



## **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.

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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 Alternate 2 Alternate 4 with 6 inches prepared subgrade	0.000184 0.000184 0.000287	0.000000 0.000020 0.000002
2	Alternate 1 Alternate 5 with 6 inches prepared subgrade MTR	0.010493 0.054516 0.062242	0.000225 0.112515 0.000943
3	Alternate 4 without prepared subgrade Alternate 5 without prepared subgrade	47.497920 48.139032	5.627380 69.762756



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- 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	

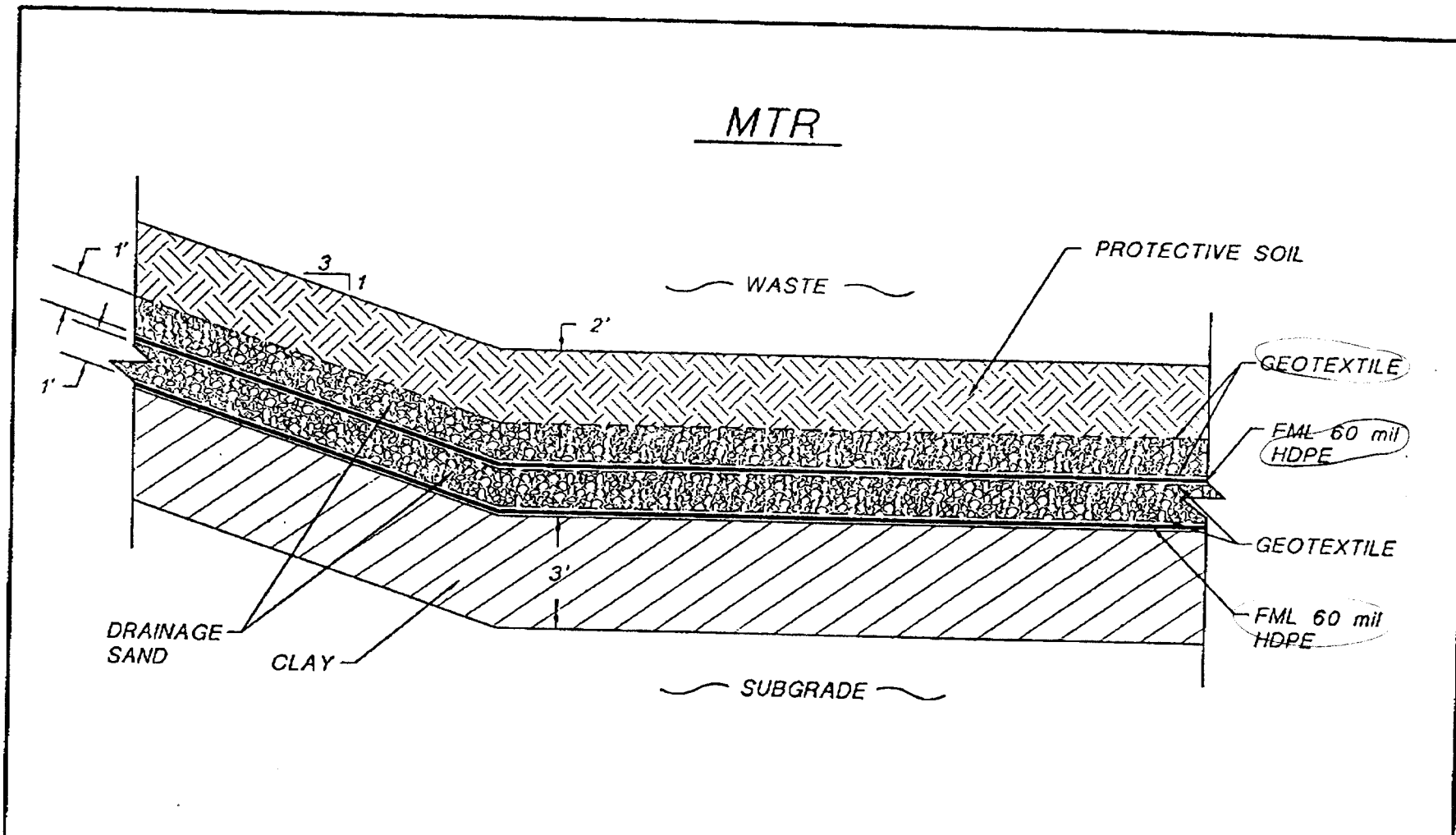
	MTR	0.000000	0.000000	0.000000	0.000000	
	1	0.000000	0.000000	0.000000	0.000000	
11	2	116.866483	5.764161	5.764161	0.000020	
	3	122.632079	0.000200	0.000000	0.000000	
	4	118.226299	5.770248	NA	NA	
	5	0.000000	0.000000	NA	NA	
	MTR	0.000000	0.000000	0.000000	0.000000	
	1	0.000000	0.000000	0.000000	0.000000	
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
<b>FLOOR</b>						
	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
<b>SLOPE</b>						
	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

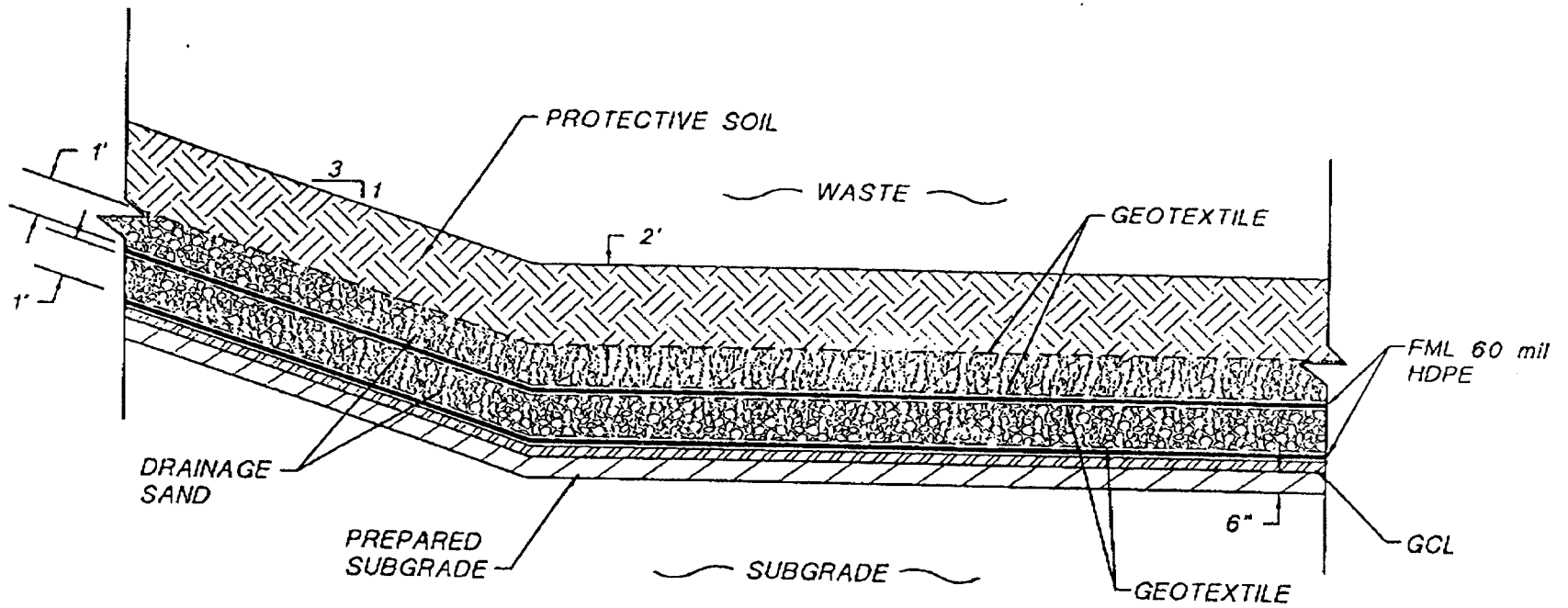
(1) Values based on average annual values



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File:	Drawn By: J. Bever	Date: February 1996	
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# ALTERNATE 1

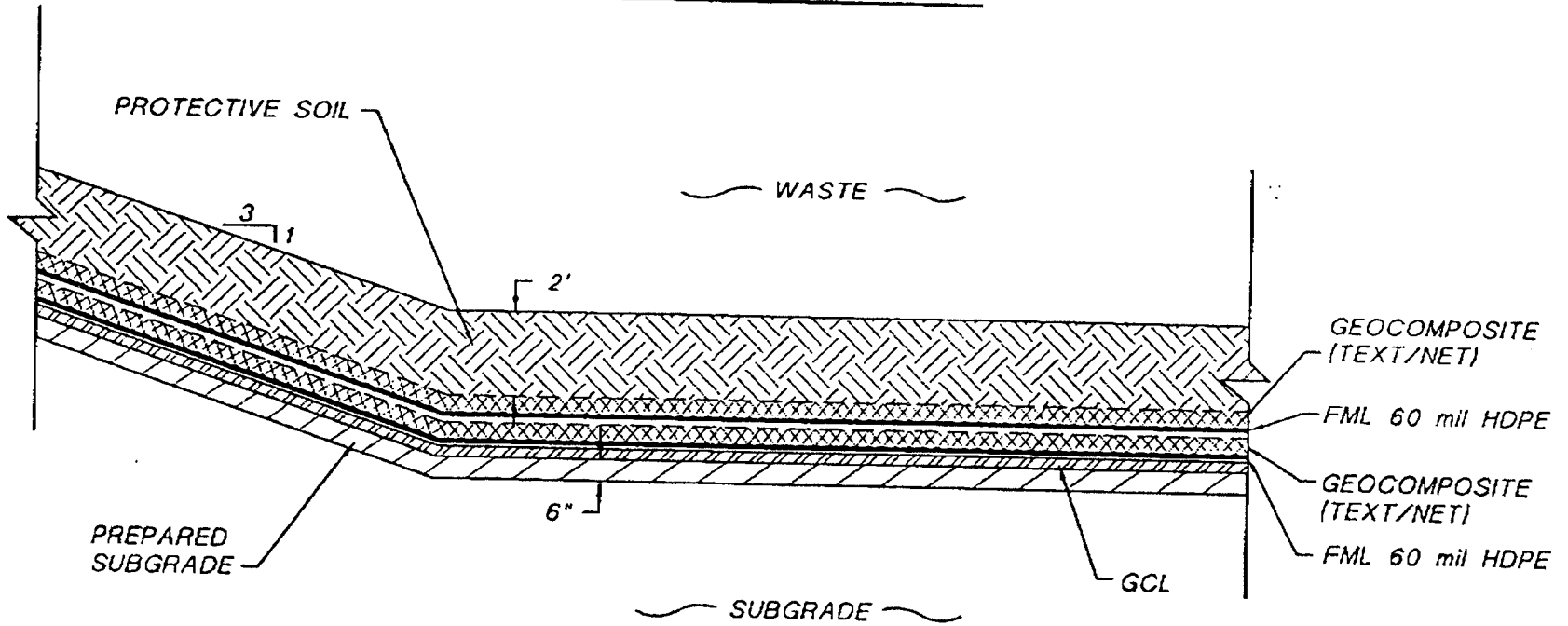



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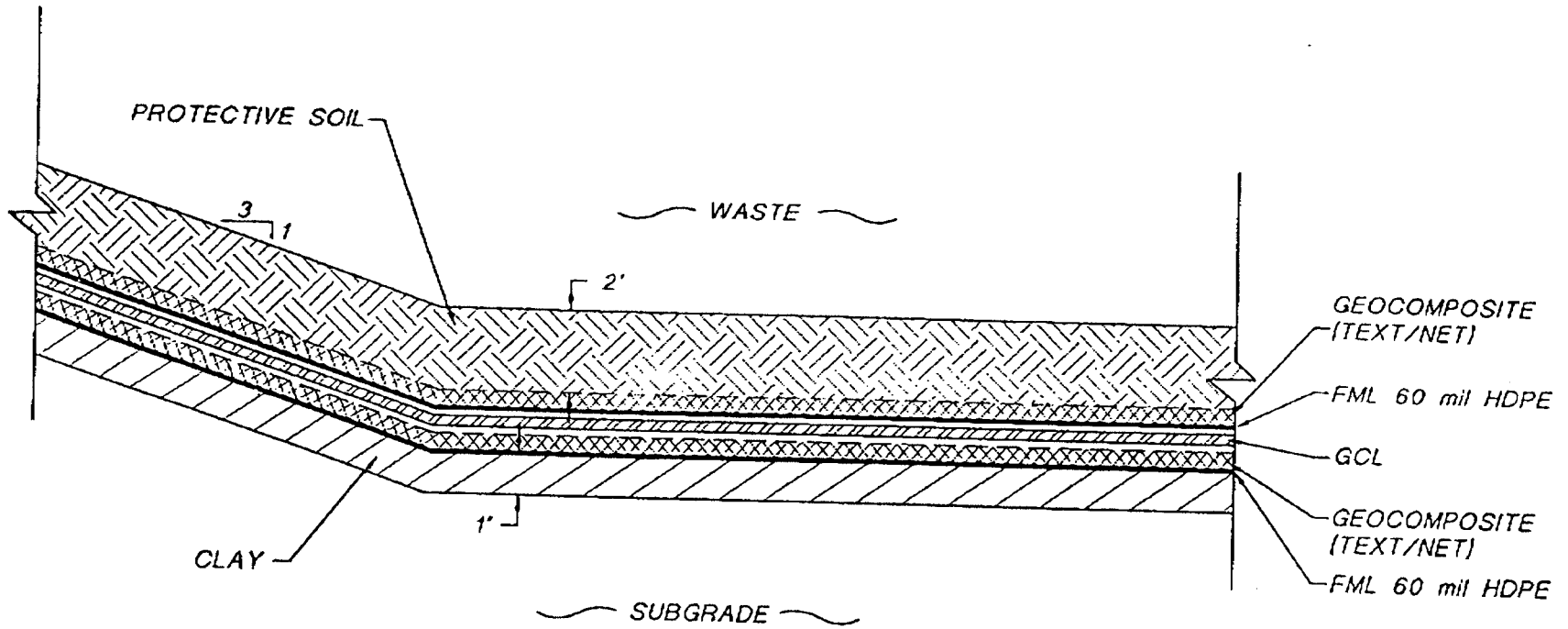
**Figure**


# ALTERNATE 2



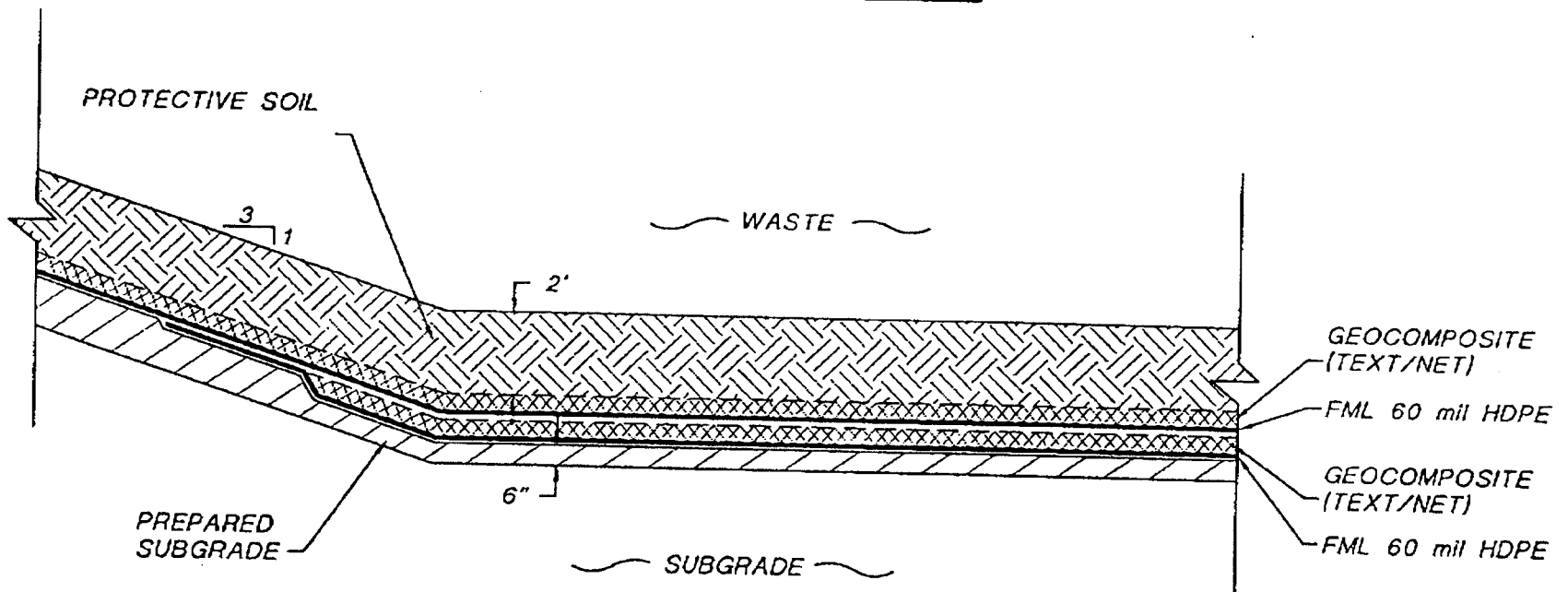
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File:	Drawn By: J. Bever	Date: February 1996	
 <b>TerraMatrix</b> <small>Engineering &amp; Construction Services          100 South Main Street, Suite 100          Lakeland, Florida 33801</small>		<h2 style="margin: 0;">Figure</h2>	


# ALTERNATE 3

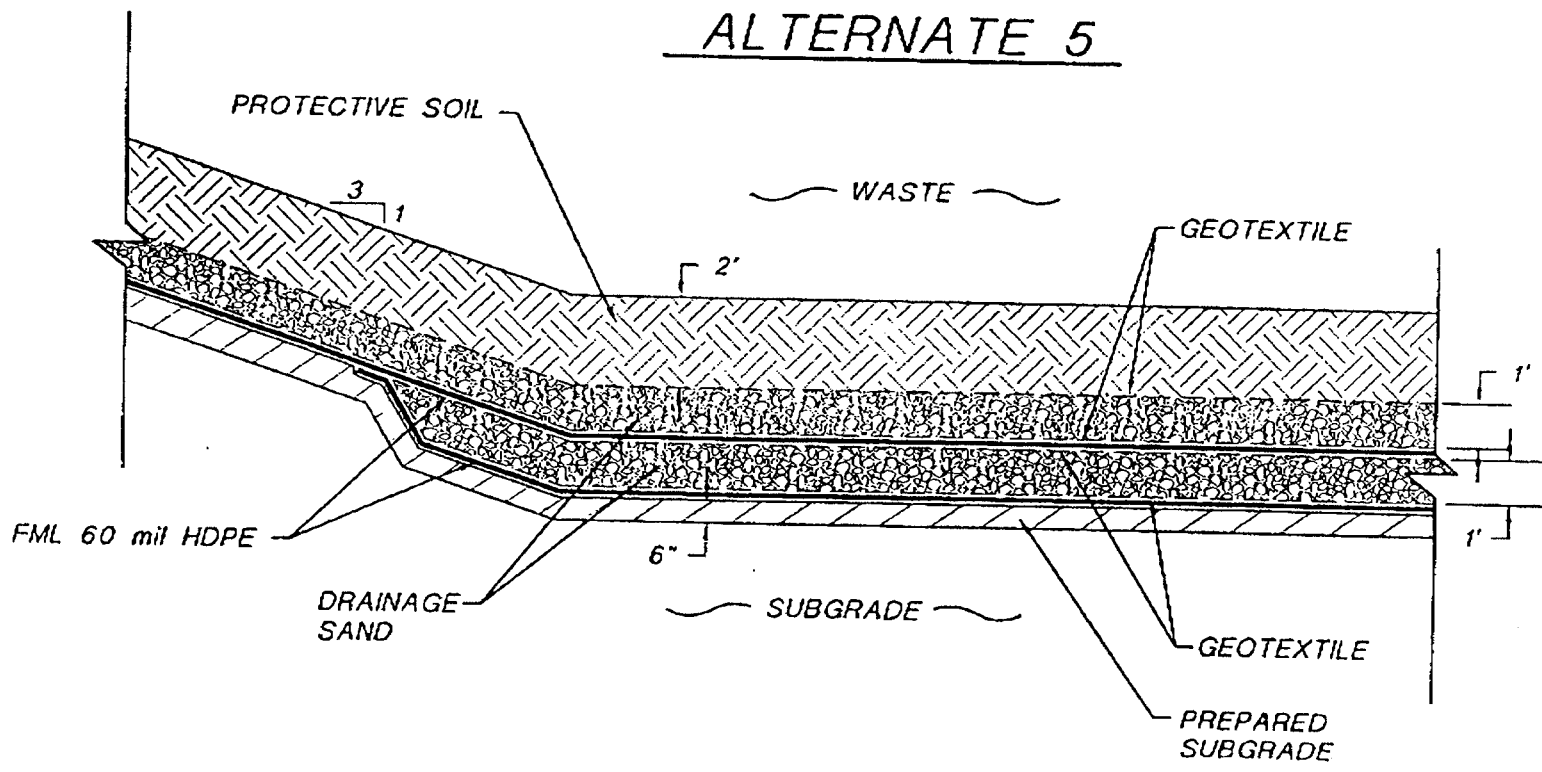


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 <b>TerraMatrix</b> <small>Engineering &amp; Environmental Services 200 South Main Street, Suite 100 Salt Lake City, Utah 84143</small>		<b>Figure</b>	

# ALTERNATE 4



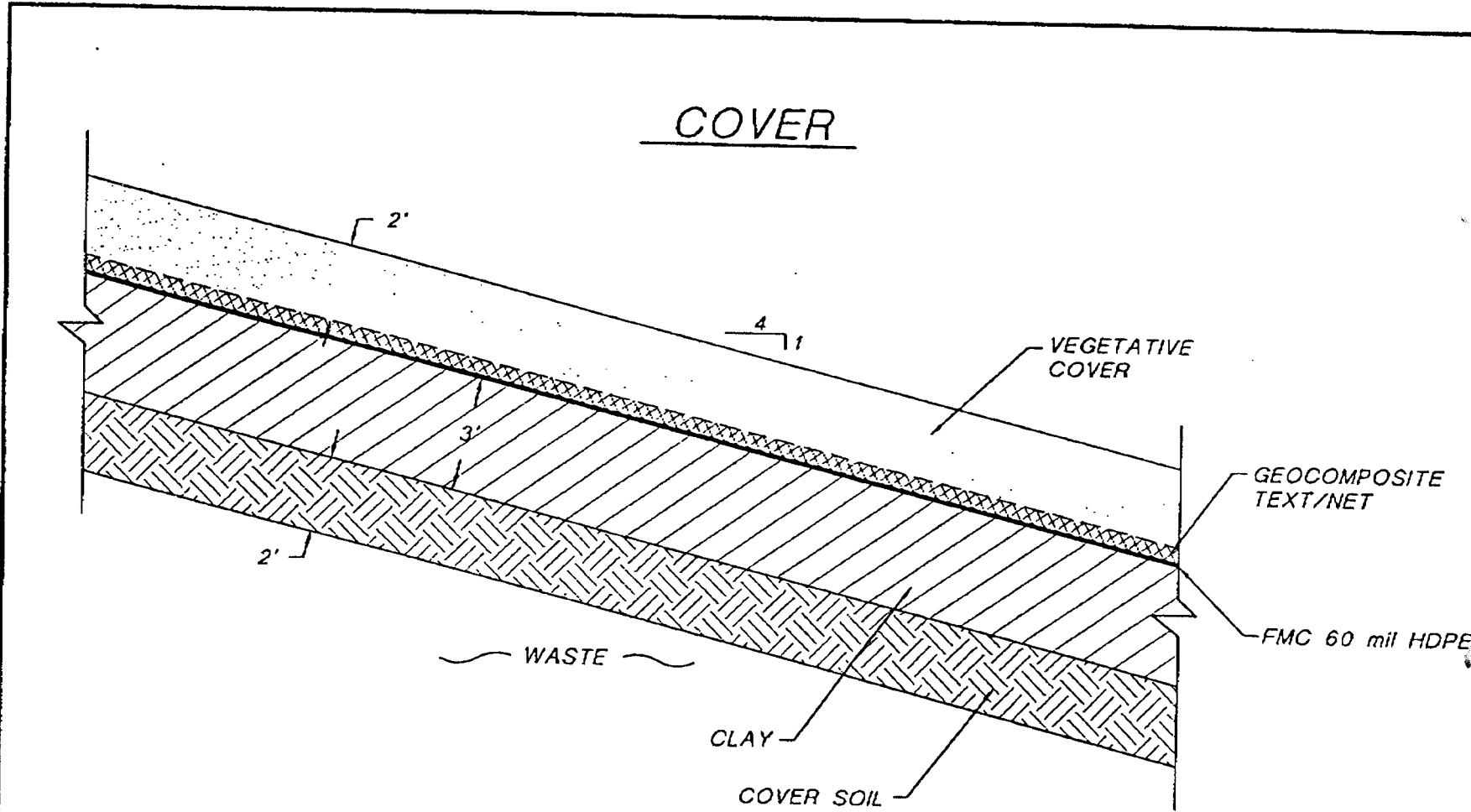
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File:	Drawn Dy: J. Bever	Date: February 1996
 <b>TerraMatrix</b> <small>Engineering &amp; Environmental Services          200 South Main, Annapolis, MD 21401          410.291.4200</small>		<p><b>Figure</b></p>




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Figure



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File:	Drawn By: J. Bever	Date: February 1996
 <b>TerraMatrix</b> <small>Environmental &amp; Geotechnical Services          100 South Lake Street, Suite 400          Lake View, Chicago, Illinois</small>		Figure