

## MEMORANDUM

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<b>Date:</b>	17 April 2020	<b>File No.:</b>	30100825/01/M1
		<b>Cont. No.:</b>	30100825/01/M1
<b>To:</b>	Mr. Katlego Sebashe Mr. Thoka Mocheke		
<b>Copy To:</b>	AM Copeland (KP) JR Williamson (KP) JH Viljoen (KP) T Mokoma (KP)		
<b>From:</b>	R Greyling (KP)		
<b>Re:</b>	<b>Task Order #966 - Matimba Power Station Continuous Ashing Project</b> <b>Final Liner Interface Testing Results and Stability</b>		

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In compliance with the request by Eskom to perform the liner interface testing, samples as per the specifications was obtained from South African distributors. At present no South African laboratory was able comply to the testing requirements for the liner interface testing and therefor the samples were shipped to the Knight Piesold Laboratory in Denver Colorado, USA.

### 1.0 SAMPLE DESCRIPTION

The samples obtained for the liner interface testing can be described as follows:

- Geosynthetic clay liner, X1000, GCL coupons from Kaytech, all 4 edges taped per D6072 code
- Bidim A6 Geofabric coupons from Kaytech
- 2 mm SST HDPE single textured liner from AKS lining Systems

The coupons were sized to be used in a 300 x 300 mm shearbox.

### 2.0 INTERFACE TESTING DESCRIPTION

The interface testing was done in a Karol Warner 300 x 300 mm shear box apparatus with a rate of displacement of 1.0 mm/min for each stress. The testing procedure for each set of the three different interface scenarios will be described in section 2.1 to 2.3.

#### 2.1 GCL VS HDPE TESTING PROCEDURE

Geosynthetic clay liner ASTM D 6243, Procedure A, 2 mm SST HDPE (textured side) vs GCL X1000 (non-woven side):

- The GCL coupon was inundated under load for one hour,
- The interface was inundated during consolidation and shear displacement.

## 2.2 A6 GEOFABRIC VS HDPE TESTING PROCEDURE

Geosynthetic interface test ASTM D 5321, Procedure A, A6 Geofabric ss 2 mm SST HDPE (smooth side):

- The geomembrane coupon was fixed at the bottom box half and the geofabric was anchored to the upper box half,
- The surface of the geomembrane was sprayed prior to testing,
- The geomembrane was tested in machine direction.

## 2.3 GCL VS SOIL TESTING PROCEDURE

Geosynthetic clay liner ASTM D 6243, Procedure B, Internal shear X1000 GCL:

- The GCL coupon was inundated under load for 24 hours prior to shearing,
- The interface was inundated during consolidation and shear displacement.

## 3.0 INTERFACE TESTING RESULTS

The interface testing results for the 3 different scenarios are presented in Table 3.1 along with the corresponding friction angles required for input in the slope stability program SLIDE:

**Table 3.1 Interface shear testing strength results and corresponding friction angle**

Case		Normal Stress (kPa)			Friction Angle (degrees)
		175	350	700	
2mm Textured HDPE vs.GCL	Peak	120	200	300	19.5
	Normal	60	110	180	12.5
A6 geofabric vs. 2 mm smooth HDPE	Peak	45	100	200	17.3
	Normal	40	70	140	10.7
GCL Internal	Peak	180	230	350	16.9
	Post Peak	120	120	200	9.6

As expected, HDPE liner vs. the A6 Geofabric resulted in the lowest shear stresses and the internal GCL friction angle was calculated from the stresses as the lowest friction angle of the different combinations.

## 4.0 SLOPE STABILITY INTERPRETATION

For the slope stability analysis during the project phase the following assumptions and procedures was followed:

- The Jones and Wagener interface testing results was used to simulate a weak layer representing the barrier system. Their measured friction angles for barrier system input in the stability models ranged from 3 degrees up to 9 degrees for the different scenarios,
- For the KP analysis the average of these result (6 degrees) was used as a worst-case scenario and to simulate the weak layer that represents the barrier system
- From the resent results (Table 3.1) it can be seen that the lowest friction angle obtained under the testing conditions described and for the specific samples obtained is 9.6 degrees.
- As the initial analysis has proved, changing the friction angle for the barrier system from 6 degrees to 9 degrees does not result in an increase of the factor of safety of more than 0.01. It was therefore decided not to rerun the slope stability analysis as the analysis was done for worse case initially and therefor is considered to be conservative.

Yours truly,  
**Knight Piésold Ltd.**

Prepared:



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R Greyling, PrEng 201901026  
Senior Civil Engineer



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JRG Williamson, Pr.Eng 704312  
Technical Consultant

Approval that this document adheres to Knight Piésold Quality Systems:

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**Attachments: Test Reults**

L2020-023 Tex HDPE vs GCL Rev 0

L2020-023 A6 Geofabric Vs Smooth Side 2mm Rev0

L2020-023 GCL Interface Rev0

### Soil / Geosynthetic Interface Test Report

Project	Matimba Power Station Ash Dump	Project No.	RI301-00825/01
Lab No.	L2020-023	Date Tested	3/24--3/27/20
Test Description	2 mm SST HDPE (textured side) vs GCLX1000 (non-woven side)		
Sample I.D.:	_____		
Normal Stress Range, kPa	175      350      700	Total No. of Points Requested	3
Geomembrane Data	Elcseal X1000		
Manufacturer	Geofabrics		
Lot No.	UNK		
Roll No.	UNK	Textured?	NA
Specified Thickness, mil	NA	Peak to Peak Thickness, mil	NA

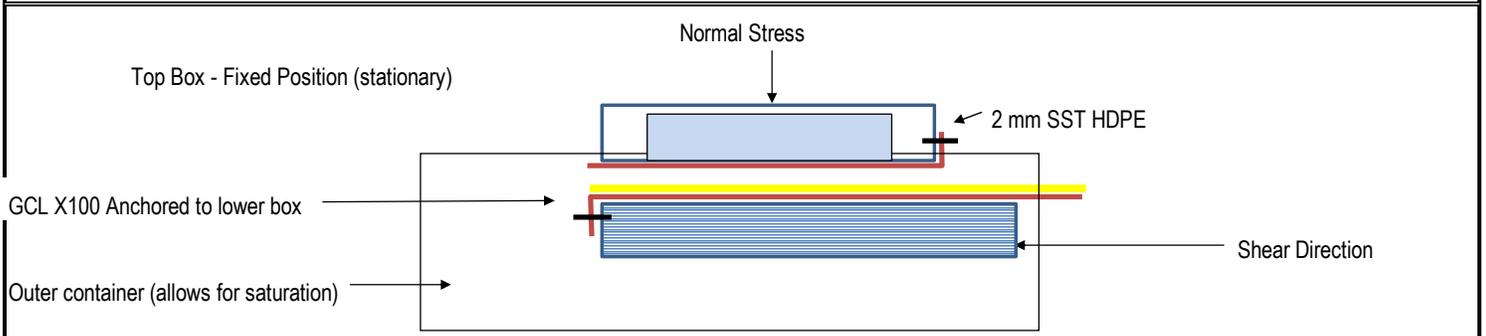
Observations: No visible damage noted on post-test coupons at any of the three stresses.

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Upper Box Half Description	2 mm SST HDPE
Lower Box Half Description	RIGID PLATE W/ Machined screws (dim.'s: 15.95 x 11.95 x 1.0 inches)



**Default Test Descriptions (unless noted otherwise)**

- 1 The test was performed in a Karol Warner 300mm shear device.
- 2 The rate of displacement was 0.04 in./min. (1.0 mm/min.) for each stress.
- 3 The GCL coupon was inundated under load for 1 hour.
- 4 Load increments were recorded in 1 lbf increments.
- 5 The Geosynthetic coupons are available for inspection at the lab.
- 6 The interface was inundated during consolidation and shear displacement.

Geosynthetic Clay Liner - ASTM D 6243, Procedure A  
300mm Shear Device  
Matimba Power Station Ash Dump  
KP Rivoinia  
RI301-00825/01

2 mm SST HDPE (textured side) vs GCLX1000 (non-woven side)

175 kPa Normal Stress				350 kPa Normal Stress				700 kPa Normal Stress			
Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress	Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress	Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress
inches	mm	lbs	kPa	inches	mm	lbs	kPa	inches	mm	lbs	kPa
0.000	0.000	0	0	0.000	0.000	0	0	0.000	0.000	0	0
0.020	0.500	655	31	0.019	0.488	675	32	0.022	0.554	1382	66
0.039	0.983	916	44	0.040	1.024	1275	61	0.039	0.986	2252	108
0.057	1.458	1153	55	0.062	1.567	1807	87	0.056	1.420	3178	152
0.077	1.951	1318	63	0.084	2.144	2270	109	0.074	1.887	3863	185
0.096	2.438	1420	68	0.104	2.631	2503	120	0.097	2.466	4479	214
0.116	2.939	1519	73	0.123	3.134	2619	125	0.120	3.058	4743	227
0.136	3.444	1615	77	0.143	3.632	2763	132	0.144	3.653	4938	236
0.155	3.937	1706	82	0.163	4.128	2898	139	0.164	4.166	5094	244
0.175	4.432	1793	86	0.182	4.613	3022	145	0.184	4.671	5235	251
0.194	4.923	1875	90	0.202	5.121	3137	150	0.204	5.187	5363	257
0.214	5.428	1952	93	0.222	5.629	3247	155	0.224	5.677	5487	263
0.234	5.933	2026	97	0.241	6.119	3355	161	0.244	6.198	5612	269
0.253	6.434	2097	100	0.261	6.624	3455	165	0.264	6.695	5732	274
0.273	6.937	2160	103	0.280	7.120	3549	170	0.284	7.203	5846	280
0.293	7.435	2220	106	0.300	7.628	3634	174	0.304	7.727	5946	285
0.313	7.945	2277	109	0.320	8.128	3713	178	0.324	8.232	6041	289
0.332	8.435	2325	111	0.340	8.631	3790	181	0.344	8.733	6131	294
0.352	8.938	2367	113	0.360	9.131	3863	185	0.365	9.258	6218	298
0.371	9.434	2400	115	0.379	9.622	3926	188	0.384	9.754	6283	301
0.391	9.934	2420	116	0.399	10.122	3986	191	0.404	10.254	6311	302
0.411	10.434	2420	116	0.418	10.617	4040	193	0.420	10.663	6300	302
0.430	10.925	2387	114	0.438	11.120	4078	195	0.436	11.079	6254	299
0.450	11.433	2316	111	0.457	11.618	4100	196	0.452	11.481	6164	295
0.471	11.953	2231	107	0.478	12.139	4096	196	0.469	11.902	6033	289
0.491	12.459	2154	103	0.497	12.624	4054	194	0.489	12.426	5863	281
0.511	12.967	2066	99	0.517	13.134	3986	191	0.510	12.946	5683	272
0.531	13.475	1971	94	0.537	13.640	3894	186	0.530	13.465	5503	263
0.550	13.975	1893	91	0.557	14.155	3790	181	0.551	13.985	5325	255
0.570	14.478	1841	88	0.578	14.674	3687	177	0.571	14.508	5153	247
0.590	14.978	1812	87	0.597	15.166	3565	171	0.591	15.016	5027	241
0.610	15.481	1806	86	0.618	15.687	3450	165	0.612	15.547	4940	237
0.629	15.984	1805	86	0.637	16.185	3359	161	0.632	16.055	4875	233
0.649	16.472	1779	85	0.658	16.701	3285	157	0.652	16.558	4804	230
0.669	16.985	1745	84	0.678	17.211	3231	155	0.672	17.074	4731	227
0.689	17.490	1709	82	0.697	17.704	3170	152	0.693	17.592	4671	224
0.708	17.983	1675	80	0.717	18.217	3114	149	0.712	18.087	4613	221
0.728	18.486	1638	78	0.737	18.715	3069	147	0.733	18.608	4544	218
0.748	18.989	1600	77	0.756	19.213	3020	145	0.753	19.124	4471	214
0.767	19.474	1578	76	0.777	19.733	2956	142	0.773	19.639	4403	211
0.787	19.985	1561	75	0.796	20.226	2903	139	0.794	20.163	4332	207
0.806	20.483	1561	75	0.817	20.739	2860	137	0.813	20.658	4289	205
0.826	20.978	1569	75	0.836	21.245	2822	135	0.834	21.176	4265	204
0.846	21.476	1576	75	0.856	21.742	2790	134	0.854	21.681	4237	203
0.865	21.979	1558	75	0.876	22.261	2760	132	0.873	22.184	4192	201
0.885	22.474	1543	74	0.896	22.746	2759	132	0.894	22.710	4154	199
0.905	22.984	1527	73	0.916	23.256	2733	131	0.914	23.216	4126	198
0.924	23.480	1507	72	0.935	23.752	2720	130	0.934	23.724	4112	197

Geosynthetic Clay Liner - ASTM D 6243, Procedure A  
300mm Shear Device  
Matimba Power Station Ash Dump  
KP Rivoinia  
RI301-00825/01

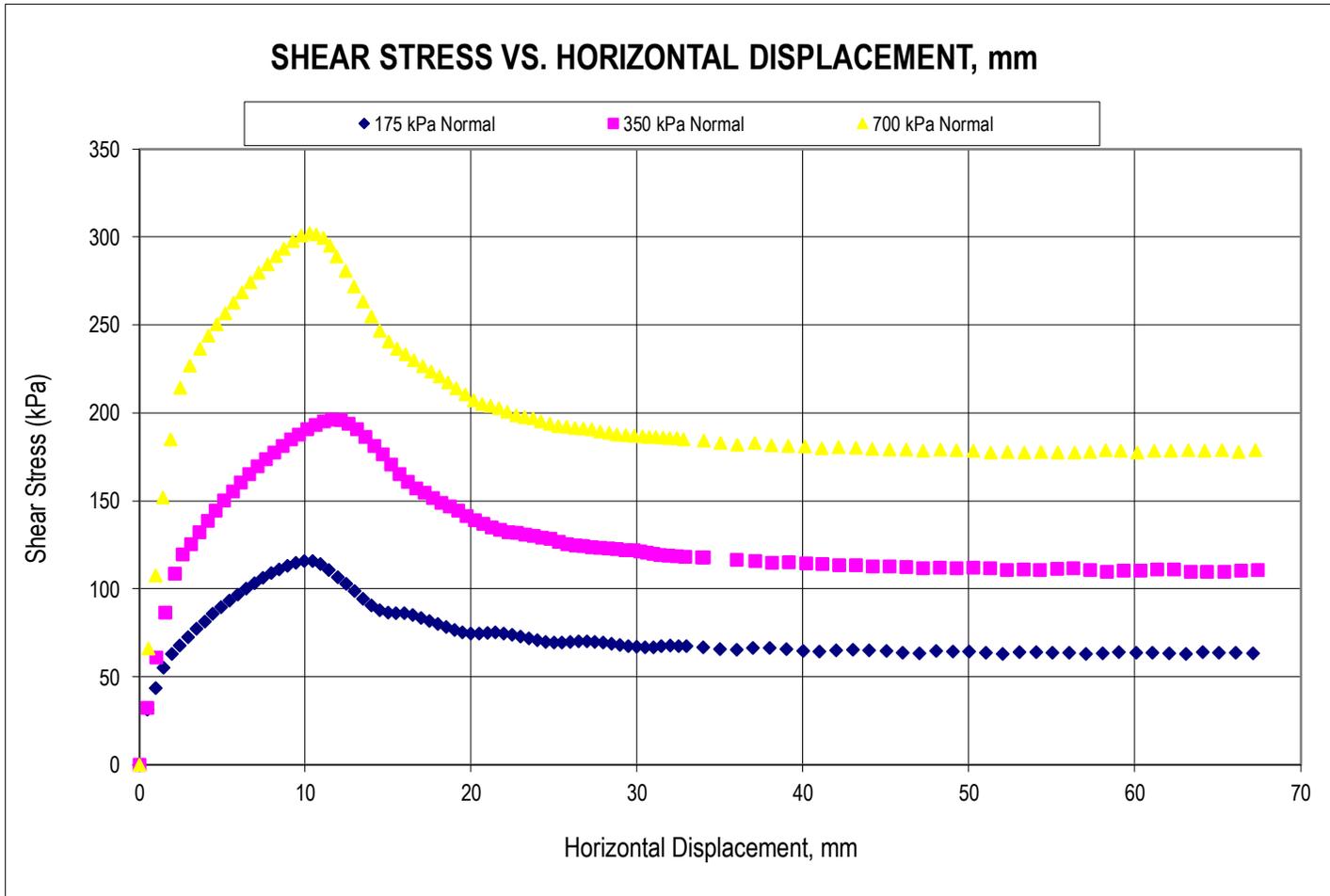
2 mm SST HDPE (textured side) vs GCLX1000 (non-woven side)

175 kPa Normal Stress				350 kPa Normal Stress				700 kPa Normal Stress			
Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress	Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress	Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress
inches	mm	lbs	kPa	inches	mm	lbs	kPa	inches	mm	lbs	kPa
0.944	23.980	1480	71	0.956	24.275	2702	129	0.953	24.216	4082	195
0.964	24.473	1464	70	0.975	24.762	2682	128	0.974	24.737	4052	194
0.984	24.983	1452	70	0.995	25.270	2650	127	0.994	25.248	4025	193
1.003	25.476	1452	70	1.016	25.794	2624	126	1.014	25.745	4012	192
1.023	25.982	1458	70	1.035	26.279	2610	125	1.034	26.264	4003	192
1.042	26.477	1465	70	1.054	26.774	2598	124	1.054	26.772	3996	191
1.062	26.977	1469	70	1.074	27.280	2586	124	1.074	27.280	3988	191
1.081	27.468	1462	70	1.093	27.772	2578	123	1.094	27.793	3961	190
1.101	27.970	1451	69	1.114	28.285	2571	123	1.114	28.303	3941	189
1.121	28.468	1441	69	1.133	28.783	2564	123	1.134	28.804	3925	188
1.141	28.981	1427	68	1.153	29.294	2553	122	1.154	29.319	3917	188
1.161	29.479	1411	68	1.173	29.799	2548	122	1.175	29.835	3907	187
1.181	29.987	1404	67	1.189	30.198	2536	121	1.195	30.343	3900	187
1.200	30.490	1397	67	1.205	30.599	2520	121	1.211	30.747	3893	186
1.220	30.993	1399	67	1.220	30.993	2508	120	1.226	31.151	3896	187
1.239	31.473	1410	68	1.236	31.394	2495	119	1.243	31.562	3889	186
1.259	31.984	1420	68	1.256	31.905	2485	119	1.259	31.971	3878	186
1.279	32.489	1414	68	1.276	32.413	2478	119	1.275	32.382	3878	186
1.299	32.990	1409	67	1.296	32.916	2474	118	1.291	32.794	3867	185
1.338	33.990	1398	67	1.336	33.929	2465	118	1.339	34.016	3849	184
1.378	34.996	1378	66	1.339	34.021	2465	118	1.379	35.037	3826	183
1.417	35.992	1369	66	1.418	36.025	2434	117	1.420	36.058	3805	182
1.457	36.995	1387	66	1.462	37.137	2422	116	1.460	37.074	3821	183
1.495	37.981	1387	66	1.502	38.148	2402	115	1.500	38.087	3796	182
1.535	38.994	1376	66	1.542	39.157	2409	115	1.540	39.116	3788	181
1.575	40.010	1357	65	1.582	40.180	2396	115	1.580	40.129	3778	181
1.614	41.001	1350	65	1.621	41.168	2383	114	1.620	41.140	3759	180
1.654	42.004	1360	65	1.660	42.174	2371	114	1.660	42.159	3771	181
1.693	43.007	1366	65	1.700	43.175	2369	113	1.700	43.180	3770	181
1.732	44.000	1361	65	1.741	44.214	2360	113	1.739	44.181	3755	180
1.773	45.022	1351	65	1.780	45.212	2361	113	1.780	45.215	3746	179
1.812	46.025	1331	64	1.820	46.223	2351	113	1.820	46.218	3742	179
1.852	47.033	1329	64	1.859	47.229	2338	112	1.860	47.247	3734	179
1.891	48.021	1355	65	1.899	48.232	2346	112	1.900	48.265	3744	179
1.930	49.027	1345	64	1.939	49.248	2336	112	1.940	49.273	3738	179
1.969	50.020	1345	64	1.979	50.259	2345	112	1.980	50.282	3728	178
2.009	51.031	1330	64	2.018	51.267	2338	112	2.020	51.305	3712	178
2.048	52.029	1319	63	2.058	52.283	2313	111	2.060	52.329	3714	178
2.089	53.048	1343	64	2.098	53.282	2323	111	2.100	53.345	3713	178
2.128	54.041	1339	64	2.137	54.287	2318	111	2.140	54.364	3716	178
2.167	55.047	1336	64	2.177	55.303	2330	112	2.180	55.362	3707	177
2.206	56.040	1334	64	2.216	56.289	2335	112	2.220	56.385	3706	177
2.247	57.061	1318	63	2.257	57.318	2313	111	2.256	57.302	3715	178
2.286	58.057	1323	63	2.296	58.316	2293	110	2.293	58.230	3735	179
2.325	59.055	1343	64	2.335	59.319	2309	111	2.329	59.144	3731	179

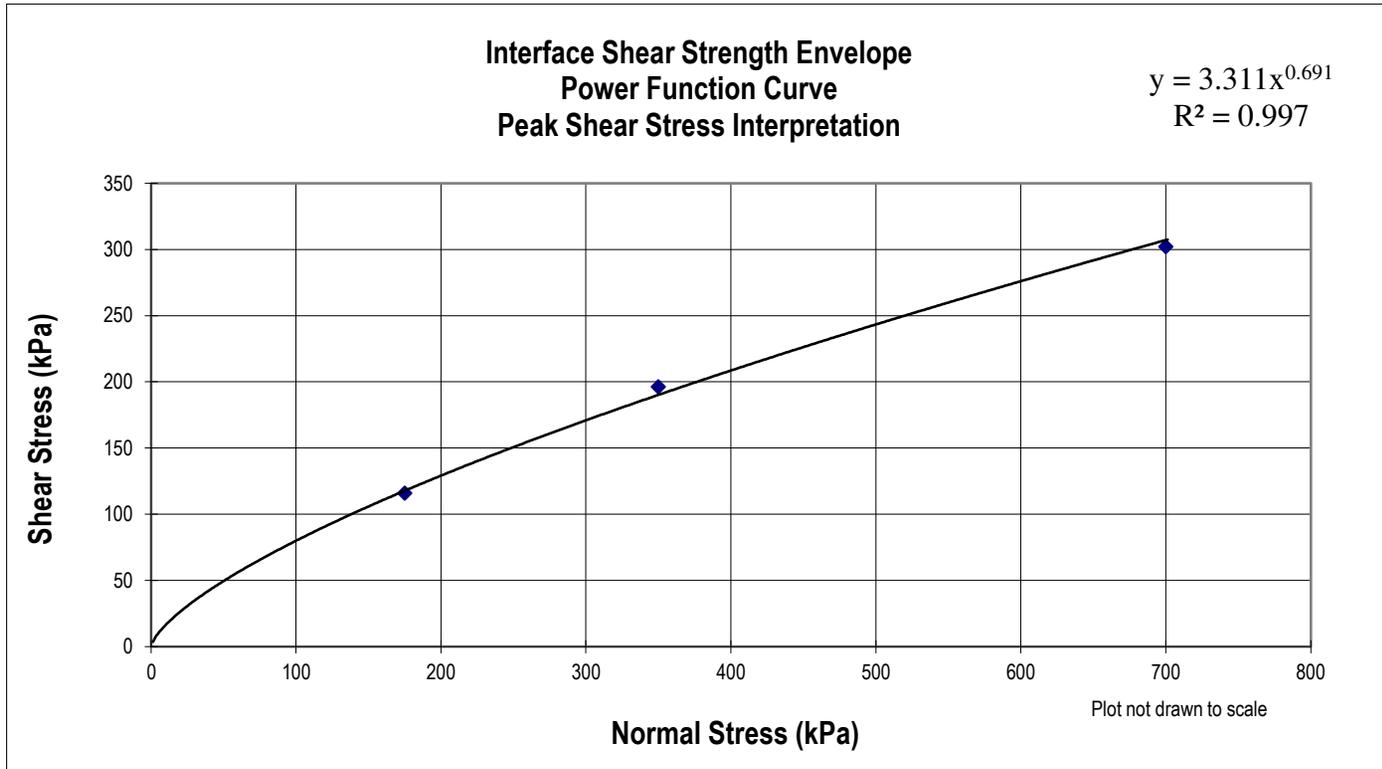
Geosynthetic Clay Liner - ASTM D 6243, Procedure A  
 300mm Shear Device  
 Matimba Power Station Ash Dump  
 KP Rivoinia  
 R1301-00825/01

2 mm SST HDPE (textured side) vs GCLX1000 (non-woven side)

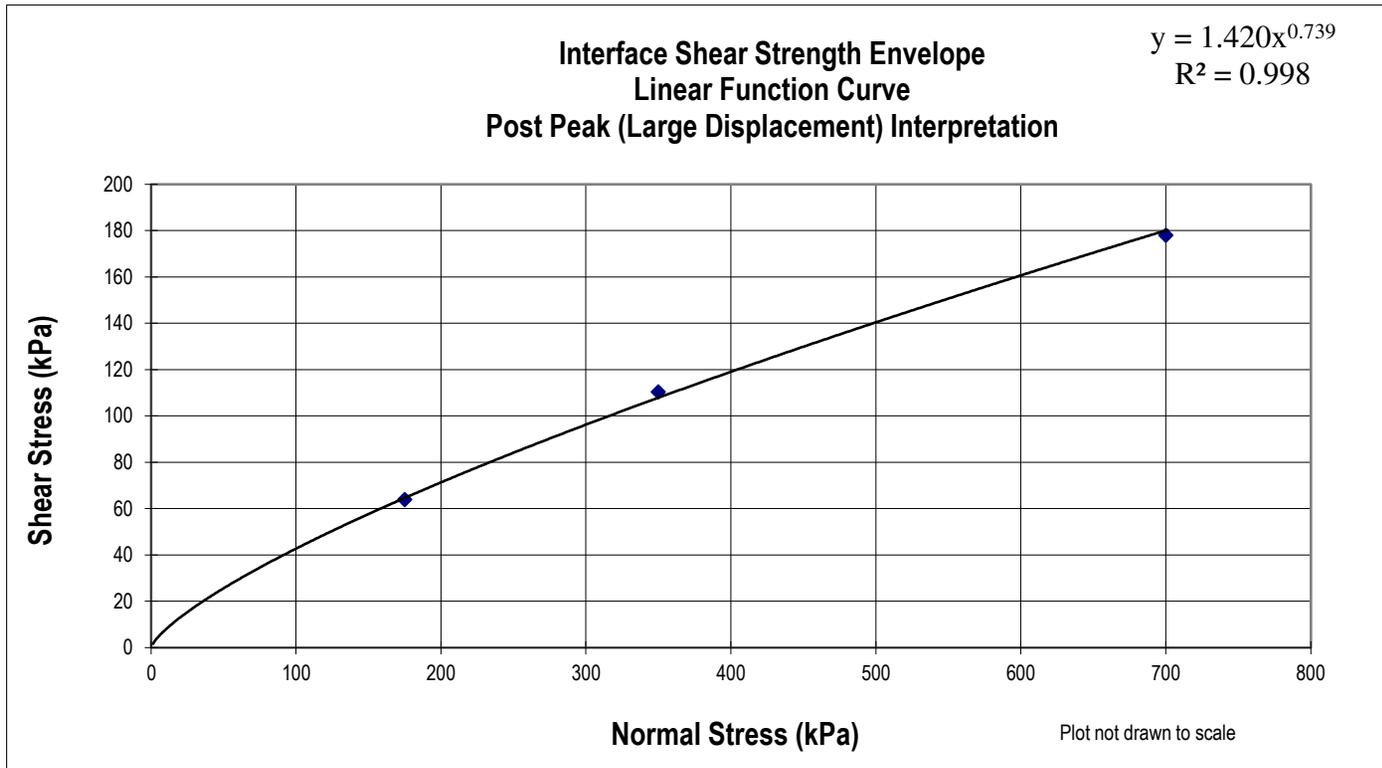
175 kPa Normal Stress				350 kPa Normal Stress				700 kPa Normal Stress			
Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress	Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress	Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress
inches	mm	lbs	kPa	inches	mm	lbs	kPa	inches	mm	lbs	kPa
2.365	60.071	1334	64	2.375	60.333	2307	110	2.368	60.155	3712	178
2.404	61.062	1330	64	2.415	61.341	2325	111	2.408	61.158	3733	179
2.444	62.075	1327	64	2.455	62.360	2321	111	2.448	62.187	3732	179
2.483	63.071	1321	63	2.495	63.365	2297	110	2.489	63.210	3736	179
2.523	64.082	1341	64	2.534	64.359	2293	110	2.528	64.219	3734	179
2.562	65.077	1336	64	2.575	65.392	2294	110	2.569	65.242	3741	179
2.602	66.096	1334	64	2.614	66.396	2305	110	2.609	66.269	3717	178
2.642	67.109	1327	64	2.654	67.404	2316	111	2.649	67.274	3739	179
Normal Stress, kPa			175				350				700
Peak shear stress			116				196				302
Post Peak (66mm) shear stress			64				110				178



**Matimba Power Station Ash Dump**  
**R1301-00825/01**  
**Geosynthetic Clay Liner - ASTM D 6243, Procedure A**  
**2 mm SST HDPE (textured side) vs GCLX1000 (non-woven side)**



**Matimba Power Station Ash Dump  
RI301-00825/01  
Geosynthetic Clay Liner - ASTM D 6243, Procedure A  
2 mm SST HDPE (textured side) vs GCLX1000 (non-woven side)**



**Matimba Power Station Ash Dump  
RI301-00825/01  
Geosynthetic Clay Liner - ASTM D 6243, Procedure A  
2 mm SST HDPE (textured side) vs GCLX1000 (non-woven side)**

***Soil / Geosynthetic Interface Test Report***

Project	<u>Matimba Power Station Ash Dump</u>			Project No.	<u>RI301-00825/01</u>
Lab No.	<u>L2020-023</u>	Date Tested	<u>3/17-3/21/20</u>		
Test Description	<u>A6 Geofabric Vs Smooth Side 2mm SST HDPE</u>			Tested By	<u>LEB</u>
Sample I.D:	_____			Checked By	<u>JDB</u>
Normal Stress Range, kPa	<u>175</u>	<u>350</u>	<u>700</u>	Total No. of Points Requested	<u>3</u>
Geomembrane Data	<u>A6 Geofabric</u>			Test No. (file)	_____
Manufacturer	<u>UNK</u>				
Lot No.	_____				
Roll No.	<u>Not Supplied</u>	Textured?	<u>NA</u>	Peak to Peak Thickness, mil	_____
Specified Thickness, mil	_____				

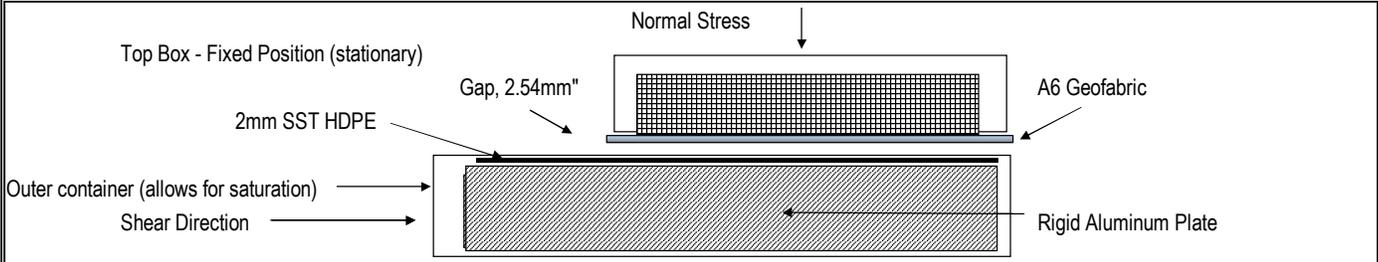
**Test Target Parameters**      Moisture Content, %      NA      Dry Density, pcf      NA

Sample Preparation:      The single sided 2mm HDPE was anchored to the lower box on top of the serrated aluminum plate. The Type A6 Geofabric was anchored to the top box at the opposite end.

Post-Test Observations:      The shear occurred at the interface. No visible signs of damage noted on the post-test coupons at any of the 3 normal stresses.

Upper Box Half Description      A6 Geofabric

Lower Box Half Description      Rigid aluminum serrated plate under the 2mm SST HDPE with smooth side up



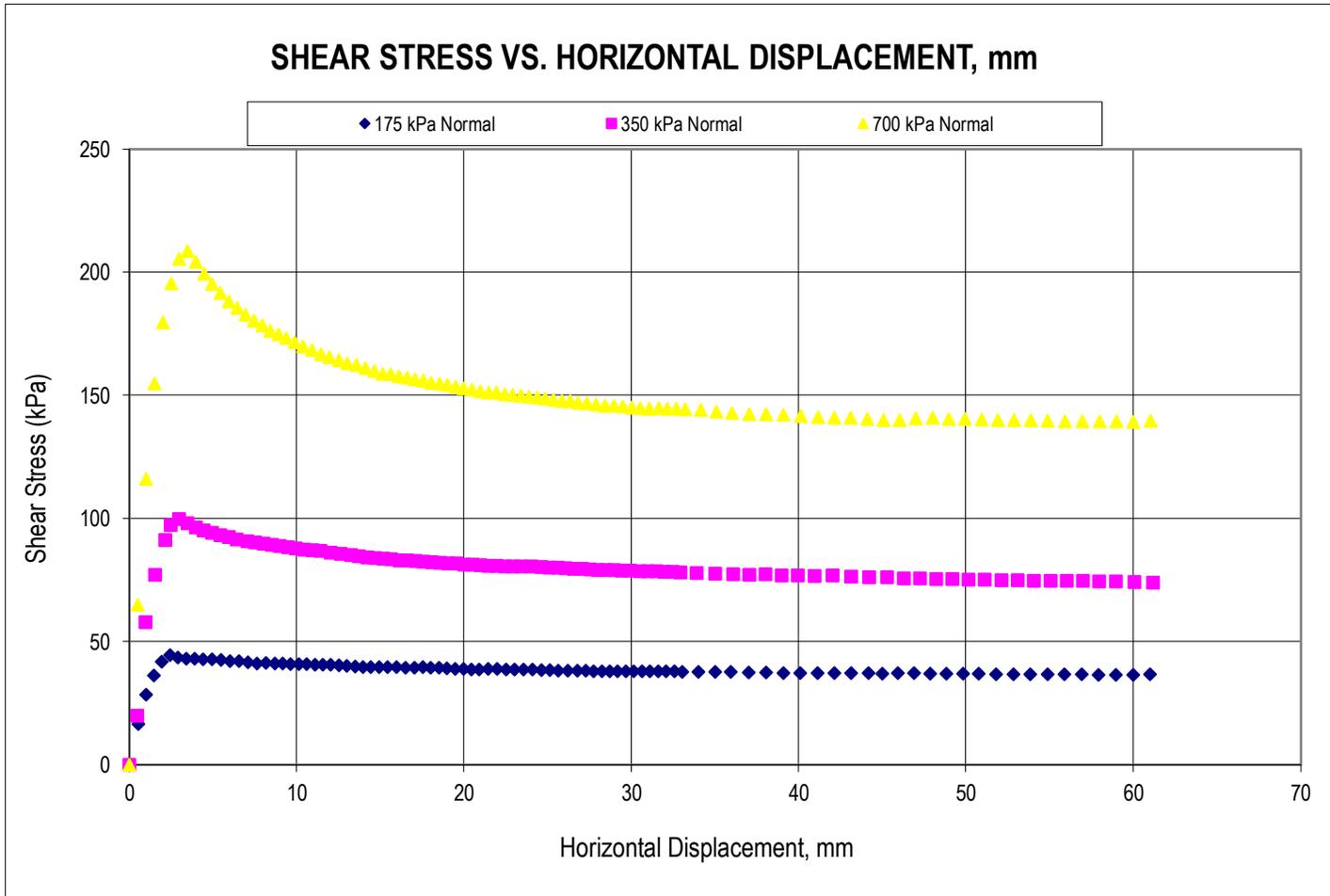
- Default Test Descriptions (unless noted otherwise)
- 1 The test was performed in a Karol Warner 300mm x 300mm shear box.
  - 2 The rate of displacement was 0.04 in./min. (1.0 mm/min.) for each stress.
  - 3 The geomembrane coupon was fixed at the bottom box half and the geofabric was anchored to the upper box half.
  - 4 Load increments were recorded in 1 lbf increments.
  - 5 The Geosynthetic coupons are available for inspection at the lab.
  - 6 The surface of the geomembrane was sprayed prior to test.
  - 7 The geomembrane was tested in machine direction. No testing was performed in the cross-machine direction.

Geosynthetic Interface Test - ASTM D 5321, Procedure A  
 300 mm Shear Device  
 Matimba Power Station Ash Dump  
 RI301-00825/01  
 A6 Geofabric Vs Smooth Side 2mm SST HDPE

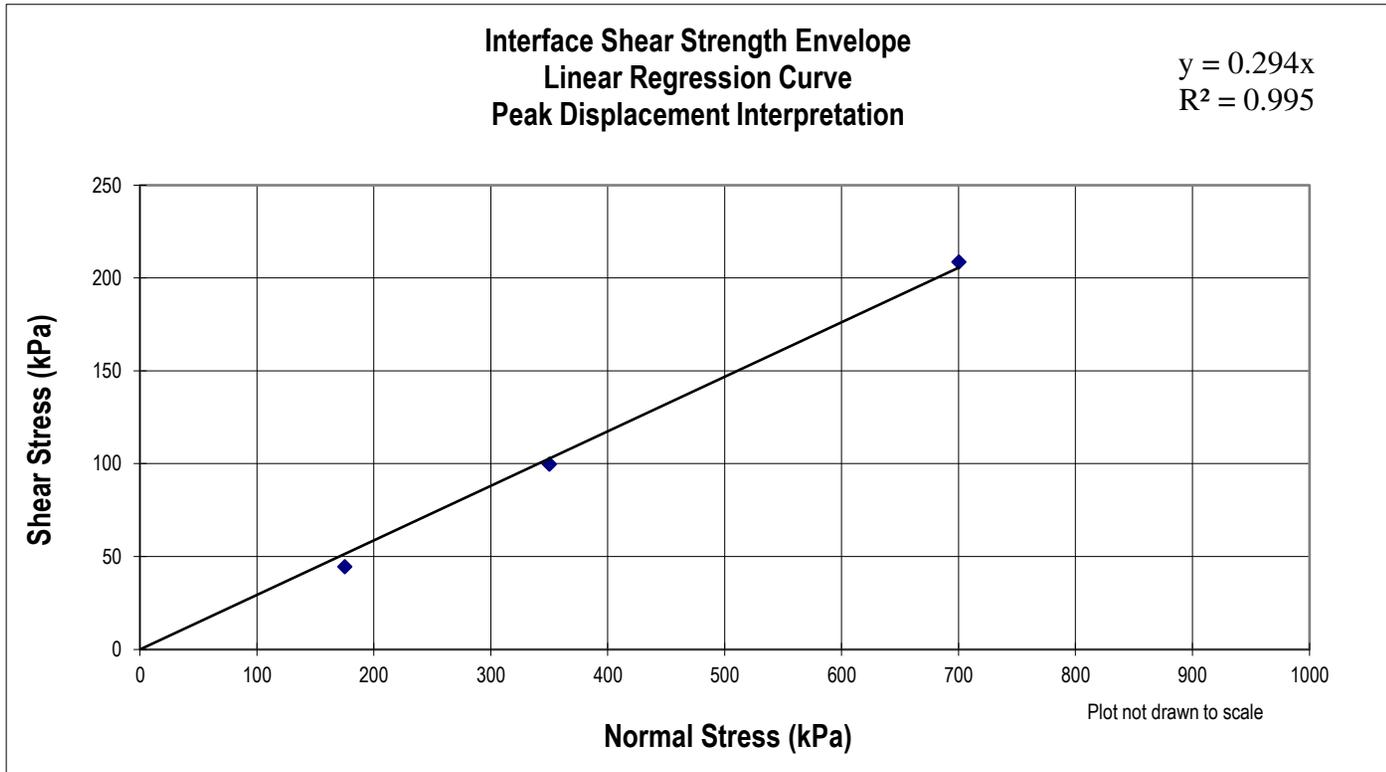
175 kPa Normal Stress				350 kPa Normal Stress				700 kPa Normal Stress			
Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress	Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress	Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress
inches	mm	lbs	kPa	inches	mm	lbs	kPa	inches	mm	lbs	kPa
0.000	0.000	2	0	0.005	0.000	0	0	0.000	0.000	0	0
0.021	0.526	351	17	0.022	0.450	417	20	0.019	0.493	1359	65
0.039	0.991	598	29	0.043	0.968	1209	58	0.040	1.011	2424	116
0.057	1.453	760	36	0.065	1.534	1615	77	0.060	1.514	3234	155
0.076	1.935	877	42	0.089	2.129	1908	91	0.079	2.012	3755	180
0.095	2.416	934	45	0.102	2.477	2033	97	0.098	2.487	4083	195
0.115	2.908	912	44	0.122	2.967	2087	100	0.117	2.964	4292	206
0.134	3.401	905	43	0.141	3.470	2050	98	0.136	3.462	4360	209
0.153	3.879	903	43	0.160	3.955	2015	96	0.156	3.960	4268	204
0.173	4.404	900	43	0.180	4.445	1989	95	0.175	4.455	4165	199
0.195	4.948	897	43	0.199	4.930	1968	94	0.195	4.940	4076	195
0.216	5.481	894	43	0.219	5.431	1950	93	0.215	5.448	4000	192
0.237	6.010	885	42	0.238	5.921	1933	93	0.234	5.949	3931	188
0.258	6.546	881	42	0.257	6.414	1913	92	0.253	6.436	3874	185
0.279	7.084	872	42	0.282	7.033	1895	91	0.273	6.932	3817	183
0.300	7.615	865	41	0.301	7.513	1887	90	0.293	7.430	3767	180
0.321	8.156	866	41	0.320	7.998	1879	90	0.312	7.925	3725	178
0.342	8.677	863	41	0.339	8.501	1866	89	0.331	8.412	3684	176
0.361	9.159	861	41	0.358	8.984	1855	89	0.351	8.903	3650	175
0.379	9.627	860	41	0.378	9.474	1847	88	0.370	9.388	3618	173
0.398	10.119	858	41	0.397	9.954	1836	88	0.389	9.878	3584	172
0.418	10.607	856	41	0.416	10.442	1828	88	0.408	10.363	3549	170
0.436	11.074	852	41	0.435	10.930	1822	87	0.429	10.907	3519	168
0.455	11.557	852	41	0.454	11.405	1815	87	0.451	11.443	3485	167
0.473	12.024	850	41	0.478	12.012	1801	86	0.471	11.963	3457	166
0.493	12.515	846	40	0.502	12.634	1789	86	0.493	12.510	3431	164
0.512	12.997	840	40	0.525	13.223	1778	85	0.513	13.028	3409	163
0.531	13.475	838	40	0.545	13.719	1769	85	0.535	13.576	3392	162
0.549	13.945	834	40	0.564	14.199	1761	84	0.556	14.115	3365	161
0.568	14.430	834	40	0.583	14.681	1756	84	0.576	14.641	3339	160
0.587	14.910	832	40	0.602	15.182	1750	84	0.596	15.131	3318	159
0.608	15.433	833	40	0.621	15.646	1743	83	0.615	15.616	3314	159
0.629	15.966	831	40	0.640	16.137	1737	83	0.634	16.104	3297	158
0.650	16.500	829	40	0.659	16.612	1734	83	0.654	16.601	3283	157
0.670	17.015	829	40	0.678	17.097	1729	83	0.673	17.082	3272	157
0.691	17.541	830	40	0.697	17.582	1725	83	0.692	17.569	3258	156
0.709	18.016	828	40	0.716	18.070	1718	82	0.711	18.047	3241	155
0.728	18.499	825	39	0.735	18.557	1714	82	0.730	18.529	3233	155
0.747	18.974	822	39	0.754	19.042	1709	82	0.749	19.020	3224	154
0.766	19.454	818	39	0.773	19.525	1707	82	0.768	19.500	3208	154
0.786	19.952	817	39	0.793	20.015	1700	81	0.787	19.980	3196	153
0.804	20.422	814	39	0.811	20.490	1699	81	0.806	20.477	3182	152
0.823	20.914	814	39	0.831	20.985	1693	81	0.825	20.965	3166	152
0.844	21.443	816	39	0.850	21.463	1690	81	0.845	21.458	3160	151
0.865	21.968	816	39	0.868	21.938	1688	81	0.864	21.941	3156	151
0.886	22.494	813	39	0.888	22.428	1686	81	0.883	22.428	3145	151
0.906	23.015	813	39	0.907	22.911	1686	81	0.902	22.913	3139	150
0.927	23.543	811	39	0.926	23.398	1684	81	0.921	23.401	3134	150
0.948	24.089	810	39	0.950	23.998	1683	81	0.940	23.879	3122	149
0.969	24.613	808	39	0.974	24.610	1681	80	0.959	24.369	3115	149
0.990	25.138	806	38	0.993	25.093	1675	80	0.979	24.854	3109	149
1.009	25.618	803	38	1.012	25.573	1672	80	0.998	25.347	3095	148

Geosynthetic Interface Test - ASTM D 5321, Procedure A  
 300 mm Shear Device  
 Matimba Power Station Ash Dump  
 RI301-00825/01  
 A6 Geofabric Vs Smooth Side 2mm SST HDPE

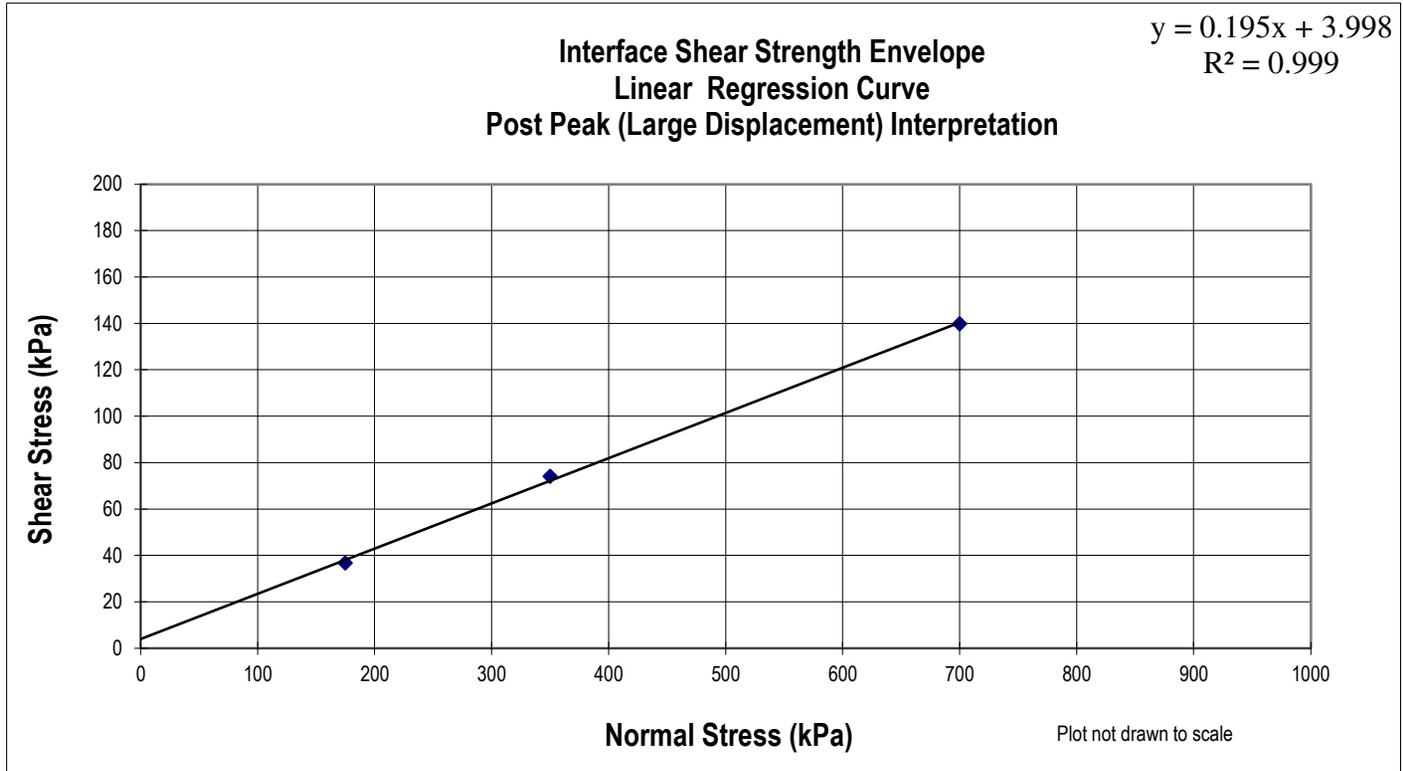
175 kPa Normal Stress				350 kPa Normal Stress				700 kPa Normal Stress			
Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress	Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress	Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress
inches	mm	lbs	kPa	inches	mm	lbs	kPa	inches	mm	lbs	kPa
1.031	26.195	800	38	1.031	26.055	1669	80	1.017	25.832	3089	148
1.055	26.784	801	38	1.050	26.543	1666	80	1.037	26.327	3085	148
1.073	27.254	801	38	1.069	27.043	1663	80	1.055	26.802	3074	147
1.092	27.742	799	38	1.088	27.516	1661	80	1.077	27.346	3065	147
1.111	28.224	799	38	1.106	27.981	1656	79	1.097	27.874	3056	146
1.129	28.687	799	38	1.125	28.466	1655	79	1.119	28.420	3048	146
1.149	29.180	799	38	1.145	28.951	1652	79	1.140	28.953	3045	146
1.168	29.655	796	38	1.164	29.434	1650	79	1.161	29.489	3041	146
1.186	30.135	796	38	1.183	29.926	1648	79	1.182	30.013	3032	145
1.206	30.620	796	38	1.207	30.531	1643	79	1.203	30.546	3025	145
1.225	31.110	794	38	1.225	31.006	1642	79	1.224	31.077	3023	145
1.244	31.590	795	38	1.244	31.488	1641	79	1.245	31.633	3026	145
1.262	32.060	794	38	1.263	31.968	1640	79	1.266	32.156	3019	145
1.282	32.555	794	38	1.283	32.459	1639	78	1.287	32.685	3021	145
1.301	33.045	792	38	1.302	32.944	1634	78	1.308	33.231	3014	144
1.339	34.003	791	38	1.340	33.909	1626	78	1.344	34.148	3010	144
1.377	34.986	791	38	1.382	34.994	1624	78	1.382	35.090	2994	143
1.415	35.936	789	38	1.425	36.083	1619	78	1.418	36.015	2985	143
1.457	37.008	788	38	1.464	37.061	1614	77	1.458	37.036	2976	142
1.498	38.057	784	37	1.502	38.024	1617	77	1.498	38.049	2977	143
1.538	39.070	782	37	1.540	38.986	1610	77	1.539	39.096	2968	142
1.579	40.102	780	37	1.578	39.957	1607	77	1.580	40.122	2960	142
1.619	41.120	782	37	1.616	40.937	1605	77	1.621	41.161	2949	141
1.659	42.139	783	37	1.659	42.022	1609	77	1.659	42.128	2943	141
1.698	43.139	779	37	1.703	43.127	1600	77	1.697	43.096	2942	141
1.739	44.166	779	37	1.745	44.214	1595	76	1.736	44.084	2936	141
1.771	44.991	776	37	1.788	45.293	1592	76	1.774	45.047	2926	140
1.808	45.918	780	37	1.827	46.281	1584	76	1.813	46.043	2923	140
1.846	46.899	779	37	1.865	47.252	1581	76	1.851	47.005	2940	141
1.885	47.866	777	37	1.903	48.224	1577	76	1.889	47.983	2942	141
1.923	48.839	778	37	1.942	49.197	1576	75	1.928	48.969	2936	141
1.961	49.807	775	37	1.980	50.162	1573	75	1.966	49.934	2934	140
1.999	50.772	774	37	2.018	51.130	1570	75	2.005	50.919	2930	140
2.039	51.793	770	37	2.056	52.111	1568	75	2.043	51.890	2922	140
2.080	52.822	770	37	2.095	53.089	1569	75	2.082	52.873	2922	140
2.120	53.843	770	37	2.133	54.064	1564	75	2.120	53.858	2922	140
2.160	54.861	771	37	2.172	55.042	1564	75	2.161	54.877	2921	140
2.200	55.885	770	37	2.210	56.020	1563	75	2.202	55.923	2915	140
2.240	56.906	770	37	2.248	56.987	1561	75	2.242	56.934	2916	140
2.281	57.930	766	37	2.287	57.965	1556	75	2.283	57.976	2913	139
2.321	58.958	767	37	2.326	58.948	1556	75	2.323	58.997	2912	139
2.362	59.982	768	37	2.369	60.056	1553	74	2.363	60.008	2911	139
2.402	61.006	771	37	2.413	61.158	1548	74	2.403	61.039	2919	140
Normal Stress, kPa			175				350				700
Peak shear stress			45				100				209
Post Peak shear stress			37				74				140



**Matimba Power Station Ash Dump**  
**RI301-00825/01**  
**Geosynthetic Interface Test - ASTM D 5321, Procedure A**  
**A6 Geofabric Vs Smooth Side 2mm SST HDPE**



**Matimba Power Station Ash Dump  
RI301-00825/01  
Geosynthetic Interface Test - ASTM D 5321, Procedure A  
A6 Geofabric Vs Smooth Side 2mm SST HDPE**



**Matimba Power Station Ash Dump  
RI301-00825/01  
Geosynthetic Interface Test - ASTM D 5321, Procedure A  
A6 Geofabric Vs Smooth Side 2mm SST HDPE**

### **Soil / Geosynthetic Interface Test Report**

Project	Matimba Power Station Ash Dump	Project No.	RI301-00825/01
Lab No.	L2020-023	Date Tested	3/30-4/3/20
Test Description	Internal Shear X1000 GCL	Tested By	LEB
Sample I.D.:		Checked By	JDB
Normal Stress Range, kPa	175      350      700	Total No. of Points Requested	3
Geomembrane Data	Elcoseal X1000		
Manufacturer	Geofabrics		
Lot No.	UNK		
Roll No.	UNK	Textured?	NA
Specified Thickness, mil	NA	Peak to Peak Thickness, mil	NA

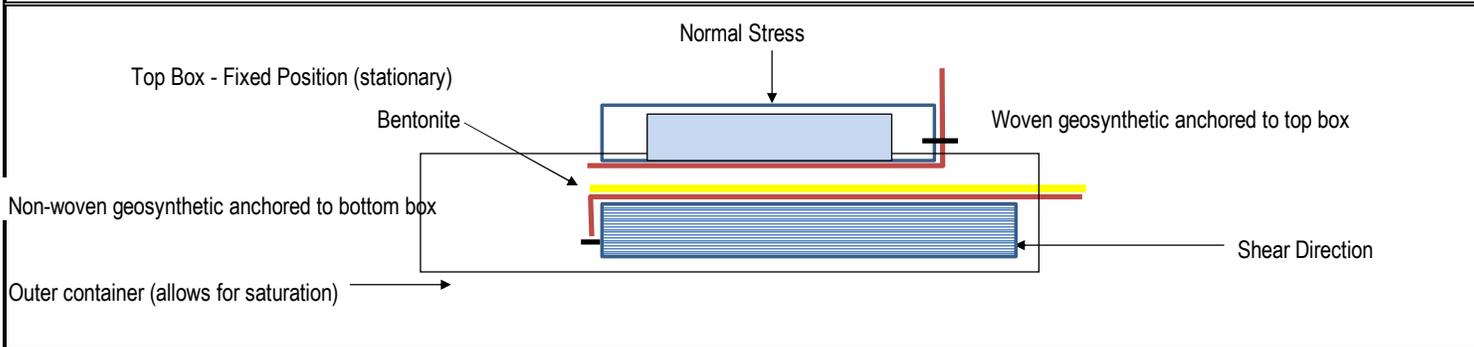
Observations: Some stretching and possible tensile shearing of the GCL may have occurred. Photos of the post-test coupons are attached.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Upper Box Half Description	RIGID PLATE W/ HDPE Drain liner (dim.'s: 11.95 x 11.95 X 1.0 inches)
Lower Box Half Description	RIGID PLATE W/ Machined screws (dim.'s: 15.95 x 11.95 x 1.0 inches)



- Default Test Descriptions (unless noted otherwise)
- 1 The test was performed in a Karol Warner 300mm shear device.
  - 2 The rate of displacement was 0.04 in./min. (1.0 mm/min.) for each stress.
  - 3 The GCL coupon was inundated under load for 24 hours prior to shearing.
  - 4 Load increments were recorded in 1 lbf increments.
  - 5 The GCL coupons are available for inspection at the lab.
  - 6 The interface was inundated during consolidation and shear displacement.

Geosynthetic Clay Liner - ASTM D 6243, Procedure B  
300mm Shear Device  
Matimba Power Station Ash Dump  
KP Rivoinia  
RI301-00825/01

Internal Shear X1000 GCL

175 kPa Normal Stress				350 kPa Normal Stress				700 kPa Normal Stress			
Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress	Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress	Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress
inches	mm	lbs	kPa	inches	mm	lbs	kPa	inches	mm	lbs	kPa
0.000	0.000	2	0	0.000	0.008	3	0	0.000	0.000	3	0
0.018	0.462	154	7	0.035	0.889	601	29	0.033	0.836	402	19
0.037	0.947	191	9	0.052	1.326	1185	57	0.051	1.298	445	21
0.056	1.433	226	11	0.068	1.717	2055	98	0.070	1.778	542	26
0.077	1.963	865	41	0.090	2.291	2389	114	0.092	2.344	864	41
0.099	2.522	1438	69	0.113	2.878	2523	121	0.113	2.865	1248	60
0.122	3.104	1624	78	0.137	3.477	2608	125	0.132	3.360	2315	111
0.142	3.607	1727	83	0.156	3.965	2670	128	0.148	3.757	3270	156
0.162	4.105	1810	87	0.177	4.483	2731	131	0.165	4.201	4071	195
0.181	4.590	1887	90	0.196	4.978	2781	133	0.184	4.663	4408	211
0.201	5.093	1959	94	0.216	5.476	2823	135	0.203	5.161	4603	220
0.221	5.603	2026	97	0.236	5.982	2862	137	0.224	5.677	4663	223
0.240	6.093	2085	100	0.256	6.495	2895	138	0.243	6.162	4742	227
0.260	6.599	2152	103	0.275	6.993	2920	140	0.264	6.693	4813	230
0.279	7.092	2225	106	0.295	7.503	2940	141	0.283	7.186	4916	235
0.299	7.592	2298	110	0.315	8.004	2950	141	0.303	7.686	5020	240
0.319	8.090	2361	113	0.335	8.504	3003	144	0.323	8.194	5124	245
0.338	8.593	2422	116	0.354	8.994	3051	146	0.343	8.710	5223	250
0.358	9.091	2490	119	0.374	9.487	3102	148	0.362	9.187	5324	255
0.377	9.578	2557	122	0.394	10.008	3155	151	0.382	9.690	5426	260
0.396	10.063	2618	125	0.413	10.488	3212	154	0.401	10.183	5516	264
0.416	10.564	2674	128	0.432	10.978	3261	156	0.421	10.683	5619	269
0.435	11.052	2727	130	0.452	11.491	3309	158	0.440	11.168	5723	274
0.455	11.560	2779	133	0.472	11.986	3349	160	0.460	11.676	5856	280
0.475	12.057	2833	136	0.491	12.482	3390	162	0.480	12.179	5922	283
0.494	12.545	2886	138	0.511	12.967	3437	164	0.499	12.672	6023	288
0.513	13.035	2942	141	0.531	13.482	3494	167	0.519	13.172	6114	293
0.533	13.531	2999	143	0.550	13.970	3554	170	0.538	13.670	6185	296
0.552	14.031	3048	146	0.569	14.453	3609	173	0.558	14.176	6261	300
0.572	14.524	3099	148	0.589	14.958	3662	175	0.578	14.684	6340	303
0.591	15.019	3148	151	0.608	15.448	3721	178	0.598	15.177	6423	307
0.611	15.519	3199	153	0.628	15.951	3777	181	0.617	15.682	6520	312
0.630	16.007	3252	156	0.647	16.441	3825	183	0.637	16.170	6601	316
0.650	16.502	3297	158	0.667	16.947	3867	185	0.656	16.670	6671	319
0.669	16.993	3341	160	0.687	17.445	3912	187	0.676	17.170	6731	322
0.689	17.490	3379	162	0.706	17.920	3965	190	0.696	17.668	6791	325
0.709	18.004	3413	163	0.726	18.428	4013	192	0.716	18.181	6835	327
0.728	18.486	3446	165	0.745	18.931	4058	194	0.736	18.689	6871	329
0.748	18.987	3473	166	0.765	19.431	4104	196	0.756	19.192	6905	330
0.767	19.479	3504	168	0.785	19.926	4138	198	0.775	19.695	6945	332
0.787	19.987	3528	169	0.804	20.419	4177	200	0.795	20.190	6980	334
0.806	20.480	3550	170	0.824	20.927	4212	202	0.815	20.704	7004	335
0.826	20.970	3573	171	0.843	21.420	4246	203	0.835	21.199	7041	337
0.846	21.481	3601	172	0.863	21.918	4277	205	0.855	21.704	7072	338
0.865	21.961	3629	174	0.883	22.426	4306	206	0.875	22.215	7093	339
0.885	22.474	3658	175	0.902	22.911	4334	207	0.895	22.720	7096	340
0.905	22.974	3683	176	0.922	23.419	4358	209	0.915	23.231	7105	340
0.924	23.462	3708	177	0.941	23.909	4409	211	0.934	23.724	7123	341

Geosynthetic Clay Liner - ASTM D 6243, Procedure B  
300mm Shear Device  
Matimba Power Station Ash Dump  
KP Rivoinia  
RI301-00825/01

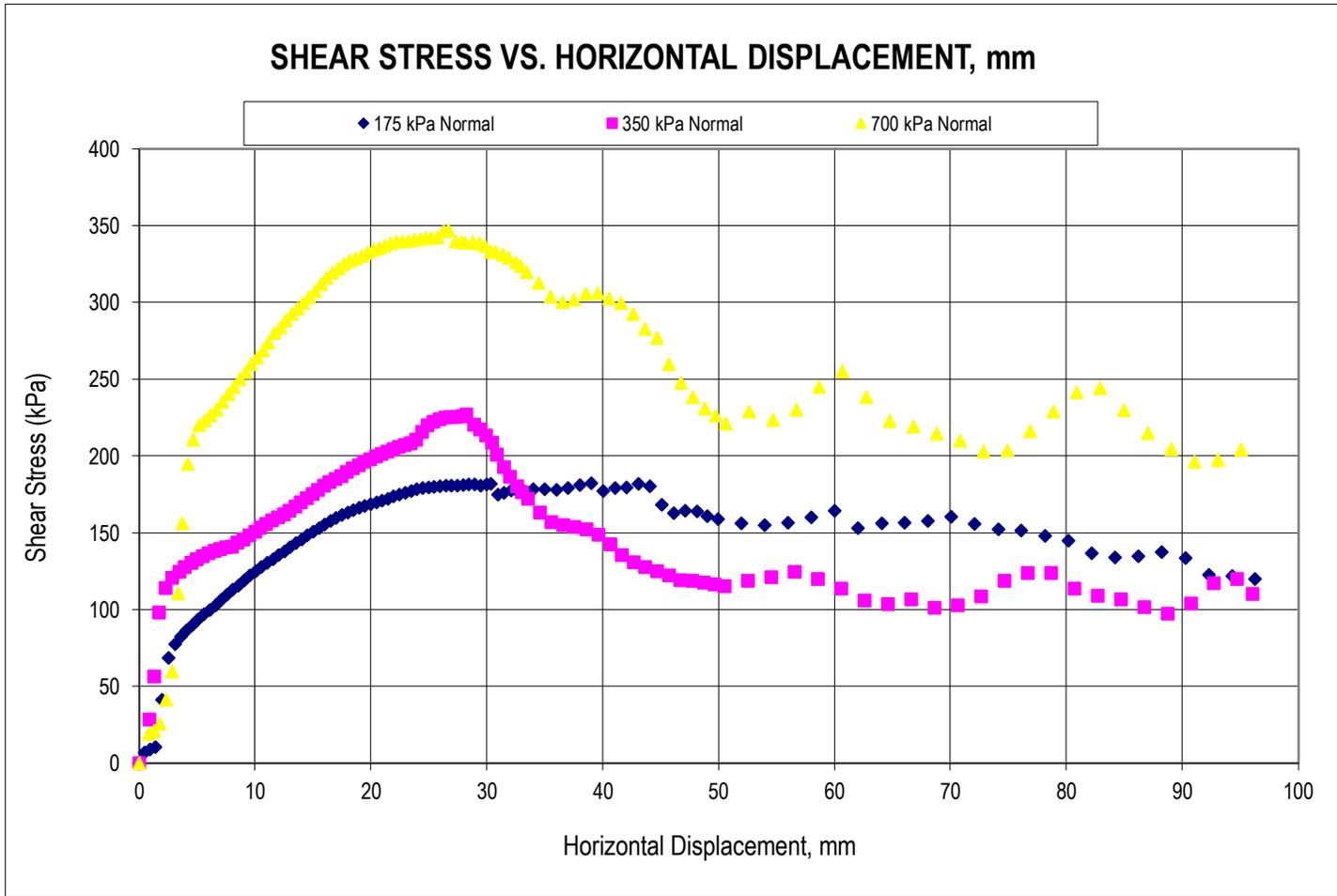
Internal Shear X1000 GCL

175 kPa Normal Stress				350 kPa Normal Stress				700 kPa Normal Stress			
Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress	Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress	Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress
inches	mm	lbs	kPa	inches	mm	lbs	kPa	inches	mm	lbs	kPa
0.944	23.965	3729	178	0.961	24.399	4510	216	0.955	24.244	7131	341
0.963	24.463	3746	179	0.980	24.887	4597	220	0.974	24.747	7142	342
0.983	24.958	3756	180	1.000	25.403	4648	222	0.994	25.243	7144	342
1.002	25.456	3762	180	1.020	25.903	4683	224	1.014	25.761	7153	342
1.022	25.961	3768	180	1.040	26.403	4706	225	1.035	26.281	7232	346
1.042	26.454	3775	181	1.059	26.901	4713	226	1.050	26.662	7253	347
1.061	26.947	3780	181	1.079	27.409	4711	225	1.075	27.292	7099	340
1.081	27.462	3782	181	1.099	27.907	4723	226	1.095	27.800	7092	339
1.101	27.953	3788	181	1.111	28.207	4745	227	1.107	28.108	7082	339
1.121	28.461	3793	182	1.139	28.923	4605	220	1.134	28.814	7085	339
1.140	28.953	3793	182	1.159	29.428	4541	217	1.155	29.347	7073	339
1.160	29.472	3779	181	1.179	29.949	4459	213	1.175	29.848	7039	337
1.180	29.972	3791	181	1.199	30.457	4361	209	1.195	30.361	6960	333
1.195	30.356	3800	182	1.216	30.874	4198	201	1.211	30.762	6956	333
1.220	30.980	3655	175	1.240	31.488	4034	193	1.235	31.377	6917	331
1.240	31.483	3679	176	1.260	31.999	3901	187	1.256	31.900	6878	329
1.263	32.090	3711	178	1.284	32.624	3769	180	1.280	32.517	6809	326
1.279	32.482	3728	178	1.300	33.023	3692	177	1.296	32.929	6763	324
1.299	32.990	3735	179	1.320	33.533	3597	172	1.317	33.439	6682	320
1.339	34.000	3726	178	1.360	34.554	3412	163	1.356	34.447	6532	313
1.378	35.004	3728	178	1.400	35.565	3279	157	1.397	35.491	6346	304
1.418	36.010	3724	178	1.440	36.576	3239	155	1.438	36.523	6274	300
1.457	37.010	3744	179	1.480	37.589	3217	154	1.477	37.526	6305	302
1.497	38.029	3790	181	1.520	38.608	3183	152	1.518	38.550	6386	306
1.537	39.032	3813	182	1.560	39.619	3113	149	1.558	39.578	6397	306
1.577	40.043	3704	177	1.600	40.635	2982	143	1.598	40.582	6328	303
1.617	41.064	3745	179	1.640	41.653	2834	136	1.638	41.610	6256	299
1.656	42.067	3757	180	1.680	42.667	2737	131	1.679	42.634	6110	292
1.696	43.066	3799	182	1.719	43.655	2671	128	1.718	43.645	5906	283
1.735	44.072	3769	180	1.760	44.691	2620	125	1.759	44.686	5786	277
1.776	45.105	3520	168	1.799	45.692	2558	122	1.800	45.715	5428	260
1.816	46.126	3406	163	1.839	46.716	2490	119	1.840	46.739	5176	248
1.855	47.125	3437	164	1.878	47.701	2484	119	1.881	47.772	4986	239
1.895	48.120	3427	164	1.918	48.705	2462	118	1.921	48.796	4831	231
1.931	49.035	3366	161	1.954	49.619	2439	117	1.957	49.713	4727	226
1.966	49.941	3322	159	1.989	50.531	2413	115	1.993	50.622	4624	221
2.046	51.963	3269	156	2.068	52.535	2483	119	2.072	52.634	4788	229
2.125	53.972	3245	155	2.147	54.531	2532	121	2.152	54.663	4675	224
2.204	55.982	3273	157	2.226	56.533	2606	125	2.231	56.678	4809	230
2.283	57.998	3348	160	2.305	58.550	2511	120	2.310	58.677	5120	245
2.362	60.002	3439	165	2.384	60.564	2384	114	2.389	60.678	5331	255
2.442	62.034	3197	153	2.464	62.593	2219	106	2.470	62.728	4980	238
2.522	64.049	3269	156	2.543	64.592	2172	104	2.550	64.767	4657	223
2.600	66.045	3270	156	2.622	66.606	2232	107	2.630	66.805	4584	219
2.680	68.062	3302	158	2.702	68.633	2124	102	2.709	68.811	4483	215

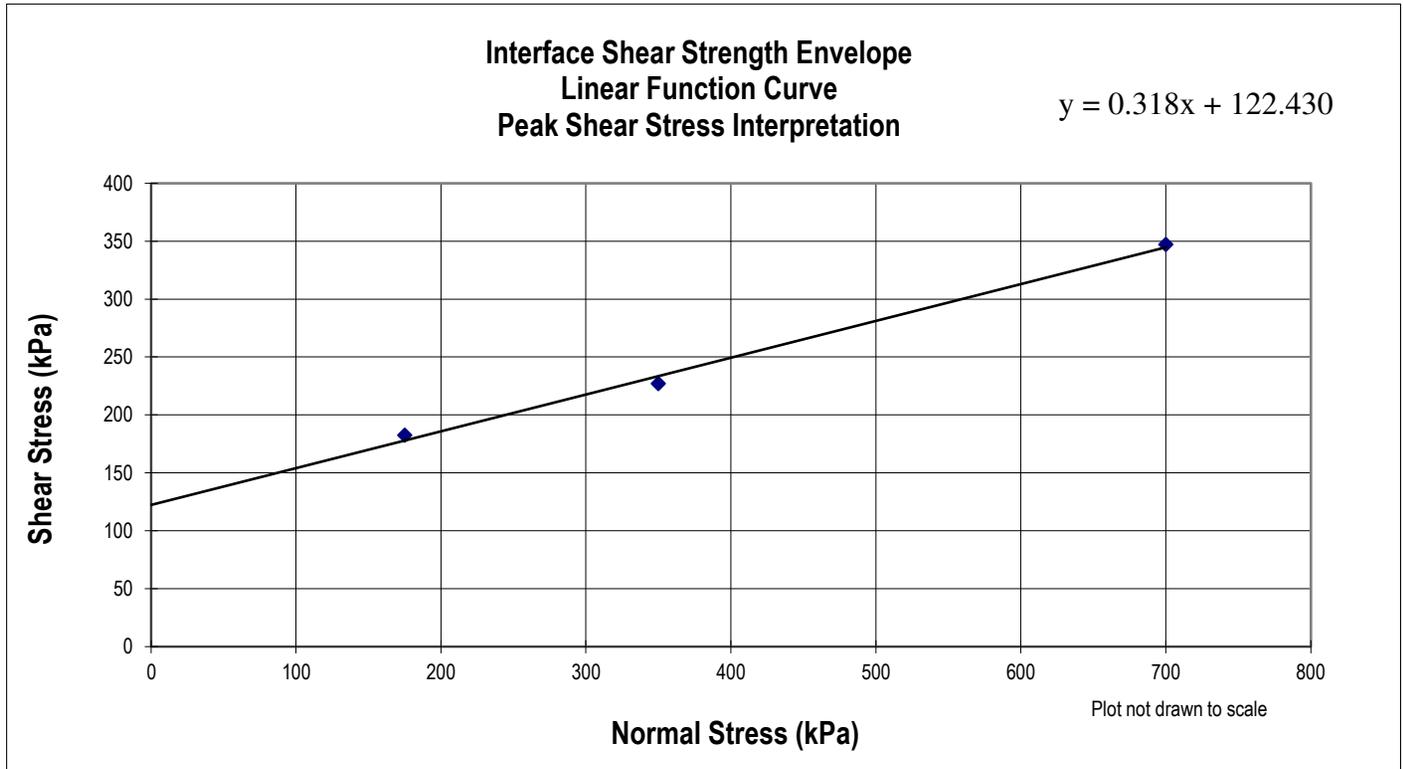
Geosynthetic Clay Liner - ASTM D 6243, Procedure B  
 300mm Shear Device  
 Matimba Power Station Ash Dump  
 KP Rivoinia  
 RI301-00825/01

Internal Shear X1000 GCL

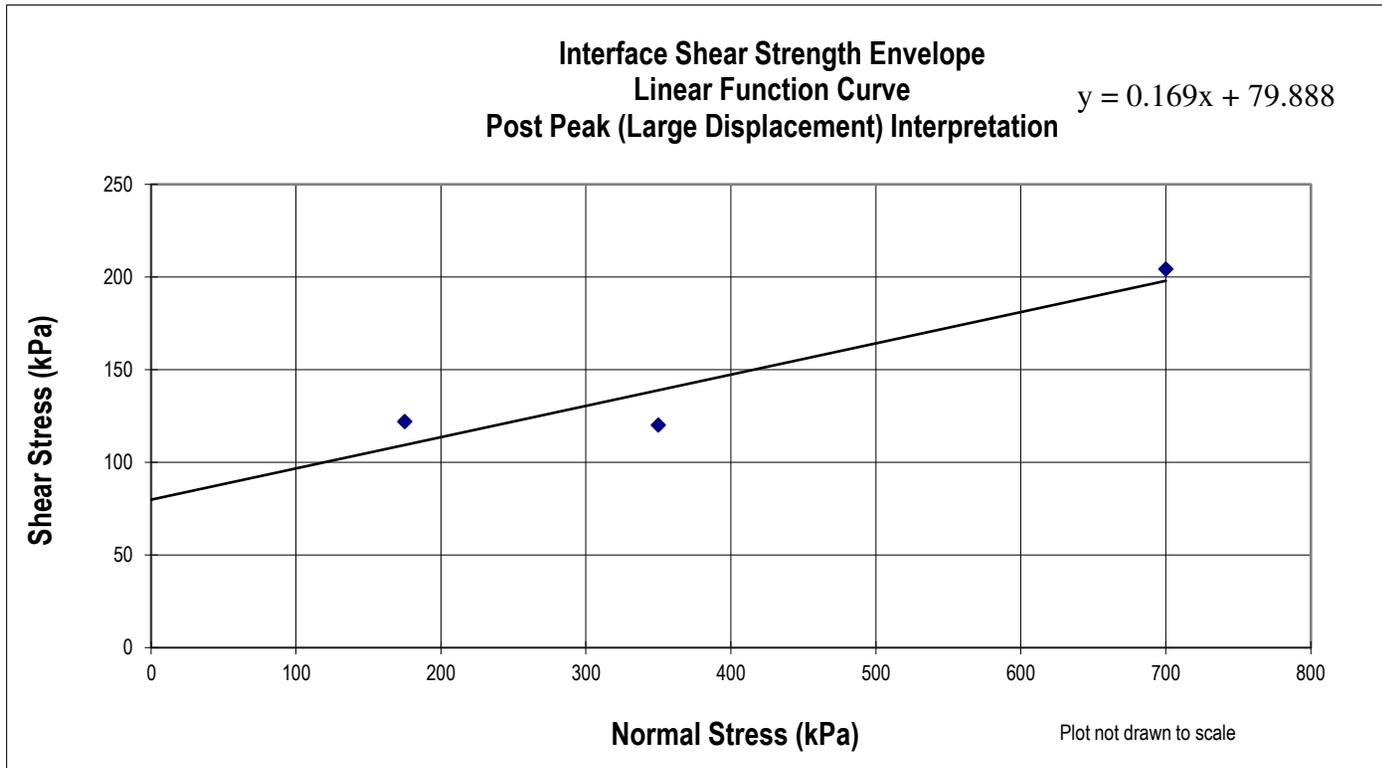
175 kPa Normal Stress				350 kPa Normal Stress				700 kPa Normal Stress			
Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress	Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress	Horiz. Displ.	Horiz. Displ.	Shear Force	Shear Stress
inches	mm	lbs	kPa	inches	mm	lbs	kPa	inches	mm	lbs	kPa
2.759	70.071	3353	160	2.781	70.645	2151	103	2.789	70.828	4386	210
2.838	72.093	3261	156	2.860	72.639	2275	109	2.869	72.865	4243	203
2.918	74.112	3185	152	2.939	74.640	2487	119	2.949	74.897	4262	204
2.997	76.116	3164	151	3.017	76.634	2588	124	3.027	76.888	4517	216
3.077	78.146	3091	148	3.096	78.649	2588	124	3.106	78.890	4791	229
3.156	80.170	3029	145	3.176	80.668	2380	114	3.185	80.894	5046	241
3.236	82.187	2858	137	3.256	82.690	2285	109	3.264	82.916	5104	244
3.315	84.209	2802	134	3.335	84.706	2230	107	3.345	84.968	4806	230
3.394	86.215	2819	135	3.415	86.736	2129	102	3.425	87.005	4497	215
3.473	88.222	2873	137	3.494	88.748	2035	97	3.506	89.045	4272	204
3.554	90.259	2792	134	3.573	90.742	2178	104	3.586	91.072	4104	196
3.633	92.281	2570	123	3.650	92.718	2452	117	3.665	93.078	4129	198
3.712	94.282	2549	122	3.730	94.732	2512	120	3.743	95.075	4269	204
3.790	96.271	2509	120	3.782	96.065	2310	110				
Normal Stress, kPa			175				350				700
Peak shear stress			182				227				347
Post Peak (95mm) shear stress			122				120				204



**Matimba Power Station Ash Dump**  
**R1301-00825/01**  
**Geosynthetic Clay Liner - ASTM D 6243, Procedure B**  
**Internal Shear X1000 GCL**



**Matimba Power Station Ash Dump**  
**RI301-00825/01**  
**Geosynthetic Clay Liner - ASTM D 6243, Procedure B**  
**Internal Shear X1000 GCL**



**Matimba Power Station Ash Dump**  
**RI301-00825/01**  
**Geosynthetic Clay Liner - ASTM D 6243, Procedure B**  
**Internal Shear X1000 GCL**

RED-5

RI301-00825/01  
Matimba Power Station Ash Dump  
X1000 GCL  
175 kPa Post Test

MD

RI301-00825/01  
Matimba Power Station Ash Dump  
X1000 GCL  
175 kPa Post Test

RI301-00825/01  
Matimba Power Station Ash Dump  
X1000 GCL  
350 kPa Post Test

RI301-00825/01  
Matimba Power Station Ash Dump  
X1000 GCL  
350 kPa Post Test

2-07

RI301-00825/01

Matimba Power Station Ash Dump

X1000 GCL

700 kPa Post Test

RI301-00825/01  
Matimba Power Station Ash Dump  
X1000 GCL  
700 kPa Post Test

