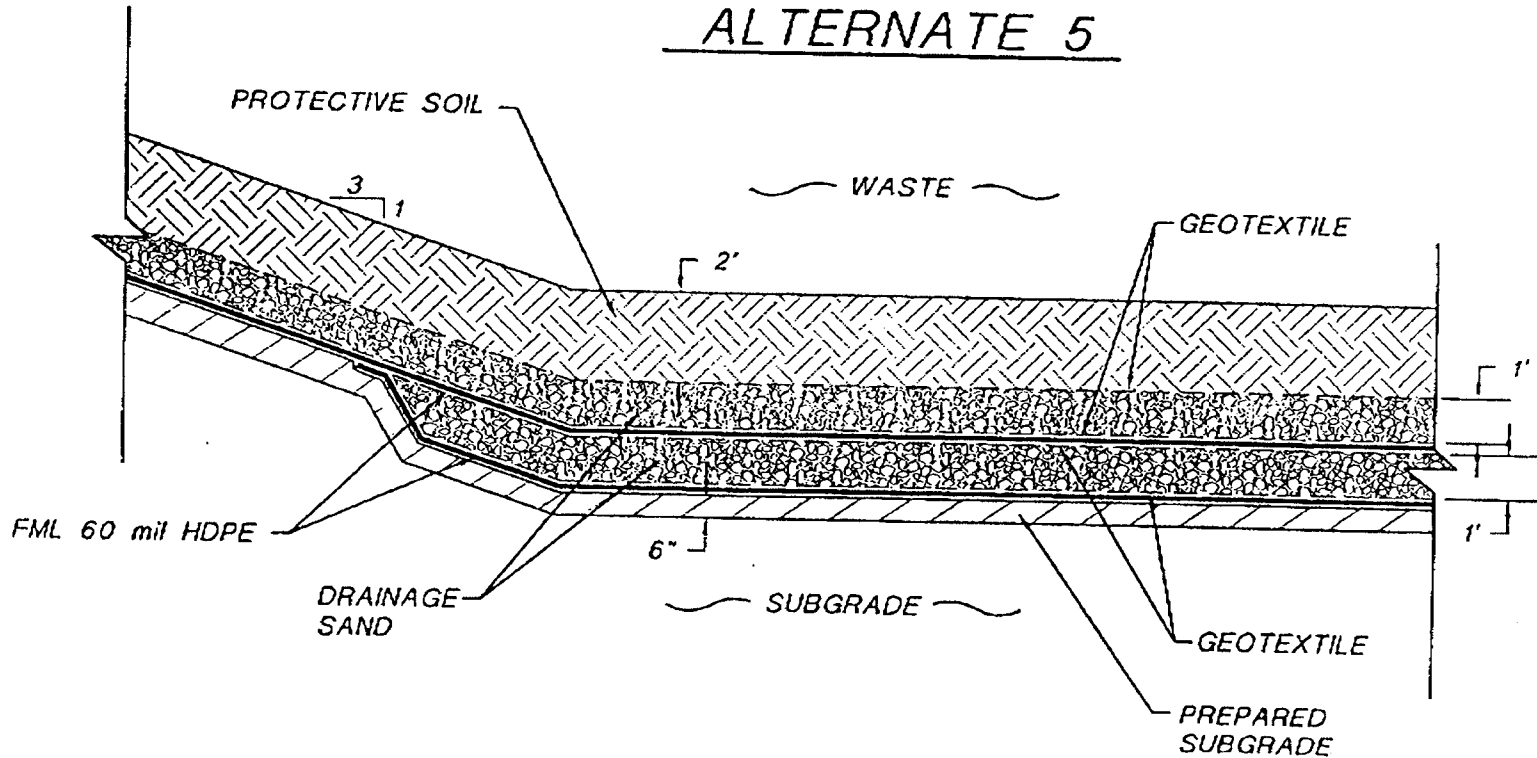
ID: 37638003
 FEB 13 1996
 10:56 No. 003 P. 12


ALTERNATE 4

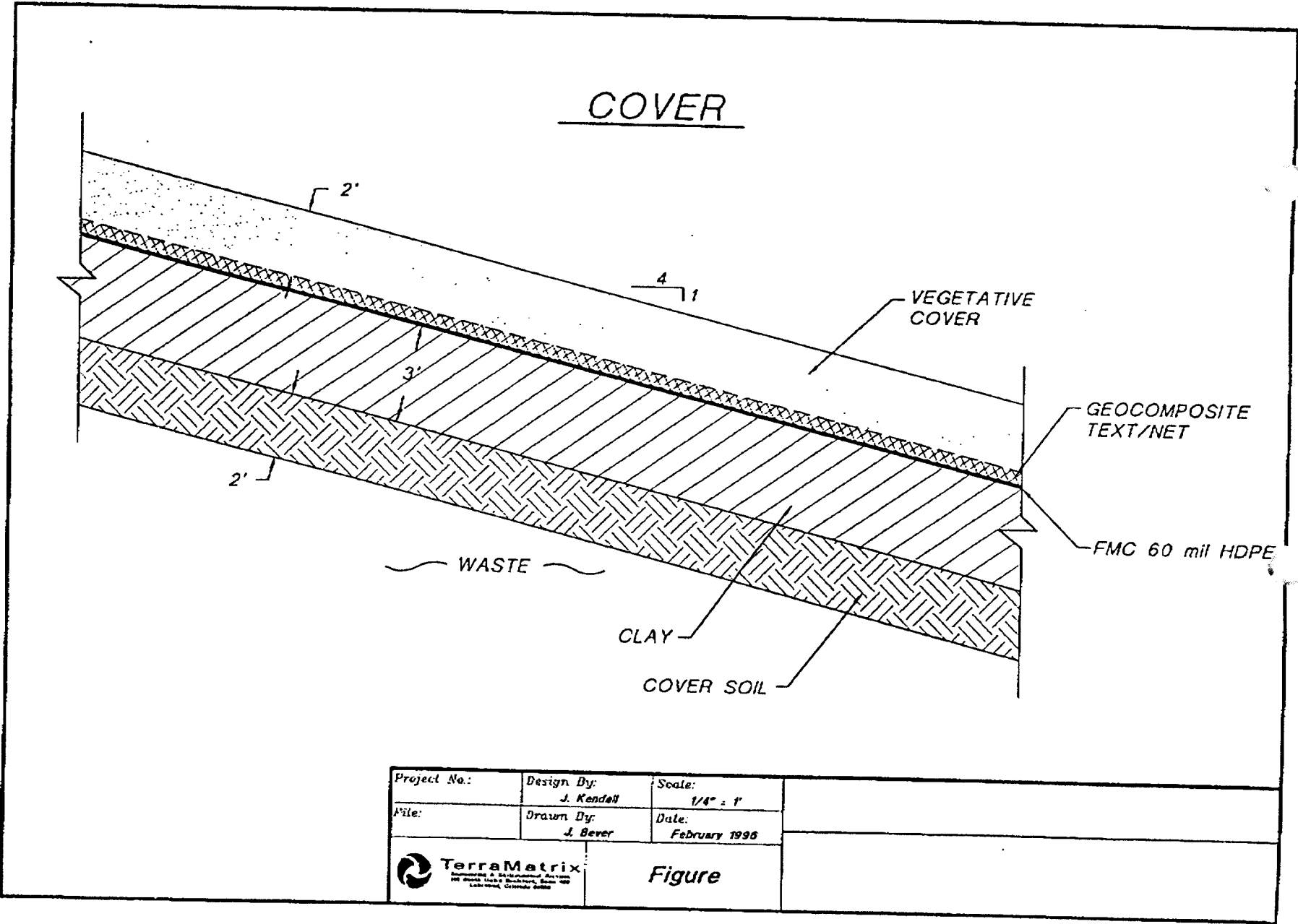



Project No.:	Design By: J. Kendall	Scale: 1/4" = 1'	
File:	Drawn By: J. Bever	Date: February 1996	
 TerraMatrix <small>Engineering & Environmental Services 200 South Main Street, Suite 200 Milford, Connecticut 06460</small>		<h2>Figure</h2>	

ALTERNATE 5



Project No.:	Design By: J. Kendall	Scale: 1/4" = 1'
File:	Drawn By: J. Bever	Date: February 1996
 TerraMatrix <small>Manufacturing & Environmental Services 200 South York St. #200 Lakeland, Florida 34601</small>		<h2>Figure</h2>



Project No.:	Design By: J. Kendall	Scale: 1/4" = 1'	
File:	Drawn By: J. Bever	Date: February 1996	
 TerraMatrix Environmental & Geotechnical Services 100 South Linn Street, Suite 400 Lakewood, Colorado 80401		Figure	