

**APPENDIX N - LABORATORY TESTING PHOTOGRAPY AND OBSERVATIONS**





Fig. N. 1. Free swell testing of Site E bentonites.



Fig. N. 2. Indentations were observed in Site A GCL in plan (a) and profile (b) view.



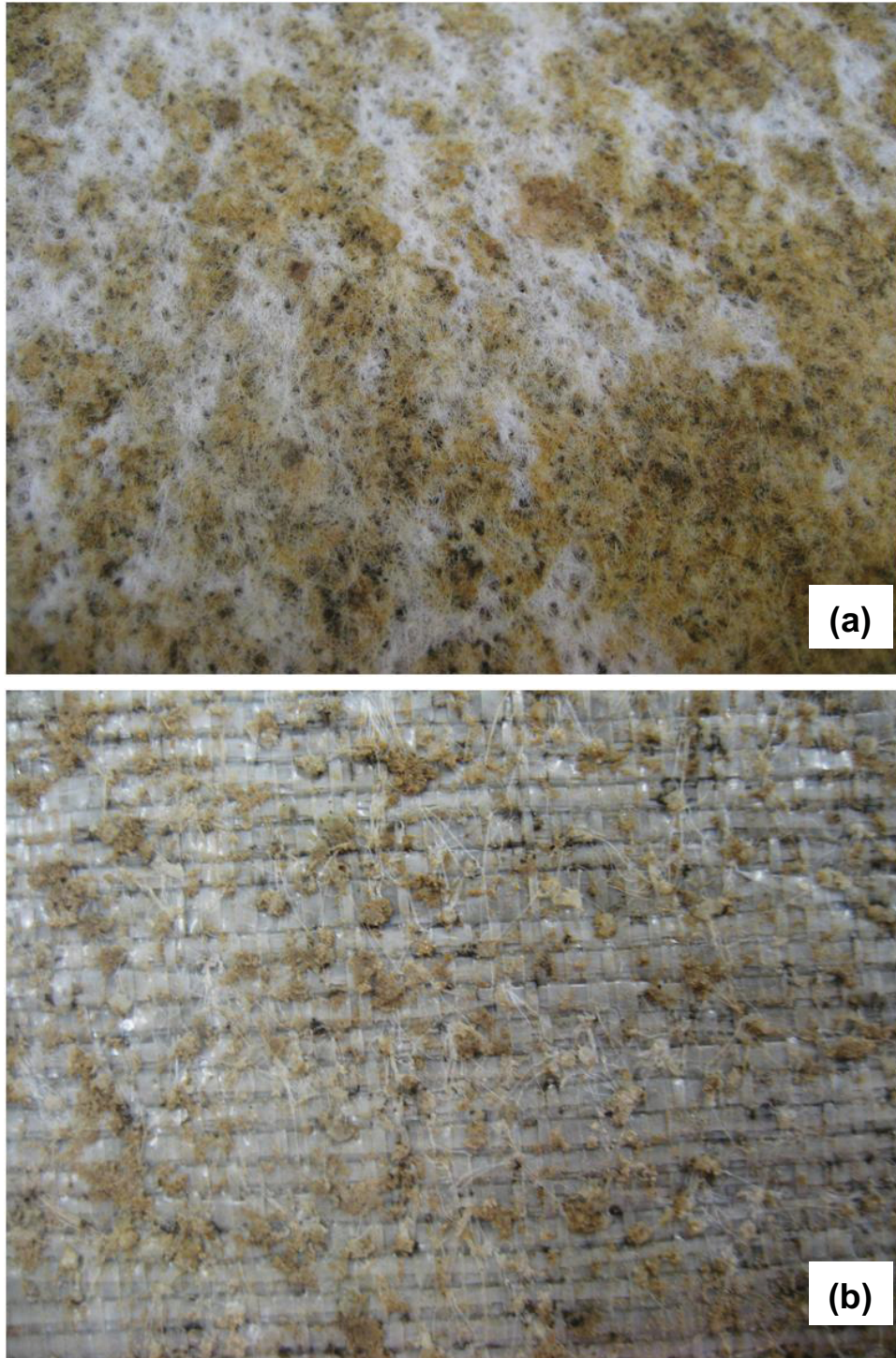


Fig. N. 3. Upper nonwoven geotextiles (a) and lower woven geotextile (b) of Site E higher hydraulic conductivity GCL prior to permeation. Dark staining visible at some needle punched fiber bundles.



Fig. N. 4. Influent nonwoven geotextiles (a) and effluent woven geotextile (b) of Site E higher hydraulic conductivity GCL after permeation and dying.



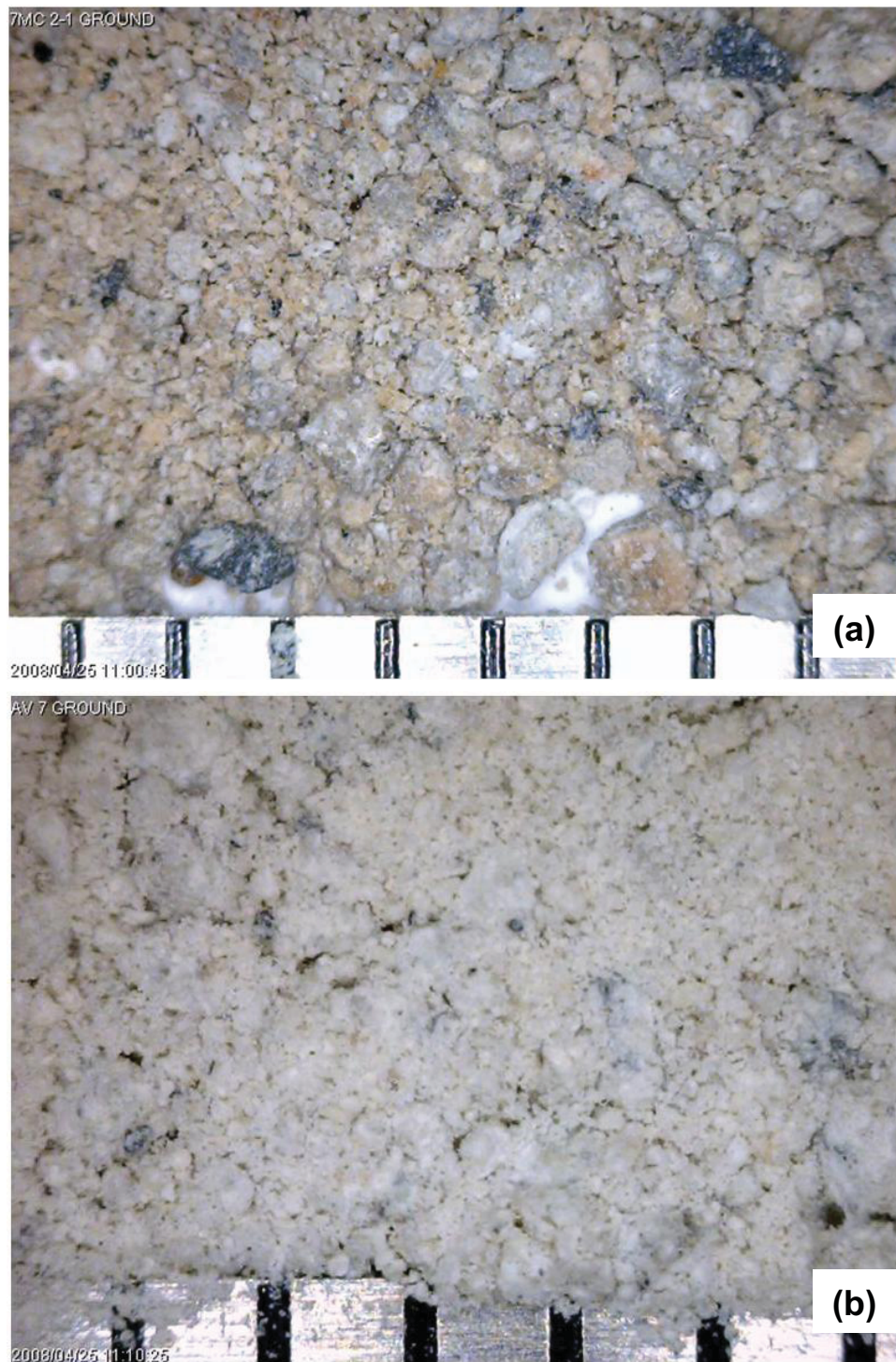


Fig. N. 5. Ground bentonite passing No. 20 sieve from Site E (a) and Site A (b).



Fig. N. 6. Bentonite from Site E TP1 during bound cation testing. Dark material is visible through the specimen.



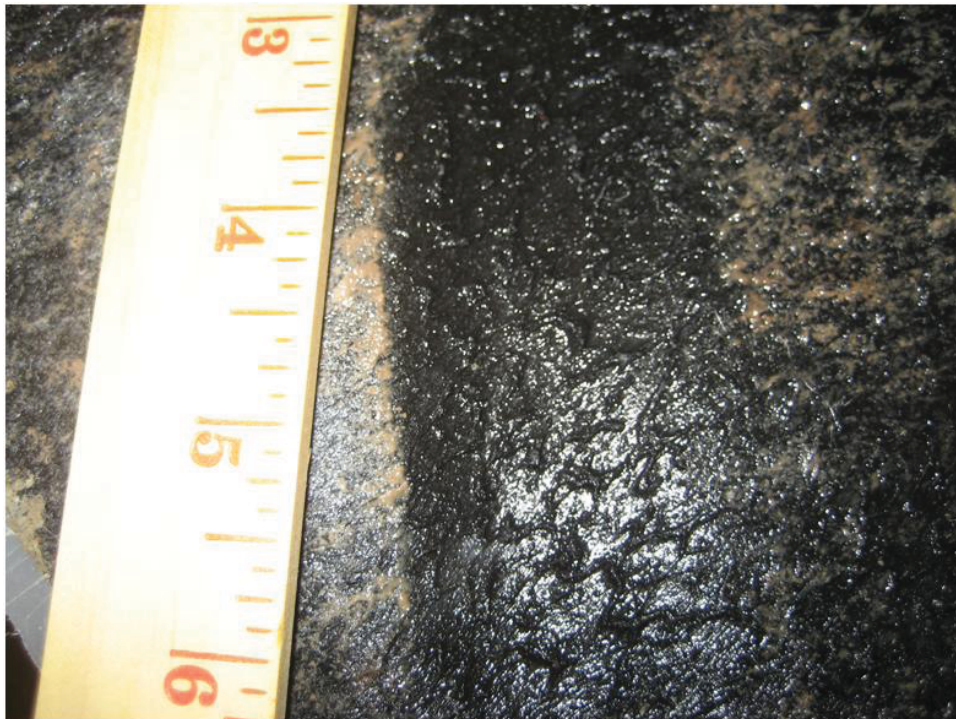


Fig. N. 7. Additional moisture visible under folds in GM exhumed from Site F TP1.





## **APPENDIX O - EXPLORATION OF GCL LABORATORY TESTING METHODS**



## O-1 EFFECT OF INCREASED EFFECTIVE STRESS DURING PERMEABILITY TESTING

After completion of permeability testing at an effective stress representative of field conditions (18 kPa), cell pressures were increased to ascertain the possible effect of increased overlying cover material. The average hydraulic gradient was maintained at approximately 150 for the duration of testing. Hydraulic conductivity is plotted versus pore volumes of flow for duplicate Site E-6 GCL specimens in Fig. O.1. The average hydraulic conductivity is also presented in Table O.1 with corresponding hydraulic conductivity at effective stress of 18 kPa ( $k_{18}$ ) over hydraulic conductivity at increased effective stress ( $k_{\text{effective increased}}$ ).

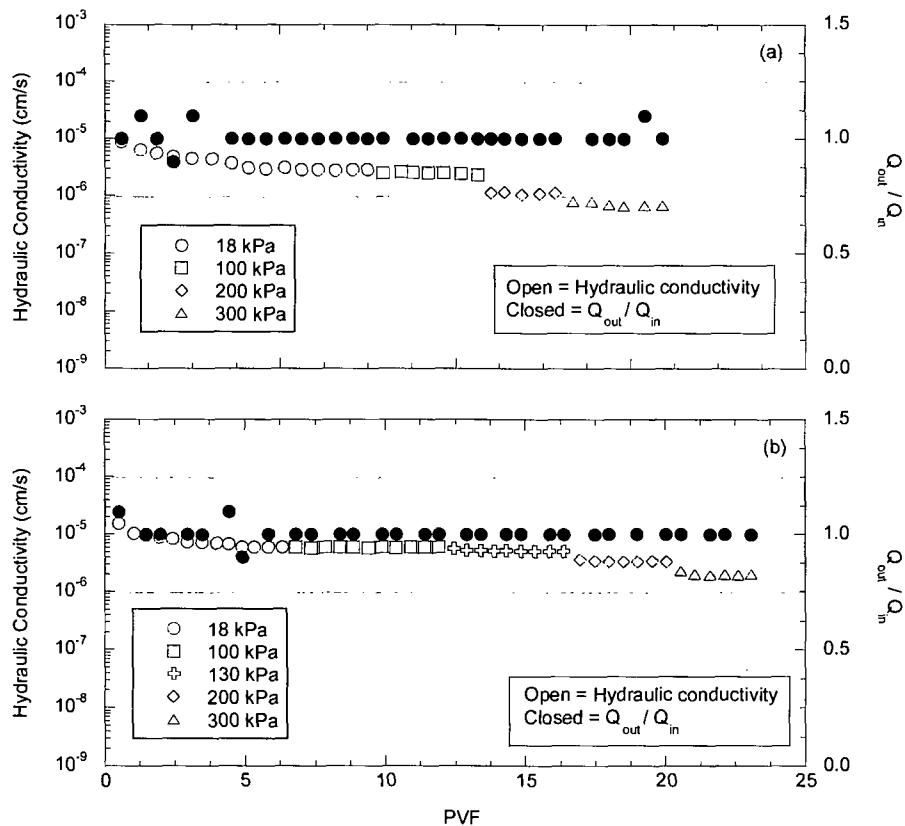


Fig. O. 1. Hydraulic conductivity and  $Q_{\text{out}} / Q_{\text{in}}$  as a function of pore volumes of flow for duplicate Site E-6 GCL permeated with standard water (Site E-6a (a), Site E-6b (b)).

Table O. 1. Final average hydraulic conductivity and  $k_{18}/k_{\text{effective}}$  increased at varying effective stresses for Site E-6 a & b GCLs.

| Effective stress<br>(kPa) | Site E-6a              |                               | Site E-6b              |                               |
|---------------------------|------------------------|-------------------------------|------------------------|-------------------------------|
|                           | Final                  |                               | Final                  |                               |
|                           | hydraulic conductivity |                               | hydraulic conductivity |                               |
|                           | (cm/s)                 | $k_{18}/k_{\text{effective}}$ | (cm/s)                 | $k_{18}/k_{\text{effective}}$ |
| 18                        | 2.84E-06               | 1.0                           | 5.99E-06               | 1.0                           |
| 100                       | 2.43E-06               | 1.2                           | 5.88E-06               | 1.0                           |
| 130                       | -                      | -                             | 5.06E-06               | 1.2                           |
| 200                       | 1.11E-06               | 2.6                           | 3.34E-06               | 1.8                           |
| 300                       | 6.81E-07               | 4.2                           | 1.99E-06               | 3.0                           |

## O-2 EFFECT OF EDGE PASTE DEFECT IN PERMEABILITY TESTING

For all hydraulic conductivity tests, bentonite paste hydrated in the permeant liquid was frosted around the perimeter of the GCL specimen. The intention of this perimeter pasting is to eliminate possible flow paths the latex membrane. A hydraulic conductivity test was assembled with a generated gap in perimeter bentonite paste to asses the sensitivity of the perimeter bentonite paste assembly method. A 1 cm gap was place in the bentonite specimen pasting of Site E Test Pit 1 GCL specimen with a free swell index of 8 mL/2g (essentially calcium bentonite). A Site E GCL was chosen to provide a worst-case scenario where minimal self healing is possible. A profile of the assemble permeameter with bentonite paste gap is presented in Fig. O.2. Hydraulic conductivity profiles for a matching Site E Test Pit 1 specimen (same sample) and for the gap-pasted specimen are plotted versus PVF in Fig. O.3. The latex membrane closely formed over the bentonite paste gap after application of effective stress as shown in Fig. O.4. Both GCLs were permeated with standard water.



Fig. O. 2. GCL assembled with missing perimeter bentonite paste.

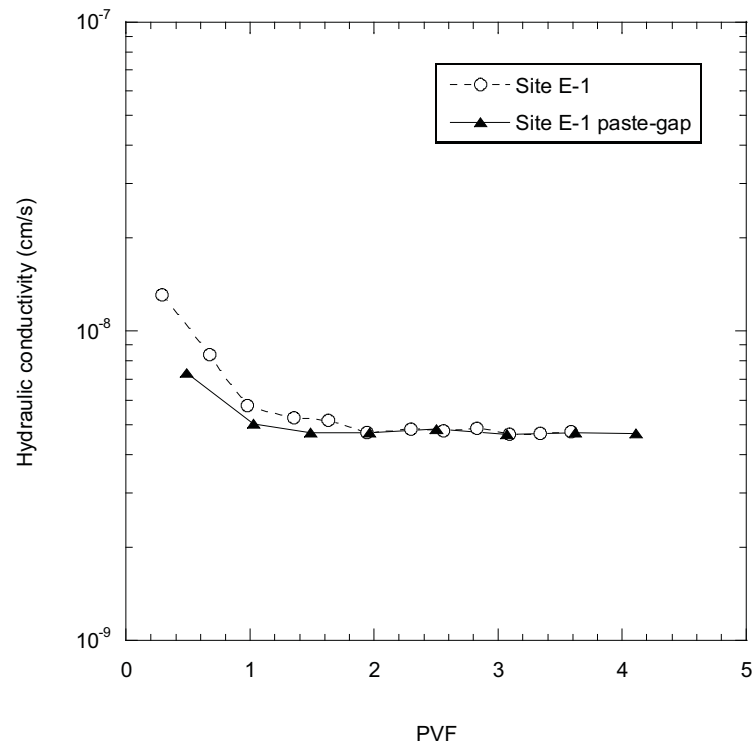


Fig. O. 3. Hydraulic conductivity versus pore volumes of flow for Site E-1 GCL and matching bentonite paste-gap specimen.



Fig. O. 4. Latex membrane over internal bentonite paste gap after application of effective stress, permeation, and disassembly.



### O-3 MANUFACTURER VERSUS UNIVERSITY OF WISCONSIN EXHUMED COMPOSTIE COVER GCL HYDRAULIC CONDUCTIVITIES

Duplicate GCL specimens were exhumed from each sampling location at Site B (4 samples) and from Test Pit 1 at Site E by the University of Wisconsin and the Manufacturer. University of Wisconsin hydraulic conductivity testing was conducted as detailed in Chapters 2,3 and 4. Manufacturer hydraulic conductivity testing was performed on 10.2 cm diameter specimen with de-aired deionized water as the permeant. A maximum effective stress of 34.4 kPa was employed with an initial head of 140.6 kPa. All tests were run until the flux ratio ASTM termination criterion was met. Hydraulic conductivities from the University of Wisconsin permeating with AW or DW are plotted versus hydraulic conductivities from the manufacturer in Fig. O.5.

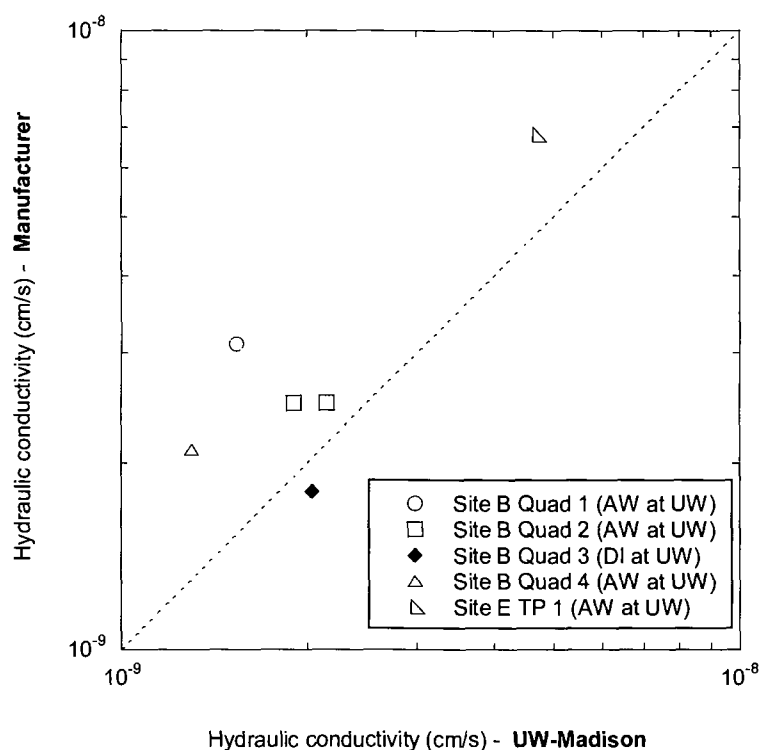


Fig. O. 5. Site B hydraulic conductivity versus testing facility for Site B GCL duplicate samples.

#### O-4. EFFECTS OF DESSICATION CYCLES ON EXHUMED COMPOSITE COVER GCLs.

Desiccation tests were conducted on Site A and Site E GCL specimens after permeation with SW. GCLs were removed from their permeameter, and the surrounding bentonite paste was manually removed with a small spatula. The GCL specimen was then placed between 2 geotextiles, 2 geocomposite drainage layers, and 2 rigid HDPE plates. The upper HDPE plate was then loaded vertically until a pressure (18-24 kPa) equal to the in-situ effective stress was achieved. GCLs were allowed to air dry for until their daily mass reached a steady state.

The saturated hydraulic conductivity before and after application of desiccation cycle(s) is plotted in Fig. O.6.

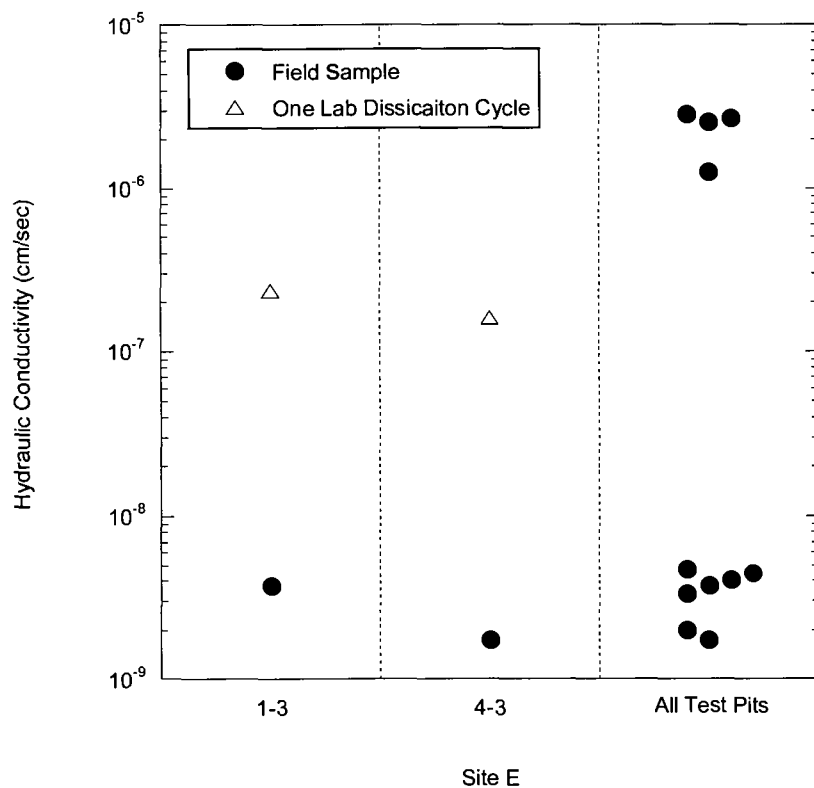


Fig. O. 6. Hydraulic conductivity after exhumation and application of desiccation cycle(s).

**APPENDIX P – SUPPLEMENTAL GRAPHS AND TABLES FROM  
GEOSYNTHETIC MEMBRANE (GM) AND GEOSYNTHETIC DRAINAGE LAYER  
(GDL) TESTS**



Table P1. Coefficient of variation (CoV) for each engineering property of exhumed geosynthetics.

|                                   | Altamont,<br>CA | Apple<br>Valley,<br>CA | Boardman,<br>OR | Cedar<br>Rapids,<br>IA | Eau Claire,<br>WI | Helena,<br>MT | Omaha,<br>NE | Polson,<br>MT | Underwood,<br>ND |
|-----------------------------------|-----------------|------------------------|-----------------|------------------------|-------------------|---------------|--------------|---------------|------------------|
| Wide Strip<br>Yield Strength      | 2.3             | 3.8                    | 4.1             | 1.8                    | 5.1               | 3.0           | 8.7          | 10.2          | 2.6              |
| Narrow Strip<br>Yield Strength    | 7.3             | 10.7                   | 9.5             | 12.9                   | 15.7              | 2.4           | 17.0         | 6.2           | 9.4              |
| Narrow Strip<br>Break<br>Strength | 9.7             | 25.4                   | 15.4            | 8.6                    | 22.8              | 14.9          | 32.7         | 37.0          | 8.0              |
| Wide Strip<br>Yield Strain        | 3.0             | 2.6                    | 4.0             | 12.6                   | 23.2              | 4.4           | 28.8         | 8.3           | 26.1             |
| Narrow Strip<br>Yield Strain      | 10.8            | 8.8                    | 16.0            | 9.6                    | 34.7              | 9.4           | 22.8         | 16.9          | 7.8              |
| Narrow Strip<br>Break Strain      | 8.5             | 31.2                   | 9.8             | 6.1                    | 36.7              | 11.3          | 32.1         | 66.1          | 5.1              |
| Ply Adhesion                      | 27.3            | 19.8                   | 30.2            | 47.0                   | 43.0              | 66.4          | 34.9         | -             | 58.9             |
| Permittivity<br>at 10 mm          | 15.4            | 10.1                   | 30.4            | 35.3                   | 43.3              | 57.1          | 47.7         | -             | 23.3             |
| Permittivity<br>at 50 mm          | 22.1            | 5.8                    | 25.7            | 20.7                   | 41.2              | 46.1          | 42.4         | -             | 35.9             |
| Transmissivity<br>(24 kPa)        | 80.0            | -                      | 55.8            | 23.7                   | 64.5              | 4.2           | 23.1         | -             | 41.9             |
| Transmissivity<br>(48 kPa)        | 66.8            | -                      | 48.5            | 23.9                   | -                 | 3.4           | 27.3         | -             | 38.8             |
| Transmissivity<br>(480 kPa)       | 82.4            | -                      | 46.8            | 29.2                   | 38.6              | 5.3           | 34.3         | -             | 41.9             |

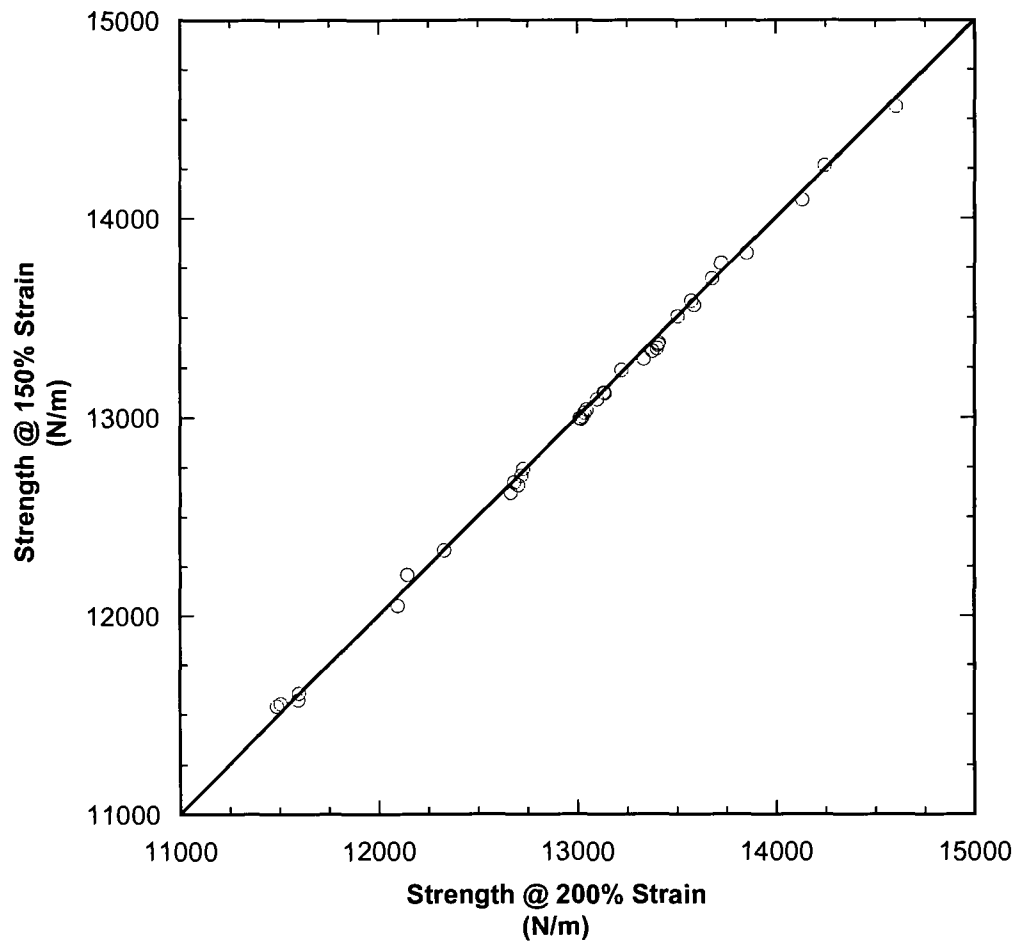
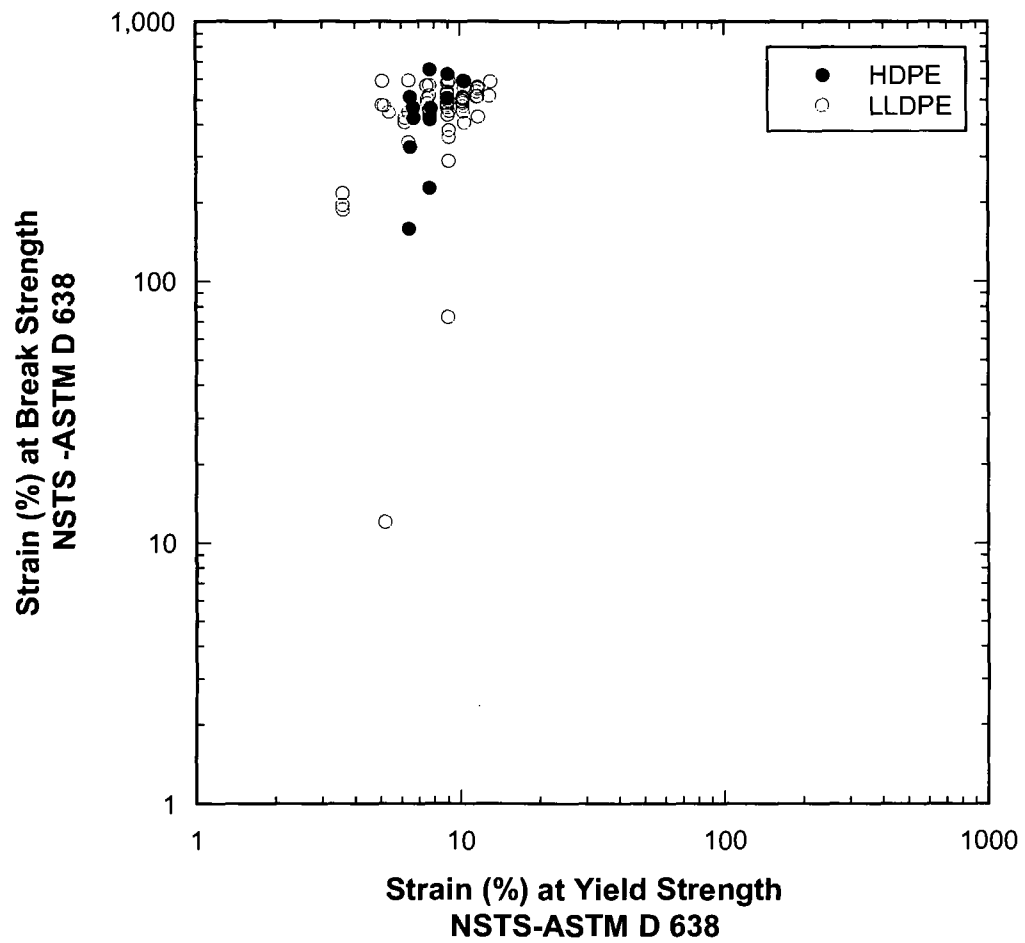


Fig. P1. Comparison of wide-width tensile strengths corresponding to 150 and 200% strain for Eau Claire samples.





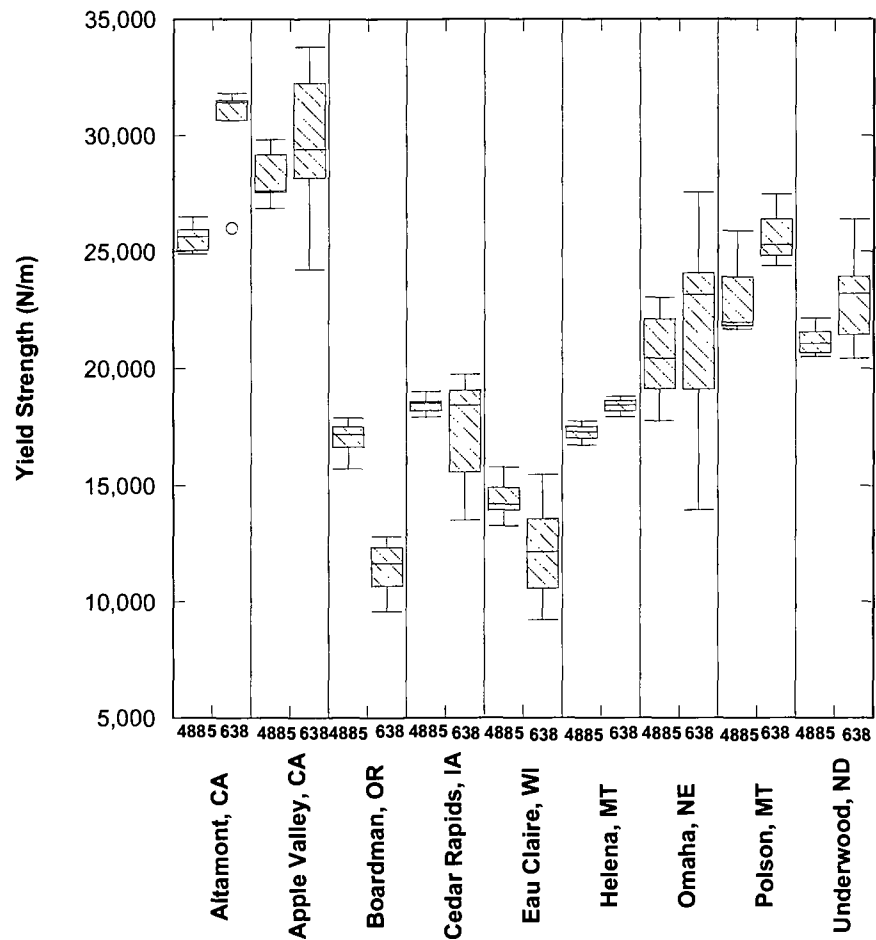


Fig. P3. Box plots comparing wide-strip and narrow-strip dumbbell tensile strengths.

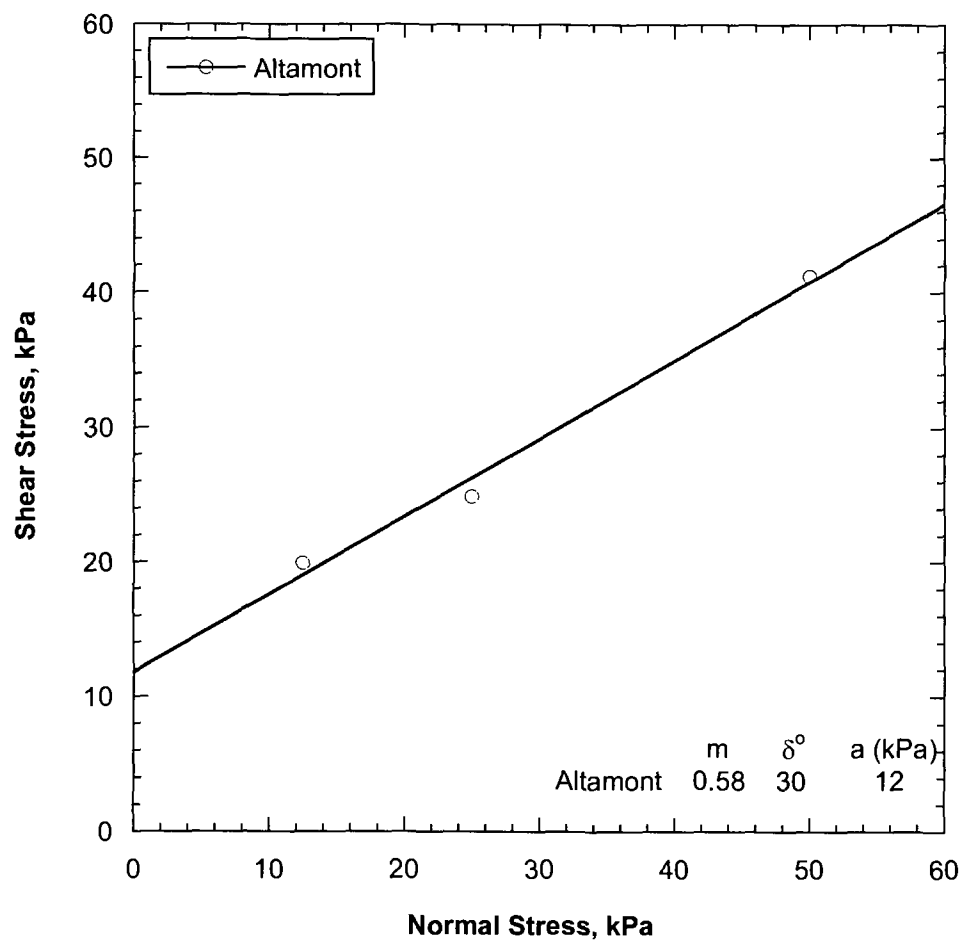


Fig. P4. Peak interface shear strength envelope for GM-GDL interface at Altamont.

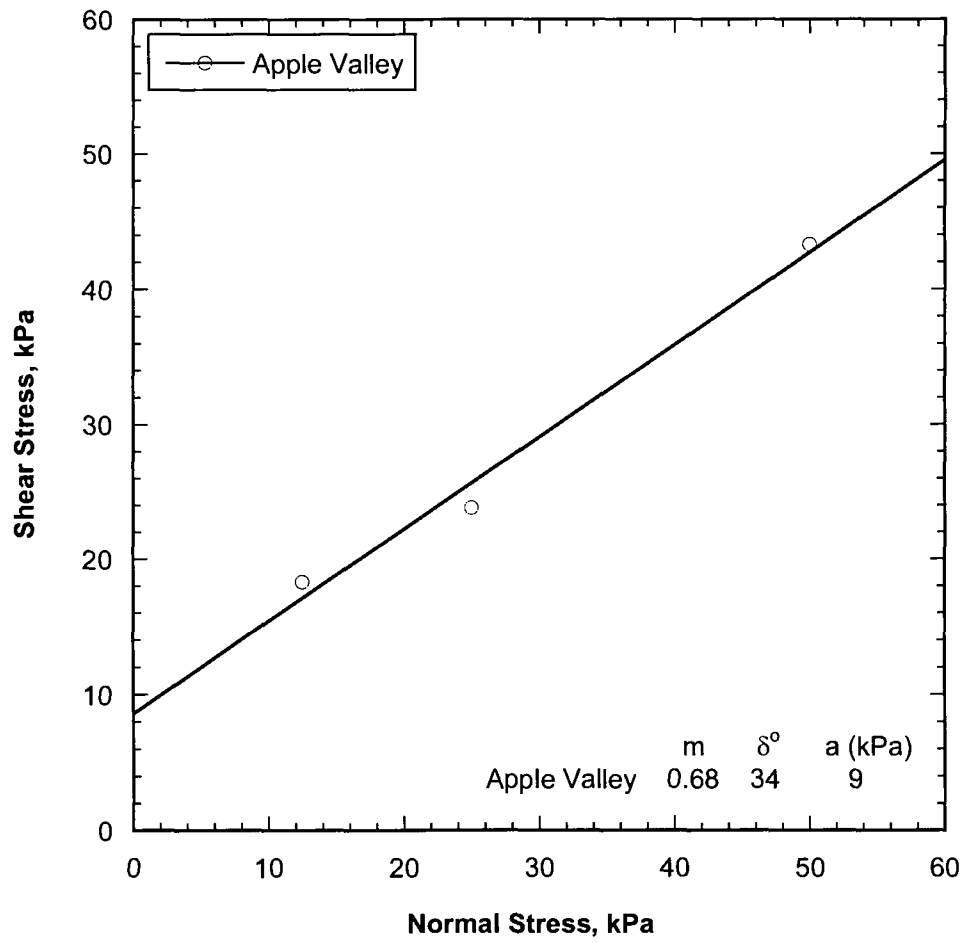


Fig. P5. Peak interface shear strength envelope for GM-GDL interface at Apple Valley.

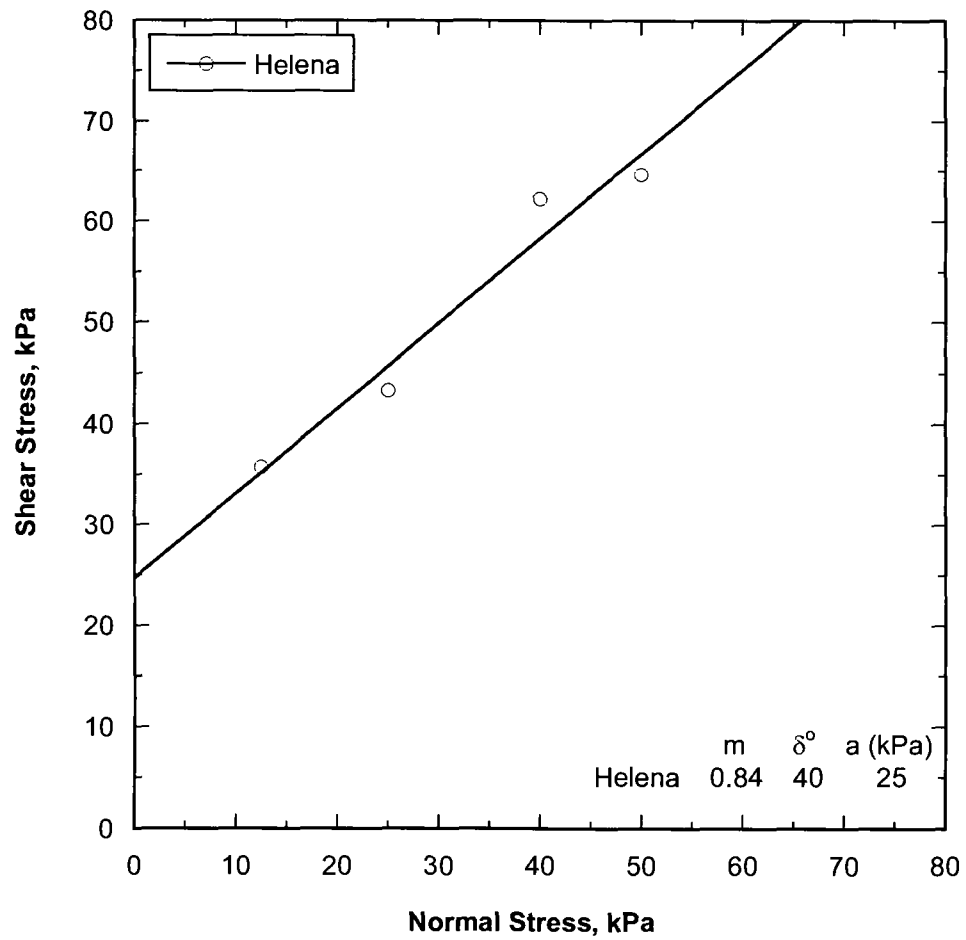


Fig. P6. Peak interface shear strength envelope for GM-GDL interface at Helena.

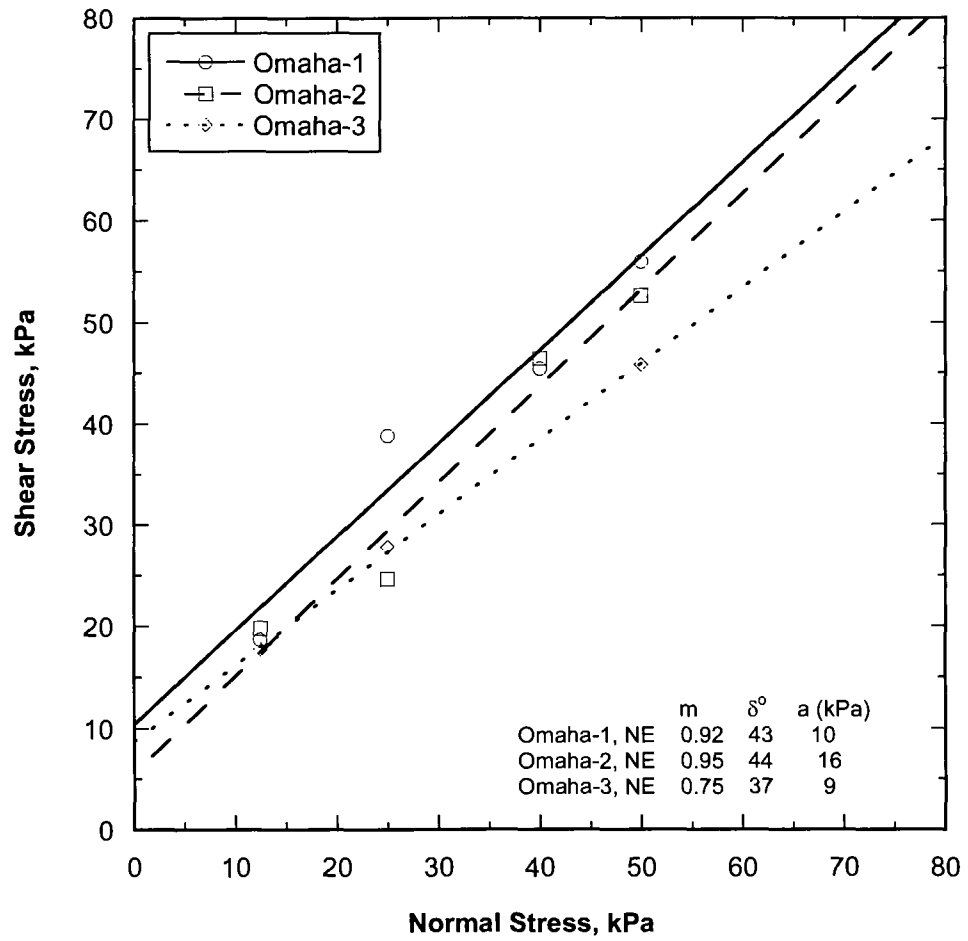


Fig. P7. Peak interface shear strength envelopes for GM-GDL interface at Omaha.



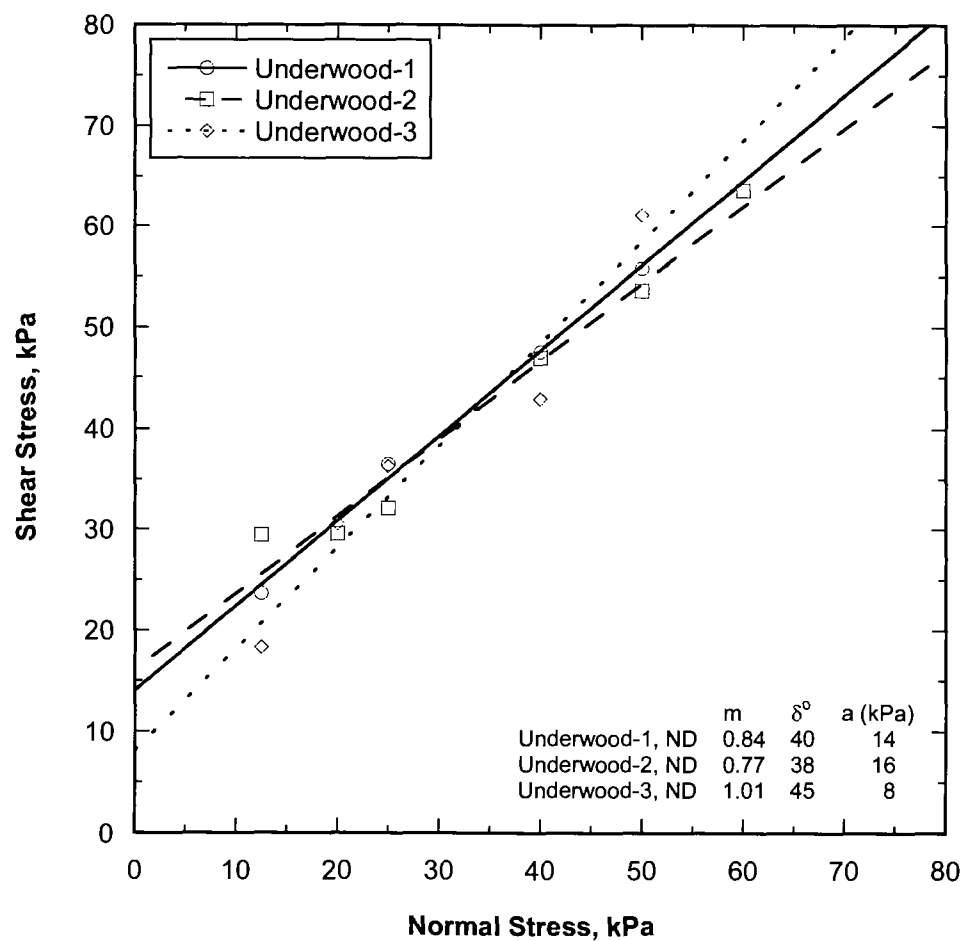


Fig. P8. Peak interface shear strength envelopes for GM-GDL interface at Underwood.



## **APPENDIX Q – PHOTOGRAPHS OF GM AND GDL TESTING**





Fig. Q1.MTS Sintech 10/GL load frame equipped with Curtis Geo-Grips used for tensile testing.



Fig. Q2. Close up of a wide-strip tensile testing of GM.

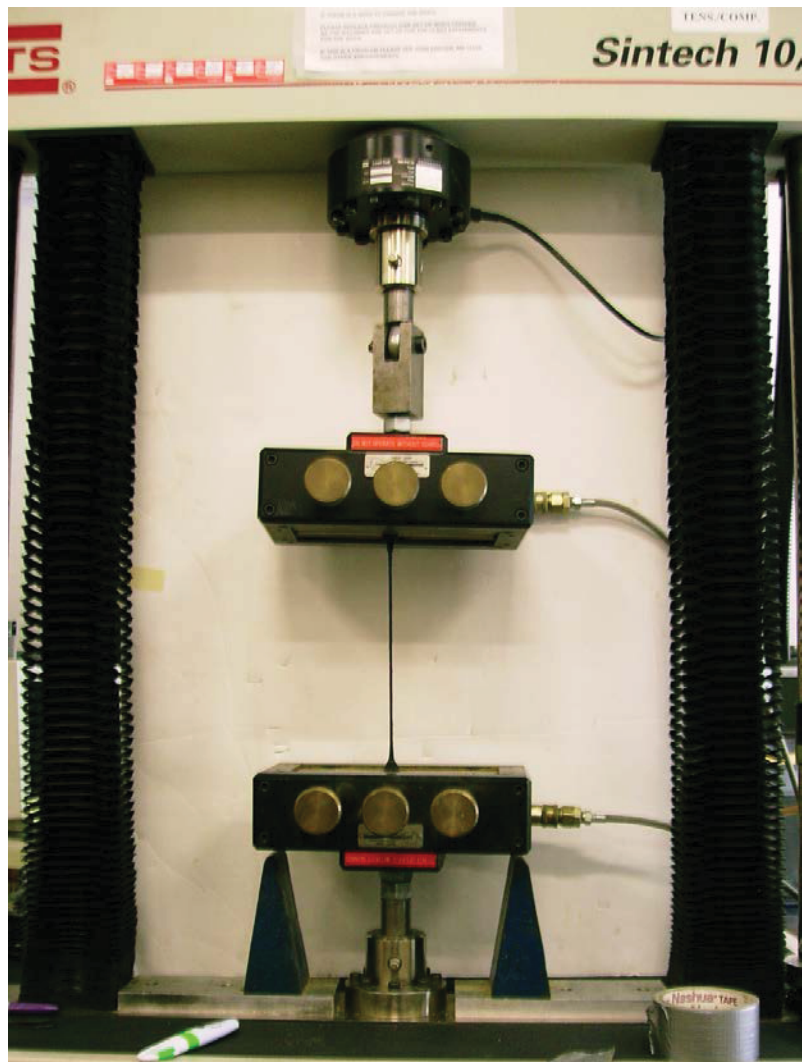


Fig. Q3. Photograph showing narrow strip specimen under tension.



Fig. Q4. Photograph of large-scale direct shear box used for interface shear tests.





Fig. Q5. Photograph of permittivity device.

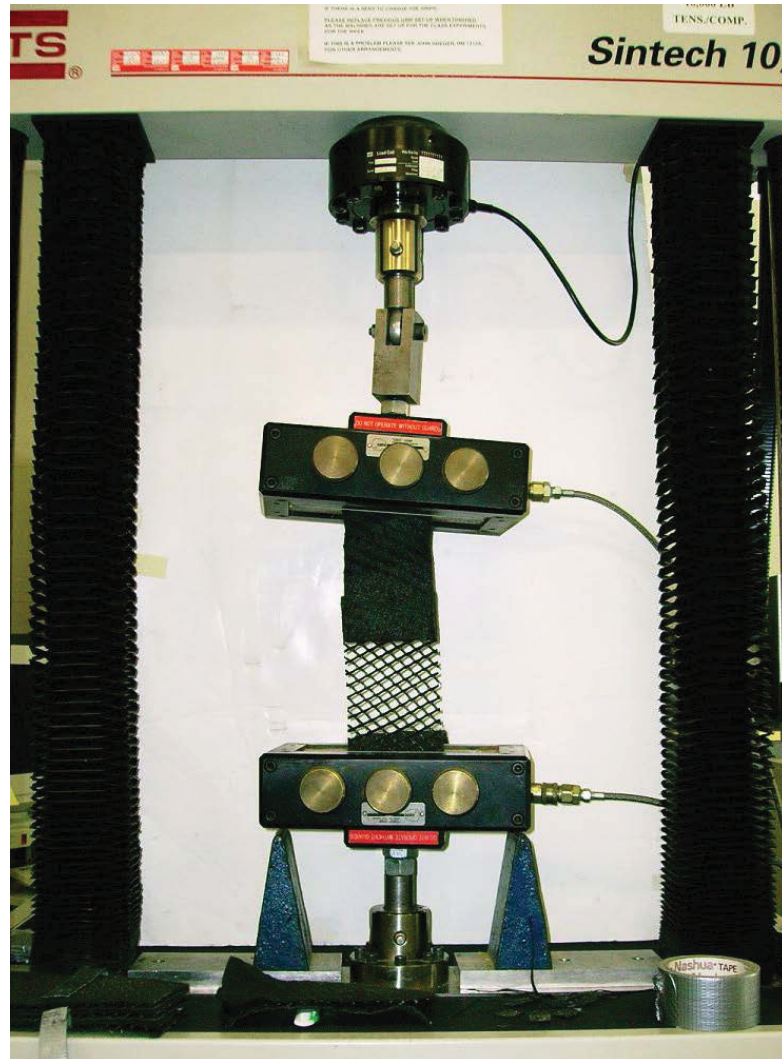


Fig. Q6. Photograph of ply adhesion test.

## **APPENDIX R – GM TEST DATA**



Table R1. Wide-strip yield strengths (ASTM D 4885).

| Identification      |               | Wide Strip Yield Strength (N/m) |       |       |              |       |       |
|---------------------|---------------|---------------------------------|-------|-------|--------------|-------|-------|
|                     |               | Specimen #                      |       |       | Mean         | Max.  | Min.  |
|                     |               | 1                               | 2     | 3     |              |       |       |
| Altamont,<br>CA     | CMP - GM2     | 26491                           | 25946 | 25718 | <b>26052</b> | 26491 | 25718 |
|                     | CMP - GM3     | 25049                           | 25577 | 24898 | <b>25175</b> | 25577 | 24898 |
| Apple Valley,<br>CA | GM1           | 29407                           | 29833 | 29179 | <b>29473</b> | 29833 | 29179 |
|                     | GM6           | 26864                           | 27241 | 27618 | <b>27241</b> | 27618 | 26864 |
|                     | GM8           | 27654                           | 27546 | 28303 | <b>27834</b> | 28303 | 27546 |
| Boardman,<br>OR     | GM1           | 17895                           | 17872 | 17423 | <b>17730</b> | 17895 | 17423 |
|                     | GM4           | 17815                           | 17062 | 17512 | <b>17463</b> | 17815 | 17062 |
|                     | Thin Cover    | 16480                           | 15728 | 16625 | <b>16278</b> | 16625 | 15728 |
| Cedar Rapids,<br>IA | Bottom Comp.1 | 18764                           | 18599 | 18424 | <b>18596</b> | 18764 | 18424 |
|                     | Bottom Comp.3 | 19037                           | 18583 | 18532 | <b>18717</b> | 19037 | 18532 |
|                     | Clay Bottom 2 | 18203                           | 18204 | 17927 | <b>18111</b> | 18204 | 17927 |
| Eau Claire,<br>WI   | TP1           | 13046                           | 12868 | 13169 | <b>13028</b> | 13169 | 12868 |
|                     | TP2           | 14407                           | 14600 | 14120 | <b>14376</b> | 14600 | 14120 |
|                     | TP3           | 14910                           | 14861 | 14471 | <b>14747</b> | 14910 | 14471 |
|                     | TP4           | 13720                           | 13132 | 12994 | <b>13282</b> | 13720 | 12994 |
| Helena, MT          | GM-AB         | 17281                           | 16723 | 17747 | <b>17250</b> | 17747 | 16723 |
| Omaha,<br>NE        | GM-A1B        | 22454                           | 23009 | 22169 | <b>22544</b> | 23009 | 22169 |
|                     | GM-A2B        | 20620                           | 19960 | 20220 | <b>20267</b> | 20620 | 19960 |
|                     | GM-CB         | 19976                           | 22026 | 21728 | <b>21243</b> | 22026 | 19976 |
|                     | GM-CM         | 18252                           | 17758 | 18311 | <b>18107</b> | 18311 | 17758 |
| Polson, MT          | GM-CM         | 21647                           | 25878 | 21949 | <b>23158</b> | 25878 | 21647 |
| Underwood,<br>ND    | GM-CC3        | 21076                           | 21112 | 20945 | <b>21044</b> | 21112 | 20945 |
|                     | GM-CC5        | 20515                           | 20675 | 20582 | <b>20591</b> | 20675 | 20515 |
|                     | GM-ET         | 21758                           | 22133 | 21548 | <b>21813</b> | 22133 | 21548 |

Table R2. Narrow-strip yield and break strengths (ASTM D 638).

| Identification      |               | Strenght (N/m) | Narrow Strip Test |       |       |              |       |       |
|---------------------|---------------|----------------|-------------------|-------|-------|--------------|-------|-------|
|                     |               |                | Specimen #        |       |       | Mean         | Max.  | Min.  |
|                     |               |                | 1                 | 2     | 3     |              |       |       |
| Altamont,<br>CA     | CMP - GM2     | @ Yield        | 26000             | 31833 | 31500 | <b>29778</b> | 31833 | 26000 |
|                     |               | @ Break        | 44383             | 38133 | 47800 | <b>43439</b> | 47800 | 38133 |
|                     | CMP - GM3     | @ Yield        | 30650             | 31517 | 31367 | <b>31178</b> | 31517 | 30650 |
|                     |               | @ Break        | 50900             | 46700 | 48750 | <b>48783</b> | 50900 | 46700 |
| Apple Valley,<br>CA | GM1           | @ Yield        | 26667             | 30133 | 32250 | <b>29683</b> | 32250 | 26667 |
|                     |               | @ Break        | 32266             | 39416 | 35466 | <b>35716</b> | 39416 | 32266 |
|                     | GM6           | @ Yield        | 33550             | 33817 | 28833 | <b>32067</b> | 33817 | 28833 |
|                     |               | @ Break        | 39550             | 36900 | 21266 | <b>32572</b> | 39550 | 21266 |
|                     | GM8           | @ Yield        | 29400             | 28167 | 24217 | <b>27261</b> | 29400 | 24217 |
|                     |               | @ Break        | 22033             | 30433 | 20316 | <b>24261</b> | 30433 | 20316 |
| Boardman,<br>OR     | GM1           | @ Yield        | 11183             | 9600  | 10683 | <b>10489</b> | 11183 | 9600  |
|                     |               | @ Break        | 29633             | 24683 | 20700 | <b>25005</b> | 29633 | 20700 |
|                     | GM4           | @ Yield        | 10323             | 11783 | 11633 | <b>11246</b> | 11783 | 10323 |
|                     |               | @ Break        | 27150             | 27533 | 25983 | <b>26889</b> | 27533 | 25983 |
|                     | Thin Cover    | @ Yield        | 12650             | 12333 | 12800 | <b>12594</b> | 12800 | 12333 |
|                     |               | @ Break        | 24800             | 29133 | 35850 | <b>29928</b> | 35850 | 24800 |
| Cedar Rapids,<br>IA | Bottom Comp.1 | @ Yield        | 19083             | 18683 | 19083 | <b>18950</b> | 19083 | 18683 |
|                     |               | @ Break        | 40233             | 38216 | 36166 | <b>38205</b> | 40233 | 36166 |
|                     | Bottom Comp.3 | @ Yield        | 19767             | 18417 | 15567 | <b>17917</b> | 19767 | 15567 |
|                     |               | @ Break        | 32250             | 40200 | 33750 | <b>35400</b> | 40200 | 32250 |
|                     | Clay Bottom 2 | @ Yield        | 15967             | 15050 | 13500 | <b>14839</b> | 15967 | 13500 |
|                     |               | @ Break        | 32600             | 33933 | 34850 | <b>33794</b> | 34850 | 32600 |

Table R2. Narrow-strip yield and break strengths (ASTM D 638) (Continued).

| Identification    |        | Strenght (N/m) | Narrow Strip Test |       |       |              |       |       |
|-------------------|--------|----------------|-------------------|-------|-------|--------------|-------|-------|
|                   |        |                | Specimen #        |       |       | Mean         | Max.  | Min.  |
|                   |        |                | 1                 | 2     | 3     |              |       |       |
| Eau Claire,<br>WI | TP1    | @ Yield        | 12433             | 10550 | 9216  | <b>10733</b> | 12433 | 9216  |
|                   |        | @ Break        | 21850             | 20283 | 20916 | <b>21016</b> | 21850 | 20283 |
|                   | TP2    | @ Yield        | 15466             | 13600 | 14750 | <b>14605</b> | 15466 | 13600 |
|                   |        | @ Break        | 30366             | 33733 | 29166 | <b>31088</b> | 33733 | 29166 |
|                   | TP3    | @ Yield        | 11516             | 13500 | 13266 | <b>12761</b> | 13500 | 11516 |
|                   |        | @ Break        | 30100             | 29450 | 16200 | <b>25250</b> | 30100 | 16200 |
|                   | TP4    | @ Yield        | 10283             | 11850 | 10583 | <b>10905</b> | 11850 | 10283 |
|                   |        | @ Break        | 33266             | 34033 | 34866 | <b>34055</b> | 34866 | 33266 |
| Helena,<br>MT     | GM-AB  | @ Yield        | 17933             | 18417 | 18800 | <b>18383</b> | 18800 | 17933 |
|                   |        | @ Break        | 22866             | 20766 | 27666 | <b>23766</b> | 27666 | 20766 |
| Omaha,<br>NE      | GM-A1B | @ Yield        | 24433             | 23717 | 21450 | <b>23200</b> | 24433 | 21450 |
|                   |        | @ Break        | 42633             | 43033 | 36250 | <b>40639</b> | 43033 | 36250 |
|                   | GM-A2B | @ Yield        | 18650             | 19000 | 19271 | <b>18974</b> | 19271 | 18650 |
|                   |        | @ Break        | 41416             | 46383 | 42683 | <b>43494</b> | 46383 | 41416 |
|                   | GM-CB  | @ Yield        | 22683             | 23583 | 23683 | <b>23316</b> | 23683 | 22683 |
|                   |        | @ Break        | 44366             | 44133 | 53383 | <b>47294</b> | 53383 | 44133 |
|                   | GM-CM  | @ Yield        | 13950             | 16250 | 17300 | <b>15833</b> | 17300 | 13950 |
|                   |        | @ Break        | 6983              | 25950 | 27550 | <b>20161</b> | 27550 | 6983  |
| Polson,<br>MT     | GM-CM  | @ Yield        | 27467             | 24383 | 25283 | <b>25711</b> | 27467 | 24383 |
|                   |        | @ Break        | 14483             | 30133 | 31100 | <b>25239</b> | 31100 | 14483 |
| Underwood,<br>ND  | GM-CC3 | @ Yield        | 23917             | 21183 | 21417 | <b>22172</b> | 23917 | 21183 |
|                   |        | @ Break        | 55033             | 54133 | 46166 | <b>51777</b> | 55033 | 46166 |
|                   | GM-CC5 | @ Yield        | 20417             | 21533 | 20833 | <b>20928</b> | 21533 | 20417 |
|                   |        | @ Break        | 48050             | 56166 | 47566 | <b>50594</b> | 56166 | 47566 |
|                   | GM-ET  | @ Yield        | 26000             | 26383 | 23767 | <b>25383</b> | 26383 | 23767 |
|                   |        | @ Break        | 53700             | 58183 | 53466 | <b>55116</b> | 58183 | 53466 |

**Table R3. Wide-strip yield strains (ASTM D 638).**

| Identification      |               | Wide Strip Yield Strain (%) |      |      |      |      |      |
|---------------------|---------------|-----------------------------|------|------|------|------|------|
|                     |               | Specimen #                  |      |      | Mean | Max. | Min. |
|                     |               | 1                           | 2    | 3    |      |      |      |
| Altamont,<br>CA     | CMP - GM2     | 16.7                        | 17.3 | 17.4 | 17.1 | 17.4 | 16.7 |
|                     | CMP - GM3     | 17.0                        | 18.0 | 18.0 | 17.7 | 18.0 | 17.0 |
| Apple Valley,<br>CA | GM1           | 14.7                        | 15.1 | 15.7 | 15.2 | 15.7 | 14.7 |
|                     | GM6           | 15.6                        | 15.2 | 15.6 | 15.5 | 15.6 | 15.2 |
|                     | GM8           | 14.9                        | 15.8 | 15.7 | 15.5 | 15.8 | 14.9 |
| Boardman,<br>OR     | GM1           | 17.1                        | 18.6 | 19.0 | 18.2 | 19.0 | 17.1 |
|                     | GM4           | 19.8                        | 18.9 | 18.5 | 19.1 | 19.8 | 18.5 |
|                     | Thin Cover    | 18.3                        | 18.7 | 17.9 | 18.3 | 18.7 | 17.9 |
| Cedar Rapids,<br>IA | Bottom Comp.1 | 23.1                        | 26.3 | 33.5 | 27.6 | 33.5 | 23.1 |
|                     | Bottom Comp.3 | 24.4                        | 23.2 | 26.9 | 24.8 | 26.9 | 23.2 |
|                     | Clay Bottom 2 | 26.5                        | 27.3 | 30.6 | 28.1 | 30.6 | 26.5 |
| Eau Claire,<br>WI   | TP1           | 23.5                        | 30.4 | 34.9 | 29.6 | 34.9 | 23.5 |
|                     | TP2           | 19.7                        | 19.2 | 17.9 | 18.9 | 19.7 | 17.9 |
|                     | TP3           | 21.0                        | 19.8 | 18.5 | 19.8 | 21.0 | 18.5 |
|                     | TP4           | 19.8                        | 21.2 | 21.2 | 20.7 | 21.2 | 19.8 |
| Helena,<br>MT       | GM-AB         | 18.3                        | 16.9 | 18.2 | 17.8 | 18.3 | 16.9 |
| Omaha,<br>NE        | GM-A1B        | 23.6                        | 20.7 | 19.8 | 21.4 | 23.6 | 19.8 |
|                     | GM-A2B        | 22.7                        | 22.4 | 30.0 | 25.0 | 30.0 | 22.4 |
|                     | GM-CB         | 20.2                        | 21.6 | 20.5 | 20.8 | 21.6 | 20.2 |
|                     | GM-CM         | 11.3                        | 11.2 | 11.6 | 11.4 | 11.6 | 11.2 |
| Polson,<br>MT       | GM-CM         | 18.0                        | 16.0 | 15.4 | 16.5 | 18.0 | 15.4 |
| Underwood,<br>ND    | GM-CC3        | 24.7                        | 32.0 | 36.9 | 31.2 | 36.9 | 24.7 |
|                     | GM-CC5        | 40.5                        | 46.8 | 49.5 | 45.6 | 49.5 | 40.5 |
|                     | GM-ET         | 23.6                        | 28.5 | 41.8 | 31.3 | 41.8 | 23.6 |



Table R4. Narrow-strip yield and break strains (ASTM D 638).

| Identification      |               | Strain (%) | Narrow Strip Test |       |       |       |       |       |
|---------------------|---------------|------------|-------------------|-------|-------|-------|-------|-------|
|                     |               |            | Specimen #        |       |       | Mean  | Max.  | Min.  |
|                     |               |            | 1                 | 2     | 3     |       |       |       |
| Altamont,<br>CA     | CMP - GM2     | @ Yield    | 7.7               | 9.0   | 9.0   | 8.6   | 9.0   | 7.7   |
|                     |               | @ Break    | 651.3             | 507.4 | 627.8 | 595.5 | 651.3 | 507.4 |
|                     | CMP - GM3     | @ Yield    | 9.0               | 10.4  | 10.3  | 9.9   | 10.4  | 9.0   |
|                     |               | @ Break    | 627.7             | 589.8 | 591.1 | 602.9 | 627.7 | 589.8 |
| Apple Valley,<br>CA | GM1           | @ Yield    | 6.7               | 6.5   | 6.7   | 6.6   | 6.7   | 6.5   |
|                     |               | @ Break    | 468.4             | 511.4 | 424.0 | 467.9 | 511.4 | 424.0 |
|                     | GM6           | @ Yield    | 7.8               | 7.7   | 7.7   | 7.7   | 7.8   | 7.7   |
|                     |               | @ Break    | 464.3             | 423.7 | 227.5 | 371.8 | 464.3 | 227.5 |
|                     | GM8           | @ Yield    | 6.4               | 7.7   | 6.5   | 6.9   | 7.7   | 6.4   |
|                     |               | @ Break    | 158.2             | 418.5 | 327.0 | 301.2 | 418.5 | 158.2 |
| Boardman,<br>OR     | GM1           | @ Yield    | 7.6               | 5.4   | 6.2   | 6.4   | 7.6   | 5.4   |
|                     |               | @ Break    | 502.1             | 446.2 | 407.8 | 452.0 | 502.1 | 407.8 |
|                     | GM4           | @ Yield    | 5.2               | 7.6   | 6.4   | 6.4   | 7.6   | 5.2   |
|                     |               | @ Break    | 473.5             | 483.8 | 445.9 | 467.7 | 483.8 | 445.9 |
|                     | Thin Cover    | @ Yield    | 6.2               | 5.1   | 7.5   | 6.3   | 7.5   | 5.1   |
|                     |               | @ Break    | 423.5             | 476.0 | 562.1 | 487.2 | 562.1 | 423.5 |
| Cedar Rapids,<br>IA | Bottom Comp.1 | @ Yield    | 10.3              | 9.0   | 10.3  | 9.9   | 10.3  | 9.0   |
|                     |               | @ Break    | 491.7             | 477.3 | 449.9 | 473.0 | 491.7 | 449.9 |
|                     | Bottom Comp.3 | @ Yield    | 10.4              | 10.3  | 7.7   | 9.5   | 10.4  | 7.7   |
|                     |               | @ Break    | 406.7             | 493.0 | 455.1 | 451.6 | 493.0 | 406.7 |
|                     | Clay Bottom 2 | @ Yield    | 9.1               | 10.3  | 10.2  | 9.9   | 10.3  | 9.1   |
|                     |               | @ Break    | 452.5             | 472.0 | 495.5 | 473.3 | 495.5 | 452.5 |

Table R4. Narrow-strip yield and break strains (ASTM D 638) (Continued).

| Identification    |        | Strain (%) | Narrow Strip Test |       |       |              |       |       |
|-------------------|--------|------------|-------------------|-------|-------|--------------|-------|-------|
|                   |        |            | Specimen #        |       |       | Mean         | Max.  | Min.  |
|                   |        |            | 1                 | 2     | 3     |              |       |       |
| Eau Claire,<br>WI | TP1    | @ Yield    | 11.7              | 9.0   | 9.0   | <b>9.9</b>   | 11.7  | 9.0   |
|                   |        | @ Break    | 428.9             | 436.8 | 466.8 | <b>444.2</b> | 466.8 | 428.9 |
|                   | TP2    | @ Yield    | 3.6               | 3.6   | 3.6   | <b>3.6</b>   | 3.6   | 3.6   |
|                   |        | @ Break    | 194.6             | 216.8 | 187.9 | <b>199.8</b> | 216.8 | 187.9 |
|                   | TP3    | @ Yield    | 9.0               | 9.0   | 9.1   | <b>9.0</b>   | 9.1   | 9.0   |
|                   |        | @ Break    | 524.4             | 485.2 | 289.0 | <b>432.9</b> | 524.4 | 289.0 |
|                   | TP4    | @ Yield    | 9.0               | 10.4  | 9.1   | <b>9.5</b>   | 10.4  | 9.0   |
|                   |        | @ Break    | 582.0             | 554.5 | 587.2 | <b>574.6</b> | 587.2 | 554.5 |
| Helena,<br>MT     | GM-AB  | @ Yield    | 9.1               | 9.1   | 7.7   | <b>8.6</b>   | 9.1   | 7.7   |
|                   |        | @ Break    | 380.6             | 357.0 | 443.3 | <b>393.6</b> | 443.3 | 357.0 |
| Omaha,<br>NE      | GM-A1B | @ Yield    | 10.3              | 10.3  | 7.7   | <b>9.4</b>   | 10.3  | 7.7   |
|                   |        | @ Break    | 485.2             | 508.7 | 449.8 | <b>481.2</b> | 508.7 | 449.8 |
|                   | GM-A2B | @ Yield    | 7.7               | 7.7   | 9.0   | <b>8.1</b>   | 9.0   | 7.7   |
|                   |        | @ Break    | 516.6             | 566.3 | 534.8 | <b>539.2</b> | 566.3 | 516.6 |
|                   | GM-CB  | @ Yield    | 10.3              | 9.1   | 9.1   | <b>9.5</b>   | 10.3  | 9.1   |
|                   |        | @ Break    | 511.3             | 494.3 | 593.8 | <b>533.1</b> | 593.8 | 494.3 |
|                   | GM-CM  | @ Yield    | 5.2               | 5.1   | 6.4   | <b>5.6</b>   | 6.4   | 5.1   |
|                   |        | @ Break    | 12.0              | 588.5 | 591.1 | <b>397.2</b> | 591.1 | 12.0  |
| Polson,<br>MT     | GM-CM  | @ Yield    | 9.0               | 6.4   | 7.7   | <b>7.7</b>   | 9.0   | 6.4   |
|                   |        | @ Break    | 73.1              | 341.1 | 431.5 | <b>281.9</b> | 431.5 | 73.1  |
| Underwood,<br>ND  | GM-CC3 | @ Yield    | 10.7              | 11.7  | 10.3  | <b>10.9</b>  | 11.7  | 10.3  |
|                   |        | @ Break    | 550.9             | 550.6 | 500.9 | <b>534.1</b> | 550.9 | 500.9 |
|                   | GM-CC5 | @ Yield    | 13.0              | 13.1  | 11.6  | <b>12.6</b>  | 13.1  | 11.6  |
|                   |        | @ Break    | 517.9             | 584.8 | 512.6 | <b>538.4</b> | 584.8 | 512.6 |
|                   | GM-ET  | @ Yield    | 11.7              | 11.7  | 11.6  | <b>11.7</b>  | 11.7  | 11.6  |
|                   |        | @ Break    | 515.3             | 559.8 | 533.6 | <b>536.2</b> | 559.8 | 515.3 |

## **APPENDIX S – GDL TEST DATA**



Table S1. Transmissivity of GDLs (ASTM D 4716).

| Sample ID    | Sample #                 | Specimen # | $\sigma = 24 \text{ kPa}$                      |                                      | $\sigma = 48 \text{ kPa}$                      |                                      | $\sigma = 480 \text{ kPa}$                     |                                      |
|--------------|--------------------------|------------|--|--------------------------------------|--|--------------------------------------|--|--------------------------------------|
|              |                          |            | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ |
| ALTAMONT, CA | Alt. Bottom of Lysimeter | 1          | 2.1E-04  | 2.1E-04                              | 7.9E-05  | 8.1E-05                              | 2.1E-05  | 2.0E-05                              |
|              |                          |            | 2.2E-04  |                                      | 8.4E-05  |                                      | 2.0E-05  |                                      |
|              |                          |            | 2.0E-04  |                                      | 8.1E-05  |                                      | 1.9E-05  |                                      |
|              |                          | 2          | 8.5E-05  | 8.4E-05                              | 5.6E-05  | 5.5E-05                              | 2.0E-05  | 2.0E-05                              |
|              |                          |            | 8.3E-05  |                                      | 5.5E-05  |                                      | 2.0E-05  |                                      |
|              |                          |            | 8.3E-05  |                                      | 5.3E-05  |                                      | 1.9E-05  |                                      |
|              |                          | 3          | 8.2E-05  | 8.1E-05                              | 5.2E-05  | 5.0E-05                              | 1.3E-05  | 1.2E-05                              |
|              |                          |            | 8.0E-05  |                                      | 5.0E-05  |                                      | 1.2E-05  |                                      |
|              |                          |            | 8.0E-05  |                                      | 4.9E-05  |                                      | 1.2E-05  |                                      |
|              | CMP-GC3                  | 1          | 2.6E-04  | 2.6E-04                              | 1.5E-04  | 1.4E-04                              | 2.3E-05  | 2.2E-05                              |
|              |                          |            | 2.6E-04  |                                      | 1.5E-04  |                                      | 2.2E-05  |                                      |
|              |                          |            | 2.6E-04  |                                      | 1.4E-04  |                                      | 2.1E-05  |                                      |
|              |                          | 2          | 2.9E-04  | 2.8E-04                              | 1.5E-04  | 1.5E-04                              | 2.3E-05  | 2.2E-05                              |
|              |                          |            | 2.8E-04  |                                      | 1.5E-04  |                                      | 2.2E-05  |                                      |
|              |                          |            | 2.8E-04  |                                      | 1.4E-04  |                                      | 2.2E-05  |                                      |
|              |                          | 3          | 3.4E-04  | 3.3E-04                              | 1.5E-04  | 1.5E-04                              | 3.1E-05  | 3.0E-05                              |
|              |                          |            | 3.2E-04  |                                      | 1.5E-04  |                                      | 3.0E-05  |                                      |
|              |                          |            | 3.2E-04  |                                      | 1.5E-04  |                                      | 2.9E-05  |                                      |

Table S1. Transmissivity of GDLs (ASTM D 4716) (Continued).

| Sample ID    | Sample #                | Specimen # | $\sigma = 24 \text{ kPa}$                      |                                      | $\sigma = 48 \text{ kPa}$                      |                                      | $\sigma = 480 \text{ kPa}$                     |                                      |
|--------------|-------------------------|------------|--|--------------------------------------|--|--------------------------------------|--|--------------------------------------|
|              |                         |            | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ |
| ALTAMONT, CA | CMP-Bottom of Lysimeter | 1          | 2.4E-04  | 2.4E-04                              | 1.7E-04  | 1.7E-04                              | 9.7E-05  | 9.7E-05                              |
|              |                         |            | 2.4E-04  |                                      | 1.7E-04  |                                      | 9.7E-05  |                                      |
|              |                         |            | 2.4E-04  |                                      | 1.7E-04  |                                      | 9.7E-05  |                                      |
|              |                         | 2          | 4.9E-05  | 4.8E-05                              | 4.4E-05  | 4.4E-05                              | 2.9E-05  | 2.8E-05                              |
|              |                         |            | 4.8E-05  |                                      | 4.4E-05  |                                      | 2.8E-05  |                                      |
|              |                         |            | 4.8E-05  |                                      | 4.3E-05  |                                      | 2.8E-05  |                                      |
|              |                         | 3          | 4.2E-05  | 4.2E-05                              | 3.7E-05  | 3.7E-05                              | 2.1E-05  | 2.1E-05                              |
|              |                         |            | 4.2E-05  |                                      | 3.7E-05  |                                      | 2.1E-05  |                                      |
|              |                         |            | 4.1E-05  |                                      | 3.6E-05  |                                      | 2.1E-05  |                                      |
|              | CMP-GC2                 | 1          | 3.6E-05  | 3.5E-05                              | 3.1E-05  | 3.1E-05                              | 1.7E-05  | 1.7E-05                              |
|              |                         |            | 3.5E-05  |                                      | 3.1E-05  |                                      | 1.7E-05  |                                      |
|              |                         |            | 3.4E-05  |                                      | 3.1E-05  |                                      | 1.7E-05  |                                      |
|              |                         | 2          | 3.8E-05  | 3.8E-05                              | 3.5E-05  | 3.4E-05                              | 2.1E-05  | 2.1E-05                              |
|              |                         |            | 3.8E-05  |                                      | 3.4E-05  |                                      | 2.1E-05  |                                      |
|              |                         |            | 3.7E-05  |                                      | 3.4E-05  |                                      | 2.0E-05  |                                      |
|              |                         | 3          | 4.7E-05  | 4.6E-05                              | 3.6E-05  | 3.6E-05                              | 1.8E-05  | 1.7E-05                              |
|              |                         |            | 4.6E-05  |                                      | 3.6E-05  |                                      | 1.7E-05  |                                      |
|              |                         |            | 4.5E-05  |                                      | 3.6E-05  |                                      | 1.7E-05  |                                      |

Table S1. Transmissivity of GDLs (ASTM D 4716) (Continued).

| Sample ID    | Sample #             | Specimen # | $\sigma = 24 \text{ kPa}$                      |                                      | $\sigma = 48 \text{ kPa}$                      |                                      | $\sigma = 480 \text{ kPa}$                     |                                      |
|--------------|----------------------|------------|--|--------------------------------------|--|--------------------------------------|--|--------------------------------------|
|              |                      |            | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ |
| BOARDMAN, OR | LOWER GEOCOMPOSITE   | 1          | 1.7E-04  | 1.8E-04                              | 1.6E-04  | 1.6E-04                              | 8.0E-05  | 7.9E-05                              |
|              |                      |            | 1.8E-04  |                                      | 1.6E-04  |                                      | 7.9E-05  |                                      |
|              |                      |            | 1.8E-04  |                                      | 1.6E-04  |                                      | 7.7E-05  |                                      |
|              |                      | 2          | 3.3E-04  | 3.4E-04                              | 5.5E-05  | 5.5E-05                              | 2.8E-05  | 2.8E-05                              |
|              |                      |            | 3.4E-04  |                                      | 5.5E-05  |                                      | 2.8E-05  |                                      |
|              |                      |            | 3.4E-04  |                                      | 5.5E-05  |                                      | 2.7E-05  |                                      |
|              |                      | 3          | 7.2E-05  | 7.2E-05                              | 5.8E-05  | 5.8E-05                              | 2.9E-05  | 2.9E-05                              |
|              |                      |            | 7.2E-05  |                                      | 5.8E-05  |                                      | 2.9E-05  |                                      |
|              |                      |            | 7.1E-05  |                                      | 5.8E-05  |                                      | 2.8E-05  |                                      |
|              | GEOCOMPOSITE 1 UPPER | 1          | 1.9E-04  | 1.9E-04                              | 1.5E-04  | 1.5E-04                              | 5.6E-05  | 5.3E-05                              |
|              |                      |            | 1.9E-04  |                                      | 1.5E-04  |                                      | 5.3E-05  |                                      |
|              |                      |            | 1.8E-04  |                                      | 1.5E-04  |                                      | 5.2E-05  |                                      |
|              |                      | 2          | 1.7E-04  | 1.6E-04                              | 1.3E-04  | 1.3E-04                              | 6.2E-05  | 6.1E-05                              |
|              |                      |            | 1.6E-04  |                                      | 1.3E-04  |                                      | 6.1E-05  |                                      |
|              |                      |            | 1.6E-04  |                                      | 1.2E-04  |                                      | 6.0E-05  |                                      |
|              |                      | 3          | 1.6E-04  | 1.6E-04                              | 1.2E-04  | 1.2E-04                              | 5.9E-05  | 5.7E-05                              |
|              |                      |            | 1.6E-04  |                                      | 1.2E-04  |                                      | 5.7E-05  |                                      |
|              |                      |            | 1.5E-04  |                                      | 1.2E-04  |                                      | 5.5E-05  |                                      |

Table S1. Transmissivity of GDLs (ASTM D 4716) (Continued).

| Sample ID        | Sample #      | Specimen # | $\sigma = 24 \text{ kPa}$                      |                                      | $\sigma = 48 \text{ kPa}$                      |                                      | $\sigma = 480 \text{ kPa}$                     |                                      |
|------------------|---------------|------------|--|--------------------------------------|--|--------------------------------------|--|--------------------------------------|
|                  |               |            | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ |
| BOARDMAN, OR     | Thick Cover 3 | 1          | 6.8E-05  | 6.6E-05                              | 4.7E-05  | 4.7E-05                              | 2.4E-05  | 2.3E-05                              |
|                  |               |            | 6.6E-05  |                                      | 4.6E-05  |                                      | 2.3E-05  |                                      |
|                  |               |            | 6.5E-05  |                                      | 4.6E-05  |                                      | 2.3E-05  |                                      |
|                  |               | 2          | 1.9E-04  | 1.9E-04                              | 1.5E-04  | 1.5E-04                              | 7.7E-05  | 7.5E-05                              |
|                  |               |            | 1.9E-04  |                                      | 1.5E-04  |                                      | 7.4E-05  |                                      |
|                  |               |            | 1.9E-04  |                                      | 1.5E-04  |                                      | 7.3E-05  |                                      |
|                  |               | 3          | 5.5E-05  | 5.7E-05                              | 4.3E-05  | 4.3E-05                              | 2.3E-05  | 2.3E-05                              |
|                  |               |            | 5.8E-05  |                                      | 4.3E-05  |                                      | 2.3E-05  |                                      |
|                  |               |            | 5.7E-05  |                                      | 4.3E-05  |                                      | 2.3E-05  |                                      |
| CEDAR RAPIDS, IA | CLAY BOTTOM 1 | 1          | 3.1E-04  | 3.0E-04                              | 1.8E-04  | 1.8E-04                              | 8.5E-05  | 8.4E-05                              |
|                  |               |            | 3.0E-04  |                                      | 1.8E-04  |                                      | 8.3E-05  |                                      |
|                  |               |            | 3.0E-04  |                                      | 1.8E-04  |                                      | 8.3E-05  |                                      |
|                  |               | 2          | 2.7E-04  | 2.8E-04                              | 2.7E-04  | 2.7E-04                              | 1.6E-04  | 1.6E-04                              |
|                  |               |            | 2.8E-04  |                                      | 2.7E-04  |                                      | 1.6E-04  |                                      |
|                  |               |            | 2.8E-04  |                                      | 2.6E-04  |                                      | 1.6E-04  |                                      |
|                  |               | 3          | 2.8E-04  | 2.8E-04                              | 2.8E-04  | 2.8E-04                              | 1.8E-04  | 1.8E-04                              |
|                  |               |            | 2.8E-04  |                                      | 2.8E-04  |                                      | 1.8E-04  |                                      |
|                  |               |            | 2.7E-04  |                                      | 2.7E-04  |                                      | 1.7E-04  |                                      |



Table S1. Transmissivity of GDLs (ASTM D 4716) (Continued).

|                  |                    |            | $\sigma = 24 \text{ kPa}$                      |                                      | $\sigma = 48 \text{ kPa}$                      |                                      | $\sigma = 480 \text{ kPa}$                     |                                      |
|------------------|--------------------|------------|--|--------------------------------------|--|--------------------------------------|--|--------------------------------------|
| Sample ID        | Sample #           | Specimen # | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ |
| CEDAR RAPIDS, IA | BOTTOM COMPOSITE 2 | 1          | 3.1E-04  | 3.1E-04                              | 2.8E-04  | 2.8E-04                              | 1.5E-04  | 1.5E-04                              |
|                  |                    |            | 3.1E-04  |                                      | 2.7E-04  |                                      | 1.5E-04  |                                      |
|                  |                    |            | 3.0E-04  |                                      | 2.7E-04  |                                      | 1.5E-04  |                                      |
|                  |                    | 2          | 3.2E-04  | 3.2E-04                              | 3.1E-04  | 3.1E-04                              | 1.8E-04  | 1.7E-04                              |
|                  |                    |            | 3.2E-04  |                                      | 3.1E-04  |                                      | 1.7E-04  |                                      |
|                  |                    |            | 3.2E-04  |                                      | 3.1E-04  |                                      | 1.7E-04  |                                      |
|                  |                    | 3          | 4.9E-04  | 4.8E-04                              | 3.9E-04  | 3.9E-04                              | 2.3E-04  | 2.3E-04                              |
|                  |                    |            | 4.9E-04  |                                      | 3.8E-04  |                                      | 2.3E-04  |                                      |
|                  |                    |            | 4.7E-04  |                                      | 3.9E-04  |                                      | 2.3E-04  |                                      |
| EAU CLAIRE, WI   | TP1-GC-1           | 1          | 4.6E-04  | 4.4E-04                              | N/A  |                                      | 2.1E-04  | 2.0E-04                              |
|                  |                    |            | 4.5E-04  |                                      |  |                                      | 2.0E-04  |                                      |
|                  |                    |            | 4.7E-04  |                                      |  |                                      | 2.0E-04  |                                      |
|                  |                    | 2          | 2.5E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                  |                    |            | 2.4E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                  |                    |            | 2.4E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                  |                    | 3          | 6.2E-04  |                                      |  |                                      | 2.9E-04  |                                      |
|                  |                    |            | 6.0E-04  |                                      |  |                                      | 2.8E-04  |                                      |
|                  |                    |            | 5.9E-04  |                                      |  |                                      | 2.8E-04  |                                      |

Table S1. Transmissivity of GDLs (ASTM D 4716) (Continued).

|                |          |            | $\sigma = 24 \text{ kPa}$                      |                                      | $\sigma = 48 \text{ kPa}$                      |                                      | $\sigma = 480 \text{ kPa}$                     |                                      |
|----------------|----------|------------|--|--------------------------------------|--|--------------------------------------|--|--------------------------------------|
| Sample ID      | Sample # | Specimen # | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ |
| EAU CLAIRE, WI | TP1-GC-2 | 1          | 5.6E-04  | 5.4E-04                              | N/A  |                                      | 2.2E-04  | 2.3E-04                              |
|                |          |            | 5.7E-04  |                                      |  |                                      | 2.2E-04  |                                      |
|                |          |            | 5.6E-04  |                                      |  |                                      | 2.2E-04  |                                      |
|                |          | 2          | 5.1E-04  |                                      |  |                                      | 2.5E-04  |                                      |
|                |          |            | 5.2E-04  |                                      |  |                                      | 2.5E-04  |                                      |
|                |          |            | 5.1E-04  |                                      |  |                                      | 2.4E-04  |                                      |
|                |          | 3          | 5.4E-04  |                                      |  |                                      | 2.3E-04  |                                      |
|                |          |            | 5.6E-04  |                                      |  |                                      | 2.2E-04  |                                      |
|                |          |            | 5.3E-04  |                                      |  |                                      | 2.2E-04  |                                      |
|                |          |            |  |                                      |  |                                      |  |                                      |
|                | TP1-GC-3 | 1          | 2.3E-04  | 3.4E-04                              | N/A  |                                      | 1.1E-04  | 1.4E-04                              |
|                |          |            | 2.3E-04  |                                      |  |                                      | 1.1E-04  |                                      |
|                |          |            | 2.3E-04  |                                      |  |                                      | 1.0E-04  |                                      |
|                |          | 2          | 4.2E-04  |                                      |  |                                      | 1.6E-04  |                                      |
|                |          |            | 4.3E-04  |                                      |  |                                      | 1.6E-04  |                                      |
|                |          |            | 4.2E-04  |                                      |  |                                      | 1.6E-04  |                                      |
|                |          | 3          | 3.8E-04  |                                      |  |                                      | 1.5E-04  |                                      |
|                |          |            | 3.7E-04  |                                      |  |                                      | 1.5E-04  |                                      |
|                |          |            | 3.7E-04  |                                      |  |                                      | 1.5E-04  |                                      |
|                |          |            |  |                                      |  |                                      |  |                                      |

Table S1. Transmissivity of GDLs (ASTM D 4716) (Continued).

|                |          |            | $\sigma = 24 \text{ kPa}$                      |                                      | $\sigma = 48 \text{ kPa}$                      |                                      | $\sigma = 480 \text{ kPa}$                     |                                      |
|----------------|----------|------------|--|--------------------------------------|--|--------------------------------------|--|--------------------------------------|
| Sample ID      | Sample # | Specimen # | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ |
| EAU CLAIRE, WI | TP2-GC-1 | 1          | 3.2E-04  | 2.8E-04                              | N/A  |                                      | 1.1E-04  | 1.1E-04                              |
|                |          |            | 3.2E-04  |                                      |  |                                      | 1.1E-04  |                                      |
|                |          |            | 3.3E-04  |                                      |  |                                      | 1.0E-04  |                                      |
|                |          | 2          | 2.8E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                |          |            | 2.9E-04  |                                      |  |                                      | 1.1E-04  |                                      |
|                |          |            | 2.9E-04  |                                      |  |                                      | 1.1E-04  |                                      |
|                |          | 3          | 2.2E-04  |                                      |  |                                      | 1.1E-04  |                                      |
|                |          |            | 2.3E-04  |                                      |  |                                      | 1.0E-04  |                                      |
|                |          |            | 2.2E-04  |                                      |  |                                      | 1.0E-04  |                                      |
|                | TP2-GC-2 | 1          | 1.0E-03  | 6.1E-04                              | N/A  |                                      | 2.6E-04  | 1.7E-04                              |
|                |          |            | 1.1E-03  |                                      |  |                                      | 2.7E-04  |                                      |
|                |          |            | 1.0E-03  |                                      |  |                                      | 2.6E-04  |                                      |
|                |          | 2          | 5.0E-04  |                                      |  |                                      | 1.3E-04  |                                      |
|                |          |            | 5.1E-04  |                                      |  |                                      | 1.3E-04  |                                      |
|                |          |            | 4.9E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                |          | 3          | 2.9E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                |          |            | 2.9E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                |          |            | 3.0E-04  |                                      |  |                                      | 1.2E-04  |                                      |

Table S1. Transmissivity of GDLs (ASTM D 4716) (Continued).

| Sample ID      | Sample # | Specimen # | $\sigma = 24 \text{ kPa}$                      |                                      | $\sigma = 48 \text{ kPa}$                      |                                      | $\sigma = 480 \text{ kPa}$                     |                                      |
|----------------|----------|------------|--|--------------------------------------|--|--------------------------------------|--|--------------------------------------|
|                |          |            | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ |
| EAU CLAIRE, WI | TP2-GC-3 | 1          | 3.7E-04  | 4.0E-04                              | N/A  |                                      | 1.5E-04  | 1.5E-04                              |
|                |          |            | 3.7E-04  |                                      |  |                                      | 1.4E-04  |                                      |
|                |          |            | 3.7E-04  |                                      |  |                                      | 1.4E-04  |                                      |
|                |          | 2          | 3.7E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                |          |            | 3.6E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                |          |            | 3.6E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                |          | 3          | 4.7E-04  |                                      |  |                                      | 1.9E-04  |                                      |
|                |          |            | 4.8E-04  |                                      |  |                                      | 1.8E-04  |                                      |
|                |          |            | 4.7E-04  |                                      |  |                                      | 1.8E-04  |                                      |
|                | TP3-GC-1 | 1          | 2.0E-04  | 3.0E-04                              | N/A  |                                      | 7.5E-05  | 1.2E-04                              |
|                |          |            | 1.9E-04  |                                      |  |                                      | 7.8E-05  |                                      |
|                |          |            | 1.9E-04  |                                      |  |                                      | 7.7E-05  |                                      |
|                |          | 2          | 4.7E-04  |                                      |  |                                      | 2.0E-04  |                                      |
|                |          |            | 4.6E-04  |                                      |  |                                      | 2.0E-04  |                                      |
|                |          |            | 4.7E-04  |                                      |  |                                      | 2.0E-04  |                                      |
|                |          | 3          | 2.4E-04  |                                      |  |                                      | 7.3E-05  |                                      |
|                |          |            | 2.3E-04  |                                      |  |                                      | 7.3E-05  |                                      |
|                |          |            | 2.3E-04  |                                      |  |                                      | 7.2E-05  |                                      |

Table S1. Transmissivity of GDLs (ASTM D 4716) (Continued).

| Sample ID      | Sample # | Specimen # | $\sigma = 24 \text{ kPa}$                      |                                      | $\sigma = 48 \text{ kPa}$                      |                                      | $\sigma = 480 \text{ kPa}$                     |                                      |
|----------------|----------|------------|--|--------------------------------------|--|--------------------------------------|--|--------------------------------------|
|                |          |            | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ |
| EAU CLAIRE, WI | TP3-GC-2 | 1          | 1.6E-03  | 7.2E-04                              | N/A  |                                      | 1.6E-04  | 1.4E-04                              |
|                |          |            | 1.6E-03  |                                      |  |                                      | 1.6E-04  |                                      |
|                |          |            | 1.6E-03  |                                      |  |                                      | 1.6E-04  |                                      |
|                |          | 2          | 2.1E-04  |                                      |  |                                      | 9.9E-05  |                                      |
|                |          |            | 2.0E-04  |                                      |  |                                      | 9.8E-05  |                                      |
|                |          |            | 2.1E-04  |                                      |  |                                      | 9.8E-05  |                                      |
|                |          | 3          | 3.7E-04  |                                      |  |                                      | 1.6E-04  |                                      |
|                |          |            | 3.7E-04  |                                      |  |                                      | 1.6E-04  |                                      |
|                |          |            | 3.7E-04  |                                      |  |                                      | 1.6E-04  |                                      |
|                | TP3-GC-3 | 1          | 3.4E-04  | 3.6E-04                              | N/A  |                                      | 1.5E-04  | 1.3E-04                              |
|                |          |            | 3.4E-04  |                                      |  |                                      | 1.5E-04  |                                      |
|                |          |            | 3.4E-04  |                                      |  |                                      | 1.5E-04  |                                      |
|                |          | 2          | 4.1E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                |          |            | 4.2E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                |          |            | 4.1E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                |          | 3          | 3.3E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                |          |            | 3.4E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                |          |            | 3.5E-04  |                                      |  |                                      | 1.2E-04  |                                      |

Table S1. Transmissivity of GDLs (ASTM D 4716) (Continued).

| Sample ID      | Sample # | Specimen # | $\sigma = 24 \text{ kPa}$                      |                                      | $\sigma = 48 \text{ kPa}$                      |                                      | $\sigma = 480 \text{ kPa}$                     |                                      |
|----------------|----------|------------|--|--------------------------------------|--|--------------------------------------|--|--------------------------------------|
|                |          |            | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ |
| EAU CLAIRE, WI | TP3-GC-4 | 1          | 5.3E-04  | 5.7E-04                              | N/A  |                                      | 1.7E-04  | 1.4E-04                              |
|                |          |            | 5.3E-04  |                                      |  |                                      | 1.6E-04  |                                      |
|                |          |            | 5.3E-04  |                                      |  |                                      | 1.6E-04  |                                      |
|                |          | 2          | 3.1E-04  |                                      |  |                                      | 1.3E-04  |                                      |
|                |          |            | 3.0E-04  |                                      |  |                                      | 1.3E-04  |                                      |
|                |          |            | 3.1E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                |          | 3          | 8.9E-04  |                                      |  |                                      | 1.5E-04  |                                      |
|                |          |            | 8.7E-04  |                                      |  |                                      | 1.4E-04  |                                      |
|                |          |            | 8.7E-04  |                                      |  |                                      | 1.4E-04  |                                      |
|                | TP4-GC-1 | 1          | 4.5E-04  | 3.3E-04                              | N/A  |                                      | 2.0E-04  | 1.2E-04                              |
|                |          |            | 4.3E-04  |                                      |  |                                      | 2.0E-04  |                                      |
|                |          |            | 4.2E-04  |                                      |  |                                      | 1.9E-04  |                                      |
|                |          | 2          | 3.9E-04  |                                      |  |                                      | 1.6E-04  |                                      |
|                |          |            | 3.8E-04  |                                      |  |                                      | 1.5E-06  |                                      |
|                |          |            | 3.8E-04  |                                      |  |                                      | 1.5E-04  |                                      |
|                |          | 3          | 1.9E-04  |                                      |  |                                      | 6.5E-05  |                                      |
|                |          |            | 1.9E-04  |                                      |  |                                      | 6.5E-05  |                                      |
|                |          |            | 1.8E-04  |                                      |  |                                      | 6.4E-05  |                                      |

Table S1. Transmissivity of GDLs (ASTM D 4716) (Continued).

| Sample ID      | Sample # | Specimen # | $\sigma = 24 \text{ kPa}$                      |                                      | $\sigma = 48 \text{ kPa}$                      |                                      | $\sigma = 480 \text{ kPa}$                     |                                      |
|----------------|----------|------------|--|--------------------------------------|--|--------------------------------------|--|--------------------------------------|
|                |          |            | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ |
| EAU CLAIRE, WI | TP4-GC-2 | 1          | 1.2E-03  | 5.7E-04                              | N/A  |                                      | 2.2E-04  | 1.2E-04                              |
|                |          |            | 1.2E-03  |                                      |  |                                      | 2.2E-04  |                                      |
|                |          |            | 1.3E-03  |                                      |  |                                      | 2.2E-04  |                                      |
|                |          | 2          | 2.4E-04  |                                      |  |                                      | 6.2E-05  |                                      |
|                |          |            | 2.4E-04  |                                      |  |                                      | 6.2E-05  |                                      |
|                |          |            | 2.4E-04  |                                      |  |                                      | 6.1E-05  |                                      |
|                |          | 3          | 2.4E-04  |                                      |  |                                      | 7.3E-05  |                                      |
|                |          |            | 2.4E-04  |                                      |  |                                      | 7.2E-05  |                                      |
|                |          |            | 2.4E-04  |                                      |  |                                      | 7.0E-05  |                                      |
|                |          |            | 2.4E-04  |                                      |  |                                      | 7.0E-05  |                                      |
|                | TP4-GC-3 | 1          | 4.5E-04  | 5.6E-04                              | N/A  |                                      | 8.9E-05  | 1.0E-04                              |
|                |          |            | 4.3E-04  |                                      |  |                                      | 8.9E-05  |                                      |
|                |          |            | 4.4E-04  |                                      |  |                                      | 8.8E-05  |                                      |
|                |          | 2          | 2.8E-04  |                                      |  |                                      | 1.4E-04  |                                      |
|                |          |            | 2.8E-04  |                                      |  |                                      | 1.4E-04  |                                      |
|                |          |            | 2.9E-04  |                                      |  |                                      | 1.4E-04  |                                      |
|                |          | 3          | 9.5E-04  |                                      |  |                                      | 7.4E-05  |                                      |
|                |          |            | 1.0E-03  |                                      |  |                                      | 7.4E-05  |                                      |
|                |          |            | 9.6E-04  |                                      |  |                                      | 7.4E-05  |                                      |
|                |          |            | 9.6E-04  |                                      |  |                                      | 7.4E-05  |                                      |



Table S1. Transmissivity of GDLs (ASTM D 4716) (Continued).

| Sample ID      | Sample # | Specimen # | $\sigma = 24 \text{ kPa}$                      |                                      | $\sigma = 48 \text{ kPa}$                      |                                      | $\sigma = 480 \text{ kPa}$                     |                                      |
|----------------|----------|------------|--|--------------------------------------|--|--------------------------------------|--|--------------------------------------|
|                |          |            | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ |
| EAU CLAIRE, WI | TP4-GC-4 | 1          | 2.6E-04  | 2.7E-04                              | N/A  |                                      | 1.1E-04  | 1.2E-04                              |
|                |          |            | 2.6E-04  |                                      |  |                                      | 1.1E-04  |                                      |
|                |          |            | 2.6E-04  |                                      |  |                                      | 1.1E-04  |                                      |
|                |          | 2          | 3.0E-04  |                                      |  |                                      | 1.4E-04  |                                      |
|                |          |            | 3.0E-04  |                                      |  |                                      | 1.4E-04  |                                      |
|                |          |            | 3.0E-04  |                                      |  |                                      | 1.4E-04  |                                      |
|                |          | 3          | 2.7E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                |          |            | 2.7E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                |          |            | 2.6E-04  |                                      |  |                                      | 1.2E-04  |                                      |
|                |          |            |  |                                      |  |                                      |  |                                      |
| HELENA, MT     | GC-AB    | 1          | 2.3E-04  | 2.3E-04                              | 2.2E-04  | 2.2E-04                              | 1.3E-04  | 1.3E-04                              |
|                |          |            | 2.4E-04  |                                      | 2.2E-04  |                                      | 1.3E-04  |                                      |
|                |          |            | 2.3E-04  |                                      | 2.2E-04  |                                      | 1.3E-04  |                                      |
|                |          | 2          | 2.5E-04  | 2.5E-04                              | 2.3E-04  | 2.3E-04                              | 1.4E-04  | 1.4E-04                              |
|                |          |            | 2.5E-04  |                                      | 2.4E-04  |                                      | 1.4E-04  |                                      |
|                |          |            | 2.5E-04  |                                      | 2.3E-04  |                                      | 1.4E-04  |                                      |
|                |          | 3          | 2.3E-04  | 2.3E-04                              | 2.2E-04  | 2.2E-04                              | 1.3E-04  | 1.3E-04                              |
|                |          |            | 2.3E-04  |                                      | 2.2E-04  |                                      | 1.3E-04  |                                      |
|                |          |            | 2.3E-04  |                                      | 2.2E-04  |                                      | 1.3E-04  |                                      |
|                |          |            |  |                                      |  |                                      |  |                                      |

Table S1. Transmissivity of GDLs (ASTM D 4716) (Continued).

| Sample ID | Sample # | Specimen # | $\sigma = 24 \text{ kPa}$                      |                                      | $\sigma = 48 \text{ kPa}$                      |                                      | $\sigma = 480 \text{ kPa}$                     |                                      |
|-----------|----------|------------|--|--------------------------------------|--|--------------------------------------|--|--------------------------------------|
|           |          |            | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ |
| OMAHA, NE | GC-A1B   | 1          | 1.7E-04  | 1.7E-04                              | 1.5E-04  | 1.5E-04                              | 7.0E-05  | 6.8E-05                              |
|           |          |            | 1.7E-04  |                                      | 1.5E-04  |                                      | 6.7E-05  |                                      |
|           |          |            | 1.7E-04  |                                      | 1.5E-04  |                                      | 6.6E-05  |                                      |
|           |          | 2          | 1.7E-04  | 1.7E-04                              | 1.6E-04  | 1.5E-04                              | 9.0E-05  | 8.9E-05                              |
|           |          |            | 1.7E-04  |                                      | 1.5E-04  |                                      | 9.0E-05  |                                      |
|           |          |            | 1.7E-04  |                                      | 1.5E-04  |                                      | 8.9E-05  |                                      |
|           |          | 3          | 1.5E-04  | 1.4E-04                              | 1.3E-04  | 1.3E-04                              | 8.4E-05  | 8.3E-05                              |
|           |          |            | 1.4E-04  |                                      | 1.3E-04  |                                      | 8.3E-05  |                                      |
|           |          |            | 1.4E-04  |                                      | 1.3E-04  |                                      | 8.2E-05  |                                      |
|           | GC-A2B   | 1          | 1.8E-04  | 1.8E-04                              | 1.5E-04  | 1.5E-04                              | 7.7E-05  | 7.5E-05                              |
|           |          |            | 1.8E-04  |                                      | 1.5E-04  |                                      | 7.5E-05  |                                      |
|           |          |            | 1.8E-04  |                                      | 1.5E-04  |                                      | 7.3E-05  |                                      |
|           |          | 2          | 1.2E-04  | 1.1E-04                              | 8.3E-05  | 8.2E-05                              | 4.1E-05  | 4.0E-05                              |
|           |          |            | 1.1E-04  |                                      | 8.2E-05  |                                      | 4.0E-05  |                                      |
|           |          |            | 1.1E-04  |                                      | 8.1E-05  |                                      | 3.9E-05  |                                      |
|           |          | 3          | 1.0E-04  | 1.0E-04                              | 9.1E-05  | 9.1E-05                              | 4.1E-05  | 3.9E-05                              |
|           |          |            | 1.0E-04  |                                      | 9.1E-05  |                                      | 3.9E-05  |                                      |
|           |          |            | 9.9E-05  |                                      | 8.9E-05  |                                      | 3.7E-05  |                                      |

Table S1. Transmissivity of GDLs (ASTM D 4716) (Continued).

| Sample ID | Sample # | Specimen # | $\sigma = 24 \text{ kPa}$                      |                                      | $\sigma = 48 \text{ kPa}$                      |                                      | $\sigma = 480 \text{ kPa}$                     |                                      |
|-----------|----------|------------|--|--------------------------------------|--|--------------------------------------|--|--------------------------------------|
|           |          |            | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ |
| OMAHA, NE | GC-CB    | 1          | 1.7E-04  | 1.7E-04                              | 1.5E-04  | 1.5E-04                              | 8.2E-05  | 8.1E-05                              |
|           |          |            | 1.7E-04  |                                      | 1.5E-04  |                                      | 8.1E-05  |                                      |
|           |          |            | 1.7E-04  |                                      | 1.5E-04  |                                      | 8.1E-05  |                                      |
|           |          | 2          | 1.9E-04  | 1.8E-04                              | 1.7E-04  | 1.7E-04                              | 9.1E-05  | 9.0E-05                              |
|           |          |            | 1.8E-04  |                                      | 1.7E-04  |                                      | 9.0E-05  |                                      |
|           |          |            | 1.8E-04  |                                      | 1.7E-04  |                                      | 8.8E-05  |                                      |
|           |          | 3          | 2.2E-04  | 2.2E-04                              | 2.2E-04  | 2.2E-04                              | 1.2E-04  | 1.2E-04                              |
|           |          |            | 2.3E-04  |                                      | 2.1E-04  |                                      | 1.2E-04  |                                      |
|           |          |            | 2.2E-04  |                                      | 2.1E-04  |                                      | 1.2E-04  |                                      |
|           | GC-CM    | 1          | 1.2E-04  | 1.2E-04                              | 1.0E-04  | 1.0E-04                              | 5.2E-05  | 5.2E-05                              |
|           |          |            | 1.2E-04  |                                      | 1.0E-04  |                                      | 5.2E-05  |                                      |
|           |          |            | 1.2E-04  |                                      | 1.0E-04  |                                      | 5.1E-05  |                                      |
|           |          | 2          | 1.5E-04  | 1.5E-04                              | 1.3E-04  | 1.3E-04                              | 5.4E-05  | 5.2E-05                              |
|           |          |            | 1.5E-04  |                                      | 1.3E-04  |                                      | 5.1E-05  |                                      |
|           |          |            | 1.5E-04  |                                      | 1.3E-04  |                                      | 5.0E-05  |                                      |
|           |          | 3          | 2.0E-04  | 2.0E-04                              | 1.9E-04  | 1.9E-04                              | 1.1E-04  | 1.1E-04                              |
|           |          |            | 2.0E-04  |                                      | 1.9E-04  |                                      | 1.1E-04  |                                      |
|           |          |            | 2.0E-04  |                                      | 1.8E-04  |                                      | 1.0E-04  |                                      |

Table S1. Transmissivity of GDLs (ASTM D 4716) (Continued).

| Sample ID     | Sample # | Specimen # | $\sigma = 24 \text{ kPa}$                      |                                      | $\sigma = 48 \text{ kPa}$                      |                                      | $\sigma = 480 \text{ kPa}$                     |                                      |
|---------------|----------|------------|--|--------------------------------------|--|--------------------------------------|--|--------------------------------------|
|               |          |            | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ |
| UNDERWOOD, ND | GC-CC3   | 1          | 2.4E-04  | 2.4E-04                              | 2.3E-04  | 2.3E-04                              | 1.0E-04  | 9.7E-05                              |
|               |          |            | 2.4E-04  |                                      | 2.3E-04  |                                      | 9.6E-05  |                                      |
|               |          |            | 2.4E-04  |                                      | 2.3E-04  |                                      | 9.2E-05  |                                      |
|               |          | 2          | 3.5E-04  | 3.4E-04                              | 3.0E-04  | 3.0E-04                              | 1.4E-04  | 1.4E-04                              |
|               |          |            | 3.5E-04  |                                      | 3.0E-04  |                                      | 1.3E-04  |                                      |
|               |          |            | 3.4E-04  |                                      | 3.0E-04  |                                      | 1.3E-04  |                                      |
|               |          | 3          | 4.1E-04  | 4.2E-04                              | 3.6E-04  | 3.6E-04                              | 1.6E-04  | 1.6E-04                              |
|               |          |            | 4.1E-04  |                                      | 3.5E-04  |                                      | 1.6E-04  |                                      |
|               |          |            | 4.3E-04  |                                      | 3.6E-04  |                                      | 1.5E-04  |                                      |
|               | GC-CC5   | 1          | 1.3E-04  | 1.4E-04                              | 1.2E-04  | 1.2E-04                              | 4.7E-05  | 4.6E-05                              |
|               |          |            | 1.4E-04  |                                      | 1.2E-04  |                                      | 4.5E-05  |                                      |
|               |          |            | 1.3E-04  |                                      | 1.2E-04  |                                      | 4.4E-05  |                                      |
|               |          | 2          | 1.3E-04  | 1.3E-04                              | 1.2E-04  | 1.2E-04                              | 5.1E-05  | 4.9E-05                              |
|               |          |            | 1.3E-04  |                                      | 1.2E-04  |                                      | 4.8E-05  |                                      |
|               |          |            | 1.3E-04  |                                      | 1.2E-04  |                                      | 4.7E-05  |                                      |
|               |          | 3          | 1.6E-04  | 1.6E-04                              | 1.4E-04  | 1.4E-04                              | 6.6E-05  | 6.4E-05                              |
|               |          |            | 1.5E-04  |                                      | 1.4E-04  |                                      | 6.4E-05  |                                      |
|               |          |            | 1.6E-04  |                                      | 1.4E-04  |                                      | 6.1E-05  |                                      |

Table S1. Transmissivity of GDLs (ASTM D 4716) (Continued).

| Sample ID     | Sample # | Specimen # | $\sigma = 24 \text{ kPa}$                      |                                      | $\sigma = 48 \text{ kPa}$                      |                                      | $\sigma = 480 \text{ kPa}$                     |                                      |
|---------------|----------|------------|--|--------------------------------------|--|--------------------------------------|--|--------------------------------------|
|               |          |            | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ | Transmissivity $\theta \text{ (m}^2/\text{s)}$ | Mean $\theta \text{ (m}^2/\text{s)}$ |
| UNDERWOOD, ND | GC-ET    | 1          | 2.0E-04  | 2.0E-04                              | 1.9E-04  | 1.8E-04                              | 8.8E-05  | 8.5E-05                              |
|               |          |            | 2.0E-04  |                                      | 1.8E-04  |                                      | 8.5E-05  |                                      |
|               |          |            | 2.0E-04  |                                      | 1.6E-04  |                                      | 8.2E-05  |                                      |
|               |          | 2          | 2.0E-04  | 2.0E-04                              | 2.0E-04  | 1.9E-04                              | 8.8E-05  | 8.5E-05                              |
|               |          |            | 2.1E-04  |                                      | 1.9E-04  |                                      | 8.5E-05  |                                      |
|               |          |            | 2.0E-04  |                                      | 1.9E-04  |                                      | 8.3E-05  |                                      |
|               |          | 3          | 2.2E-04  | 2.2E-04                              | 2.1E-04  | 2.1E-04                              | 8.9E-05  | 8.6E-05                              |
|               |          |            | 2.3E-04  |                                      | 2.1E-04  |                                      | 8.6E-05  |                                      |
|               |          |            | 2.2E-04  |                                      | 2.1E-04  |                                      | 8.3E-05  |                                      |

Table S2. Permittivity of GDLs (ASTM D 4491).

|          |                           |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|----------|---------------------------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID       |                           | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| ALTAMONT | CMP - Bottom of Lysimeter | 1 | 11/19/07 | 12.03               | 552.4                     | 0.43                                   | 0.40 | 1.8E-02   | 23.81               | 372.7                     | 0.74                                   | 0.72 | 1.3E-02   |
|          |                           |   |          | 8.73                | 366.9                     | 0.40                                   |      |           | 20.92               | 325.1                     | 0.73                                   |      |           |
|          |                           |   |          | 9.96                | 418.3                     | 0.39                                   |      |           | 21.77               | 334.6                     | 0.72                                   |      |           |
|          |                           |   |          | 10.68               | 448.1                     | 0.39                                   |      |           | 27.36               | 417.3                     | 0.72                                   |      |           |
|          |                           |   |          | 8.98                | 370.4                     | 0.39                                   |      |           | 22.27               | 333.2                     | 0.70                                   |      |           |
|          |                           | 2 | 05/28/08 | 9.77                | 596.1                     | 0.57                                   | 0.57 | 1.3E-02   | 36.05               | 556.3                     | 0.73                                   | 0.71 | 9.7E-03   |
|          |                           |   |          | 7.09                | 435.7                     | 0.58                                   |      |           | 30.87               | 471.2                     | 0.72                                   |      |           |
|          |                           |   |          | 6.57                | 401.5                     | 0.57                                   |      |           | 23.78               | 362.2                     | 0.72                                   |      |           |
|          |                           |   |          | 6.44                | 383.3                     | 0.56                                   |      |           | 25.18               | 378.2                     | 0.71                                   |      |           |
|          |                           |   |          | 8.07                | 470.2                     | 0.55                                   |      |           | 23.97               | 357.4                     | 0.70                                   |      |           |
|          |                           | 3 | 05/28/08 | 7.42                | 418.8                     | 0.53                                   | 0.52 | 8.3E-03   | 23.31               | 326.9                     | 0.66                                   | 0.65 | 7.1E-03   |
|          |                           |   |          | 6.88                | 380.0                     | 0.52                                   |      |           | 22.48               | 310.1                     | 0.65                                   |      |           |
|          |                           |   |          | 7.43                | 410.2                     | 0.52                                   |      |           | 22.30               | 308.4                     | 0.65                                   |      |           |
|          |                           |   |          | 8.78                | 479.8                     | 0.51                                   |      |           | 21.30               | 291.3                     | 0.64                                   |      |           |
|          |                           |   |          | 6.77                | 366.1                     | 0.51                                   |      |           | 21.84               | 297.9                     | 0.64                                   |      |           |
|          |                           | 4 | 05/28/08 | 9.41                | 515.8                     | 0.52                                   | 0.50 | 1.0E-02   | 23.19               | 290.2                     | 0.59                                   | 0.57 | 2.7E-02   |
|          |                           |   |          | 8.14                | 443.6                     | 0.51                                   |      |           | 22.63               | 281.2                     | 0.58                                   |      |           |
|          |                           |   |          | 8.01                | 423.8                     | 0.50                                   |      |           | 26.08               | 289.8                     | 0.52                                   |      |           |
|          |                           |   |          | 7.18                | 383.7                     | 0.50                                   |      |           | 29.83               | 365.6                     | 0.58                                   |      |           |
|          |                           |   |          | 7.68                | 401.4                     | 0.49                                   |      |           | 25.97               | 317.2                     | 0.57                                   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|          |           |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|----------|-----------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID       |           | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| ALTAMONT | CMP - GC3 | 1 | 05/28/08 | 7.44                | 415.0                     | 0.52                                   | 0.48 | 2.7E-02   | 21.86               | 320.8                     | 0.69                                   | 0.66 | 2.3E-02   |
|          |           |   |          | 8.03                | 418.7                     | 0.49                                   |      |           | 23.29               | 336.9                     | 0.68                                   |      |           |
|          |           |   |          | 7.82                | 395.6                     | 0.48                                   |      |           | 22.97               | 324.5                     | 0.66                                   |      |           |
|          |           |   |          | 7.67                | 380.6                     | 0.47                                   |      |           | 23.90               | 332.0                     | 0.65                                   |      |           |
|          |           |   |          | 7.23                | 350.4                     | 0.46                                   |      |           | 25.83               | 346.3                     | 0.63                                   |      |           |
|          |           |   |          | 7.63                | 408.7                     | 0.50                                   |      |           | 27.91               | 291.2                     | 0.49                                   |      |           |
|          |           | 2 | 05/28/08 | 12.70               | 666.4                     | 0.49                                   | 0.45 | 4.9E-02   | 21.33               | 220.3                     | 0.49                                   | 0.48 | 1.3E-02   |
|          |           |   |          | 14.77               | 681.9                     | 0.43                                   |      |           | 23.37               | 237.2                     | 0.48                                   |      |           |
|          |           |   |          | 9.17                | 400.7                     | 0.41                                   |      |           | 28.36               | 281.8                     | 0.47                                   |      |           |
|          |           |   |          | 7.29                | 305.5                     | 0.39                                   |      |           | 27.90               | 272.4                     | 0.46                                   |      |           |
|          |           |   |          | 5.58                | 316.2                     | 0.53                                   |      |           | 30.23               | 537.0                     | 0.84                                   |      |           |
|          |           | 3 | 05/28/08 | 8.91                | 483.0                     | 0.51                                   | 0.50 | 2.5E-02   | 21.19               | 373.3                     | 0.83                                   | 0.80 | 2.8E-02   |
|          |           |   |          | 9.43                | 495.1                     | 0.49                                   |      |           | 25.23               | 431.2                     | 0.80                                   |      |           |
|          |           |   |          | 6.05                | 312.0                     | 0.49                                   |      |           | 25.22               | 423.0                     | 0.79                                   |      |           |
|          |           |   |          | 7.87                | 390.1                     | 0.47                                   |      |           | 24.03               | 392.8                     | 0.77                                   |      |           |
|          |           |   |          | 11.00               | 695.1                     | 0.59                                   |      |           | 30.43               | 470.5                     | 0.73                                   |      |           |
|          |           | 4 | 05/28/08 | 9.09                | 549.5                     | 0.57                                   | 0.55 | 2.9E-02   | 24.29               | 373.0                     | 0.72                                   | 0.68 | 4.7E-02   |
|          |           |   |          | 8.87                | 514.9                     | 0.55                                   |      |           | 22.14               | 332.8                     | 0.71                                   |      |           |
|          |           |   |          | 8.46                | 482.3                     | 0.54                                   |      |           | 24.77               | 335.6                     | 0.64                                   |      |           |
|          |           |   |          | 10.60               | 587.1                     | 0.52                                   |      |           | 25.69               | 345.1                     | 0.63                                   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

| ID       | #                         | Date     | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|----------|---------------------------|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
|          |                           |          | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| ALTAMONT | Alt - Bottom of Lysimeter | 05/28/08 | 9.97                | 442.6                     | 0.42                                   | 0.39 | 1.7E-02   | 29.37               | 524.4                     | 0.84                                   | 0.82 | 1.8E-02   |
|          |                           |          | 9.72                | 417.6                     | 0.40                                   |      |           | 28.58               | 504.5                     | 0.83                                   |      |           |
|          |                           |          | 6.68                | 280.0                     | 0.39                                   |      |           | 22.31               | 385.2                     | 0.81                                   |      |           |
|          |                           |          | 9.14                | 371.3                     | 0.38                                   |      |           | 22.60               | 394.9                     | 0.82                                   |      |           |
|          |                           |          | 9.27                | 371.2                     | 0.38                                   |      |           | 20.93               | 353.3                     | 0.79                                   |      |           |
|          |                           | 05/28/08 | 8.93                | 579.2                     | 0.61                                   | 0.56 | 4.4E-02   | 27.62               | 366.1                     | 0.62                                   | 0.60 | 2.5E-01   |
|          |                           |          | 7.19                | 449.3                     | 0.59                                   |      |           | 25.64               | 303.0                     | 0.56                                   |      |           |
|          |                           |          | 6.52                | 396.9                     | 0.57                                   |      |           | 25.05               | 257.5                     | 0.48                                   |      |           |
|          |                           |          | 9.52                | 526.1                     | 0.52                                   |      |           | 33.01               | 231.4                     | 0.33                                   |      |           |
|          |                           |          | 8.33                | 450.3                     | 0.51                                   |      |           | 18.02               | 388.0                     | 1.01                                   |      |           |
|          |                           | 05/28/08 | 12.07               | 335.5                     | 0.26                                   | 0.20 | 4.3E-02   | 20.52               | 405.9                     | 0.93                                   | 0.83 | 8.9E-02   |
|          |                           |          | 18.68               | 451.7                     | 0.23                                   |      |           | 19.38               | 366.4                     | 0.89                                   |      |           |
|          |                           |          | 9.10                | 199.5                     | 0.21                                   |      |           | 22.35               | 397.9                     | 0.84                                   |      |           |
|          |                           |          | 13.08               | 246.4                     | 0.18                                   |      |           | 20.72               | 341.4                     | 0.77                                   |      |           |
|          |                           |          | 14.23               | 227.6                     | 0.15                                   |      |           | 21.19               | 318.5                     | 0.71                                   |      |           |
|          |                           | 05/28/08 | 8.04                | 534.3                     | 0.62                                   | 0.58 | 4.3E-02   | 21.88               | 365.3                     | 0.78                                   | 0.75 | 2.7E-02   |
|          |                           |          | 7.83                | 504.8                     | 0.61                                   |      |           | 21.37               | 350.2                     | 0.77                                   |      |           |
|          |                           |          | 8.51                | 521.7                     | 0.58                                   |      |           | 23.67               | 377.2                     | 0.75                                   |      |           |
|          |                           |          | 8.33                | 485.6                     | 0.55                                   |      |           | 30.94               | 478.6                     | 0.73                                   |      |           |
|          |                           |          | 7.81                | 431.6                     | 0.52                                   |      |           | 24.00               | 368.2                     | 0.72                                   |      |           |



Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|              |                |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |   |      |           |
|--------------|----------------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|---|------|-----------|
| ID           |                | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permit-tivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| APPLE VALLEY | Lysimeter Base | 1 | 05/29/08 | 7.45                | 606.2                     | 0.77                                   | 0.74 | 2.7E-02   | 22.89               | 502.5                     | 1.03                                    | 1.03 | 3.2E-02   |
|              |                |   |          | 4.92                | 394.2                     | 0.75                                   |      |           | 23.61               | 545.6                     | 1.09                                    |      |           |
|              |                |   |          | 6.12                | 484.6                     | 0.74                                   |      |           | 14.87               | 324.4                     | 1.03                                    |      |           |
|              |                |   |          | 5.55                | 438.6                     | 0.74                                   |      |           | 18.34               | 395.7                     | 1.01                                    |      |           |
|              |                |   |          | 10.12               | 747.2                     | 0.69                                   |      |           | 15.77               | 337.4                     | 1.01                                    |      |           |
|              |                | 2 | 05/29/08 | 9.84                | 867.2                     | 0.83                                   | 0.76 | 4.4E-02   | 15.70               | 294.2                     | 0.88                                    | 0.87 | 8.0E-03   |
|              |                |   |          | 6.37                | 515.5                     | 0.76                                   |      |           | 18.02               | 336.4                     | 0.88                                    |      |           |
|              |                |   |          | 7.23                | 576.9                     | 0.75                                   |      |           | 14.58               | 272.4                     | 0.88                                    |      |           |
|              |                |   |          | 6.58                | 514.5                     | 0.74                                   |      |           | 20.34               | 374.6                     | 0.87                                    |      |           |
|              |                |   |          | 6.67                | 504.8                     | 0.71                                   |      |           | 18.20               | 334.2                     | 0.86                                    |      |           |
|              |                | 3 | 05/29/08 | 6.80                | 598.5                     | 0.83                                   | 0.80 | 2.0E-02   | 26.23               | 628.8                     | 1.13                                    | 1.11 | 1.8E-02   |
|              |                |   |          | 10.67               | 922.4                     | 0.81                                   |      |           | 15.86               | 380.5                     | 1.13                                    |      |           |
|              |                |   |          | 5.98                | 512.8                     | 0.81                                   |      |           | 15.14               | 363.2                     | 1.13                                    |      |           |
|              |                |   |          | 6.83                | 575.5                     | 0.79                                   |      |           | 17.77               | 416.0                     | 1.10                                    |      |           |
|              |                |   |          | 7.36                | 607.3                     | 0.78                                   |      |           | 15.89               | 368.4                     | 1.09                                    |      |           |
|              |                | 4 | 05/29/08 | 7.62                | 743.7                     | 0.92                                   | 0.84 | 5.0E-02   | 18.20               | 384.3                     | 0.99                                    | 0.99 | 4.6E-03   |
|              |                |   |          | 6.02                | 553.0                     | 0.86                                   |      |           | 16.55               | 349.9                     | 0.99                                    |      |           |
|              |                |   |          | 8.52                | 739.1                     | 0.82                                   |      |           | 17.28               | 363.5                     | 0.99                                    |      |           |
|              |                |   |          | 5.87                | 510.7                     | 0.82                                   |      |           | 19.61               | 411.1                     | 0.99                                    |      |           |
|              |                |   |          | 8.00                | 673.4                     | 0.79                                   |      |           | 16.67               | 348.5                     | 0.98                                    |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|          |                      |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |   |      |           |
|----------|----------------------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|---|------|-----------|
| ID       |                      | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permit-tivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| BOARDMAN | Geocomposite 1 Upper | 1 | 05/29/08 | 6.77                | 494.3                     | 0.69                                   | 0.66 | 1.7E-02   | 38.02               | 731.8                     | 0.90                                    | 0.87 | 5.4 E-02  |
|          |                      |   |          | 8.79                | 626.1                     | 0.67                                   |      |           | 29.71               | 573.5                     | 0.91                                    |      |           |
|          |                      |   |          | 11.37               | 789.4                     | 0.65                                   |      |           | 31.67               | 601.5                     | 0.89                                    |      |           |
|          |                      |   |          | 7.37                | 510.4                     | 0.65                                   |      |           | 32.68               | 615.9                     | 0.89                                    |      |           |
|          |                      |   |          | 6.33                | 433.5                     | 0.64                                   |      |           | 26.20               | 433.8                     | 0.78                                    |      |           |
|          |                      |   |          |                     |                           |  |      |           |                     |                           |   |      |           |
|          |                      | 2 | 05/29/08 | 6.73                | 555.2                     | 0.78                                   | 0.70 | 5.0E-02   | 45.88               | 751.8                     | 0.77                                    | 0.76 | 1.8 E-02  |
|          |                      |   |          | 7.25                | 551.3                     | 0.72                                   |      |           | 28.35               | 464.2                     | 0.77                                    |      |           |
|          |                      |   |          | 12.15               | 885.7                     | 0.69                                   |      |           | 22.85               | 380.1                     | 0.78                                    |      |           |
|          |                      |   |          | 8.49                | 593.7                     | 0.66                                   |      |           | 24.25               | 388.0                     | 0.75                                    |      |           |
|          |                      |   |          | 7.03                | 488.1                     | 0.65                                   |      |           | 35.23               | 552.0                     | 0.74                                    |      |           |
|          |                      |   |          |                     |                           |  |      |           |                     |                           |   |      |           |
|          |                      | 3 | 05/29/08 | 8.11                | 599.9                     | 0.70                                   | 0.67 | 2.2E-02   | 45.73               | 894.7                     | 0.92                                    | 0.90 | 1.9 E-02  |
|          |                      |   |          | 8.70                | 636.4                     | 0.69                                   |      |           | 24.89               | 480.4                     | 0.91                                    |      |           |
|          |                      |   |          | 7.39                | 524.1                     | 0.67                                   |      |           | 21.37               | 406.4                     | 0.89                                    |      |           |
|          |                      |   |          | 7.94                | 555.0                     | 0.66                                   |      |           | 20.21               | 380.8                     | 0.89                                    |      |           |
|          |                      |   |          | 13.07               | 892.1                     | 0.64                                   |      |           | 23.05               | 427.0                     | 0.87                                    |      |           |
|          |                      |   |          |                     |                           |  |      |           |                     |                           |   |      |           |
|          |                      | 4 | 05/29/08 | 9.97                | 744.5                     | 0.70                                   | 0.66 | 3.4E-02   | 34.31               | 522.7                     | 0.72                                    | 0.70 | 1.2 E-02  |
|          |                      |   |          | 6.59                | 475.4                     | 0.68                                   |      |           | 31.87               | 479.8                     | 0.71                                    |      |           |
|          |                      |   |          | 7.62                | 530.4                     | 0.65                                   |      |           | 31.67               | 469.7                     | 0.70                                    |      |           |
|          |                      |   |          | 7.70                | 520.9                     | 0.64                                   |      |           | 26.16               | 386.6                     | 0.69                                    |      |           |
|          |                      |   |          | 9.15                | 597.8                     | 0.61                                   |      |           | 28.94               | 422.1                     | 0.69                                    |      |           |
|          |                      |   |          |                     |                           |  |      |           |                     |                           |   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|          |             |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |   |      |           |
|----------|-------------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|---|------|-----------|
| ID       |             | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permit-tivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| BOARDMAN | Thcik Cover | 1 | 05/29/08 | 10.30               | 456.3                     | 0.42                                   | 0.41 | 5.6E-03   | 28.64               | 320.7                     | 0.53                                    | 0.52 | 7.7E-03   |
|          |             |   |          | 14.98               | 652.0                     | 0.41                                   |      |           | 24.23               | 267.9                     | 0.52                                    |      |           |
|          |             |   |          | 10.42               | 453.2                     | 0.41                                   |      |           | 24.40               | 268.6                     | 0.52                                    |      |           |
|          |             |   |          | 8.42                | 364.5                     | 0.41                                   |      |           | 39.11               | 423.3                     | 0.51                                    |      |           |
|          |             |   |          | 12.27               | 523.1                     | 0.40                                   |      |           | 24.70               | 267.1                     | 0.51                                    |      |           |
|          |             | 2 | 05/29/08 | 10.92               | 465.5                     | 0.40                                   | 0.39 | 8.3E-03   | 32.53               | 290.9                     | 0.42                                    | 0.42 | 5.2E-03   |
|          |             |   |          | 15.89               | 665.8                     | 0.39                                   |      |           | 31.83               | 285.3                     | 0.42                                    |      |           |
|          |             |   |          | 13.52               | 561.2                     | 0.39                                   |      |           | 38.20               | 337.7                     | 0.42                                    |      |           |
|          |             |   |          | 14.30               | 577.2                     | 0.38                                   |      |           | 37.48               | 330.1                     | 0.41                                    |      |           |
|          |             |   |          | 8.48                | 346.5                     | 0.38                                   |      |           | 27.05               | 235.1                     | 0.41                                    |      |           |
|          |             | 3 | 05/29/08 | 12.98               | 591.6                     | 0.43                                   | 0.42 | 1.1E-02   | 31.25               | 336.5                     | 0.51                                    | 0.50 | 4.6E-03   |
|          |             |   |          | 10.98               | 497.5                     | 0.43                                   |      |           | 50.27               | 536.8                     | 0.50                                    |      |           |
|          |             |   |          | 9.58                | 431.1                     | 0.42                                   |      |           | 28.33               | 301.7                     | 0.50                                    |      |           |
|          |             |   |          | 21.11               | 918.8                     | 0.41                                   |      |           | 31.48               | 333.9                     | 0.50                                    |      |           |
|          |             |   |          | 13.14               | 564.0                     | 0.40                                   |      |           | 33.36               | 350.3                     | 0.49                                    |      |           |
|          |             | 4 | 05/29/08 | 8.05                | 390.0                     | 0.46                                   | 0.43 | 1.6E-02   | 24.02               | 236.4                     | 0.46                                    | 0.44 | 2.2E-02   |
|          |             |   |          | 18.48               | 862.4                     | 0.44                                   |      |           | 33.17               | 289.0                     | 0.41                                    |      |           |
|          |             |   |          | 10.36               | 466.2                     | 0.42                                   |      |           | 25.27               | 246.5                     | 0.46                                    |      |           |
|          |             |   |          | 8.70                | 394.6                     | 0.43                                   |      |           | 29.20               | 271.7                     | 0.44                                    |      |           |
|          |             |   |          | 11.95               | 527.6                     | 0.42                                   |      |           | 31.55               | 288.7                     | 0.43                                    |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|              |               |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|--------------|---------------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID           |               | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| CEDAR RAPIDS | Clay Bottom 1 | 1 | 05/29/08 | 6.14                | 523.9                     | 0.80                                   | 0.77 | 2.9E-02   | 13.31               | 337.7                     | 1.19                                   | 1.16 | 2.5E-02   |
|              |               |   |          | 6.69                | 570.6                     | 0.80                                   |      |           | 14.66               | 368.3                     | 1.18                                   |      |           |
|              |               |   |          | 5.09                | 420.1                     | 0.78                                   |      |           | 11.95               | 297.9                     | 1.17                                   |      |           |
|              |               |   |          | 7.50                | 600.9                     | 0.75                                   |      |           | 14.68               | 355.5                     | 1.14                                   |      |           |
|              |               |   |          | 8.08                | 632.9                     | 0.74                                   |      |           | 14.29               | 346.2                     | 1.14                                   |      |           |
|              |               | 2 | 05/29/08 | 6.93                | 541.8                     | 0.74                                   | 0.62 | 8.6E-02   | 39.88               | 505.8                     | 0.60                                   | 0.57 | 2.2E-02   |
|              |               |   |          | 9.84                | 714.4                     | 0.68                                   |      |           | 70.82               | 868.4                     | 0.58                                   |      |           |
|              |               |   |          | 6.71                | 419.7                     | 0.59                                   |      |           | 41.33               | 498.9                     | 0.57                                   |      |           |
|              |               |   |          | 8.54                | 504.6                     | 0.56                                   |      |           | 70.22               | 820.4                     | 0.55                                   |      |           |
|              |               |   |          | 8.66                | 491.5                     | 0.53                                   |      |           | 43.69               | 503.7                     | 0.54                                   |      |           |
|              |               | 3 | 05/29/08 | 6.57                | 716.4                     | 1.03                                   | 1.01 | 1.5E-02   | 20.47               | 658.6                     | 1.51                                   | 1.47 | 2.7E-02   |
|              |               |   |          | 5.93                | 643.1                     | 1.02                                   |      |           | 20.03               | 627.5                     | 1.47                                   |      |           |
|              |               |   |          | 5.76                | 624.8                     | 1.02                                   |      |           | 17.10               | 534.1                     | 1.47                                   |      |           |
|              |               |   |          | 5.99                | 641.9                     | 1.01                                   |      |           | 15.99               | 497.2                     | 1.46                                   |      |           |
|              |               |   |          | 6.99                | 734.1                     | 0.99                                   |      |           | 18.63               | 569.6                     | 1.44                                   |      |           |
|              |               | 4 | 05/29/08 | 6.62                | 683.9                     | 0.97                                   | 0.92 | 3.3E-02   | 19.57               | 446.1                     | 1.07                                   | 1.06 | 6.3E-03   |
|              |               |   |          | 4.87                | 478.9                     | 0.92                                   |      |           | 15.51               | 351.8                     | 1.07                                   |      |           |
|              |               |   |          | 7.06                | 691.6                     | 0.92                                   |      |           | 16.78               | 378.0                     | 1.06                                   |      |           |
|              |               |   |          | 8.87                | 834.7                     | 0.88                                   |      |           | 15.23               | 344.5                     | 1.06                                   |      |           |
|              |               |   |          | 6.16                | 590.7                     | 0.90                                   |      |           | 16.89               | 379.2                     | 1.06                                   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|            |             |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|------------|-------------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID         |             | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| EAU CLAIRE | TP1<br>GC-1 | 1 | 11/19/07 | 13.98               | 308.1                     | 0.21                                   | 0.20 | 4.1E-03   | 78.27               | 416.4                     | 0.25                                   | 0.25 | 3.6E-03   |
|            |             |   |          | 14.42               | 311.4                     | 0.20                                   |      |           | 64.67               | 345.2                     | 0.25                                   |      |           |
|            |             |   |          | 14.20               | 304.5                     | 0.20                                   |      |           | 60.33               | 319.5                     | 0.25                                   |      |           |
|            |             |   |          | 14.70               | 309.5                     | 0.20                                   |      |           | 58.98               | 307.2                     | 0.24                                   |      |           |
|            |             |   |          | 14.23               | 298.3                     | 0.20                                   |      |           | 59.52               | 307.3                     | 0.24                                   |      |           |
|            |             | 2 | 11/19/07 | 13.53               | 507.3                     | 0.35                                   | 0.34 | 1.3E-02   | 54.11               | 553.7                     | 0.48                                   | 0.48 | 1.2E-02   |
|            |             |   |          | 12.86               | 482.6                     | 0.35                                   |      |           | 47.25               | 505.3                     | 0.50                                   |      |           |
|            |             |   |          | 10.12               | 365.8                     | 0.34                                   |      |           | 42.42               | 434.9                     | 0.48                                   |      |           |
|            |             |   |          | 12.39               | 436.9                     | 0.33                                   |      |           | 38.50               | 390.2                     | 0.48                                   |      |           |
|            |             |   |          | 15.11               | 518.0                     | 0.32                                   |      |           | 38.09               | 383.3                     | 0.47                                   |      |           |
|            |             | 3 | 11/19/07 | 23.18               | 412.2                     | 0.17                                   | 0.16 | 3.9E-03   | 58.02               | 285.4                     | 0.23                                   | 0.22 | 6.2E-03   |
|            |             |   |          | 22.46               | 396.3                     | 0.17                                   |      |           | 61.98               | 298.4                     | 0.23                                   |      |           |
|            |             |   |          | 16.39               | 280.6                     | 0.16                                   |      |           | 61.14               | 289.2                     | 0.22                                   |      |           |
|            |             |   |          | 18.42               | 315.9                     | 0.16                                   |      |           | 59.39               | 278.3                     | 0.22                                   |      |           |
|            |             |   |          | 17.38               | 291.5                     | 0.16                                   |      |           | 56.31               | 257.2                     | 0.21                                   |      |           |
|            |             | 4 | 11/19/07 | 21.20               | 252.1                     | 0.11                                   | 0.11 | 3.4E-03   | 78.92               | 425.7                     | 0.25                                   | 0.26 | 1.4E-03   |
|            |             |   |          | 20.03               | 238.2                     | 0.11                                   |      |           | 60.30               | 327.9                     | 0.26                                   |      |           |
|            |             |   |          | 22.61               | 262.9                     | 0.11                                   |      |           | 55.59               | 303.7                     | 0.26                                   |      |           |
|            |             |   |          | 21.39               | 249.4                     | 0.11                                   |      |           | 58.83               | 320.8                     | 0.26                                   |      |           |
|            |             |   |          | 21.05               | 263.9                     | 0.12                                   |      |           | 64.60               | 353.1                     | 0.26                                   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|            |             |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|------------|-------------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID         |             | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| EAU CLAIRE | TP1<br>GC-2 | 1 | 11/19/07 | 14.27               | 315.1                     | 0.21                                   | 0.20 | 4.1E-03   | 61.61               | 368.9                     | 0.28                                   | 0.28 | 4.5E-03   |
|            |             |   |          | 15.36               | 332.8                     | 0.20                                   |      |           | 62.75               | 368.4                     | 0.28                                   |      |           |
|            |             |   |          | 13.70               | 293.8                     | 0.20                                   |      |           | 53.52               | 315.6                     | 0.28                                   |      |           |
|            |             |   |          | 15.27               | 323.0                     | 0.20                                   |      |           | 52.36               | 303.1                     | 0.27                                   |      |           |
|            |             |   |          | 13.45               | 282.3                     | 0.20                                   |      |           | 52.92               | 303.8                     | 0.27                                   |      |           |
|            |             | 2 | 11/19/07 | 8.77                | 420.4                     | 0.45                                   | 0.42 | 1.7E-02   | 62.77               | 693.9                     | 0.52                                   | 0.51 | 8.3E-03   |
|            |             |   |          | 7.89                | 359.5                     | 0.43                                   |      |           | 46.62               | 509.7                     | 0.51                                   |      |           |
|            |             |   |          | 10.14               | 456.1                     | 0.42                                   |      |           | 35.18               | 379.7                     | 0.51                                   |      |           |
|            |             |   |          | 6.73                | 299.0                     | 0.42                                   |      |           | 29.86               | 318.5                     | 0.50                                   |      |           |
|            |             |   |          | 6.67                | 286.9                     | 0.40                                   |      |           | 25.30               | 269.1                     | 0.50                                   |      |           |
|            |             | 3 | 11/20/07 | 24.08               | 456.2                     | 0.18                                   | 0.17 | 3.7E-03   | 58.89               | 274.3                     | 0.22                                   | 0.22 | 3.2E-03   |
|            |             |   |          | 17.95               | 337.9                     | 0.18                                   |      |           | 61.30               | 284.3                     | 0.22                                   |      |           |
|            |             |   |          | 17.75               | 328.7                     | 0.17                                   |      |           | 62.30               | 282.4                     | 0.21                                   |      |           |
|            |             |   |          | 16.84               | 311.0                     | 0.17                                   |      |           | 65.55               | 298.2                     | 0.21                                   |      |           |
|            |             |   |          | 14.65               | 262.9                     | 0.17                                   |      |           | 59.42               | 267.4                     | 0.21                                   |      |           |
|            |             | 4 | 11/20/07 | 11.58               | 524.9                     | 0.43                                   | 0.43 | 1.5E-03   | 55.64               | 661.5                     | 0.56                                   | 0.56 | 3.4E-03   |
|            |             |   |          | 9.55                | 432.4                     | 0.43                                   |      |           | 41.20               | 490.5                     | 0.56                                   |      |           |
|            |             |   |          | 10.33               | 471.8                     | 0.43                                   |      |           | 32.36               | 384.7                     | 0.56                                   |      |           |
|            |             |   |          | 9.52                | 433.0                     | 0.43                                   |      |           | 31.42               | 368.9                     | 0.55                                   |      |           |
|            |             |   |          | 9.37                | 424.9                     | 0.43                                   |      |           | 29.17               | 344.0                     | 0.55                                   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|            |             | # | Date     | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|------------|-------------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID         |             |   |          | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| EAU CLAIRE | TP1<br>GC-3 | 1 | 11/20/07 | 10.33               | 435.5                     | 0.40                                   | 0.39 | 7.3E-03   | 51.37               | 455.1                     | 0.42                                   | 0.42 | 4.2E-03   |
|            |             |   |          | 11.48               | 484.7                     | 0.40                                   |      |           | 38.52               | 340.2                     | 0.42                                   |      |           |
|            |             |   |          | 7.52                | 310.5                     | 0.39                                   |      |           | 34.20               | 302.5                     | 0.42                                   |      |           |
|            |             |   |          | 8.17                | 335.5                     | 0.39                                   |      |           | 37.08               | 324.4                     | 0.41                                   |      |           |
|            |             |   |          | 7.33                | 295.9                     | 0.38                                   |      |           | 32.77               | 294.8                     | 0.42                                   |      |           |
|            |             |   |          |                     |                           |  |      |           |                     |                           |  |      |           |
|            |             | 2 | 11/20/07 | 8.95                | 624.7                     | 0.66                                   | 0.64 | 1.6E-02   | 29.42               | 498.5                     | 0.80                                   | 0.79 | 8.6E-03   |
|            |             |   |          | 6.70                | 468.7                     | 0.66                                   |      |           | 29.34               | 493.9                     | 0.79                                   |      |           |
|            |             |   |          | 5.77                | 392.7                     | 0.64                                   |      |           | 25.61               | 428.6                     | 0.79                                   |      |           |
|            |             |   |          | 5.33                | 355.3                     | 0.63                                   |      |           | 21.15               | 353.6                     | 0.79                                   |      |           |
|            |             |   |          | 5.37                | 356.6                     | 0.62                                   |      |           | 21.08               | 346.8                     | 0.77                                   |      |           |
|            |             |   |          |                     |                           |  |      |           |                     |                           |  |      |           |
|            |             | 3 | 11/20/07 | 6.61                | 371.4                     | 0.53                                   | 0.51 | 1.4E-02   | 26.48               | 368.6                     | 0.65                                   | 0.65 | 5.9E-03   |
|            |             |   |          | 5.23                | 290.5                     | 0.52                                   |      |           | 26.02               | 362.3                     | 0.65                                   |      |           |
|            |             |   |          | 6.70                | 361.5                     | 0.51                                   |      |           | 24.05               | 332.2                     | 0.65                                   |      |           |
|            |             |   |          | 7.02                | 372.2                     | 0.50                                   |      |           | 21.37               | 293.3                     | 0.65                                   |      |           |
|            |             |   |          | 6.92                | 365.3                     | 0.50                                   |      |           | 24.48               | 333.7                     | 0.64                                   |      |           |
|            |             |   |          |                     |                           |  |      |           |                     |                           |  |      |           |
|            |             | 4 | 11/20/07 | 7.23                | 394.1                     | 0.51                                   | 0.50 | 7.8E-03   | 30.23               | 384.6                     | 0.60                                   | 0.60 | 2.9E-03   |
|            |             |   |          | 12.64               | 670.7                     | 0.50                                   |      |           | 26.20               | 333.9                     | 0.60                                   |      |           |
|            |             |   |          | 6.36                | 344.3                     | 0.51                                   |      |           | 23.89               | 302.8                     | 0.60                                   |      |           |
|            |             |   |          | 7.21                | 383.9                     | 0.50                                   |      |           | 25.70               | 325.1                     | 0.59                                   |      |           |
|            |             |   |          | 7.92                | 415.6                     | 0.49                                   |      |           | 28.08               | 353.4                     | 0.59                                   |      |           |
|            |             |   |          |                     |                           |  |      |           |                     |                           |  |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|            |             | # | Date     | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|------------|-------------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID         |             |   |          | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| EAU CLAIRE | TP2<br>GC-1 | 1 | 11/20/07 | 8.12                | 484.2                     | 0.56                                   | 0.54 | 1.7E-02   | 24.69               | 485.8                     | 0.93                                   | 0.87 | 3.5E-02   |
|            |             |   |          | 7.62                | 445.1                     | 0.55                                   |      |           | 22.14               | 418.6                     | 0.89                                   |      |           |
|            |             |   |          | 8.22                | 469.7                     | 0.54                                   |      |           | 20.10               | 371.8                     | 0.87                                   |      |           |
|            |             |   |          | 6.03                | 341.0                     | 0.53                                   |      |           | 20.81               | 374.1                     | 0.85                                   |      |           |
|            |             |   |          | 5.23                | 287.1                     | 0.52                                   |      |           | 18.70               | 333.4                     | 0.84                                   |      |           |
|            |             | 2 | 11/20/07 | 9.60                | 349.4                     | 0.34                                   | 0.33 | 7.4E-03   | 48.76               | 493.3                     | 0.48                                   | 0.47 | 7.2E-03   |
|            |             |   |          | 7.80                | 272.5                     | 0.33                                   |      |           | 38.23               | 384.0                     | 0.47                                   |      |           |
|            |             |   |          | 11.07               | 388.3                     | 0.33                                   |      |           | 32.97               | 327.9                     | 0.47                                   |      |           |
|            |             |   |          | 8.41                | 292.7                     | 0.33                                   |      |           | 65.05               | 632.9                     | 0.46                                   |      |           |
|            |             |   |          | 9.60                | 328.9                     | 0.32                                   |      |           | 51.42               | 507.1                     | 0.46                                   |      |           |
|            |             | 3 | 11/20/07 | 9.40                | 458.7                     | 0.46                                   | 0.45 | 7.1E-03   | 33.69               | 465.9                     | 0.65                                   | 0.64 | 9.7E-03   |
|            |             |   |          | 10.85               | 516.7                     | 0.45                                   |      |           | 29.49               | 402.6                     | 0.64                                   |      |           |
|            |             |   |          | 7.16                | 344.2                     | 0.45                                   |      |           | 28.46               | 383.1                     | 0.63                                   |      |           |
|            |             |   |          | 9.85                | 460.9                     | 0.44                                   |      |           | 30.07               | 401.4                     | 0.63                                   |      |           |
|            |             |   |          | 6.17                | 292.4                     | 0.45                                   |      |           | 26.47               | 353.6                     | 0.63                                   |      |           |
|            |             | 4 | 11/20/07 | 7.21                | 299.6                     | 0.39                                   | 0.37 | 1.2E-02   | 30.03               | 259.4                     | 0.41                                   | 0.39 | 7.7E-03   |
|            |             |   |          | 9.01                | 356.8                     | 0.37                                   |      |           | 50.77               | 429.4                     | 0.40                                   |      |           |
|            |             |   |          | 8.65                | 346.5                     | 0.38                                   |      |           | 39.21               | 328.2                     | 0.39                                   |      |           |
|            |             |   |          | 11.81               | 457.5                     | 0.36                                   |      |           | 43.95               | 366.4                     | 0.39                                   |      |           |
|            |             |   |          | 8.83                | 337.3                     | 0.36                                   |      |           | 39.68               | 325.1                     | 0.39                                   |      |           |



Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|            |             | # | Date     | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|------------|-------------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID         |             |   |          | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| EAU CLAIRE | TP2<br>GC-2 | 1 | 11/21/07 | 10.14               | 335.3                     | 0.31                                   | 0.31 | 3.4E-03   | 55.58               | 502.7                     | 0.43                                   | 0.41 | 7.9E-03   |
|            |             |   |          | 9.32                | 310.9                     | 0.31                                   |      |           | 44.13               | 386.6                     | 0.41                                   |      |           |
|            |             |   |          | 8.66                | 286.7                     | 0.31                                   |      |           | 44.71               | 387.4                     | 0.41                                   |      |           |
|            |             |   |          | 8.11                | 275.3                     | 0.32                                   |      |           | 38.61               | 335.5                     | 0.41                                   |      |           |
|            |             |   |          | 11.48               | 381.1                     | 0.31                                   |      |           | 36.20               | 312.3                     | 0.41                                   |      |           |
|            |             |   |          |                     |                           |  |      |           |                     |                           |  |      |           |
|            |             | 2 | 11/21/07 | 6.08                | 469.1                     | 0.73                                   | 0.70 | 2.5E-02   | 45.10               | 803.3                     | 0.84                                   | 0.81 | 1.9E-02   |
|            |             |   |          | 5.93                | 452.9                     | 0.72                                   |      |           | 23.80               | 415.7                     | 0.82                                   |      |           |
|            |             |   |          | 5.26                | 396.2                     | 0.71                                   |      |           | 24.31               | 416.1                     | 0.80                                   |      |           |
|            |             |   |          | 5.89                | 435.8                     | 0.70                                   |      |           | 17.72               | 299.3                     | 0.79                                   |      |           |
|            |             |   |          | 5.52                | 388.8                     | 0.66                                   |      |           | 19.37               | 325.9                     | 0.79                                   |      |           |
|            |             |   |          |                     |                           |  |      |           |                     |                           |  |      |           |
|            |             | 3 | 11/21/07 | 8.12                | 538.6                     | 0.62                                   | 0.60 | 1.5E-02   | 44.40               | 728.3                     | 0.77                                   | 0.77 | 4.4E-03   |
|            |             |   |          | 7.19                | 470.0                     | 0.61                                   |      |           | 27.71               | 452.6                     | 0.77                                   |      |           |
|            |             |   |          | 6.34                | 397.5                     | 0.59                                   |      |           | 28.88               | 477.7                     | 0.78                                   |      |           |
|            |             |   |          | 6.12                | 386.5                     | 0.59                                   |      |           | 22.10               | 365.7                     | 0.78                                   |      |           |
|            |             |   |          | 4.75                | 300.9                     | 0.60                                   |      |           | 27.18               | 446.1                     | 0.77                                   |      |           |
|            |             |   |          |                     |                           |  |      |           |                     |                           |  |      |           |
|            |             | 4 | 11/21/07 | 7.47                | 474.6                     | 0.60                                   | 0.57 | 2.0E-02   | 25.35               | 406.4                     | 0.75                                   | 0.74 | 1.2E-02   |
|            |             |   |          | 6.68                | 415.1                     | 0.58                                   |      |           | 21.34               | 341.8                     | 0.75                                   |      |           |
|            |             |   |          | 5.31                | 329.7                     | 0.58                                   |      |           | 22.27               | 352.9                     | 0.75                                   |      |           |
|            |             |   |          | 5.59                | 332.7                     | 0.56                                   |      |           | 20.54               | 316.4                     | 0.72                                   |      |           |
|            |             |   |          | 5.61                | 326.6                     | 0.55                                   |      |           | 20.56               | 325.2                     | 0.74                                   |      |           |
|            |             |   |          |                     |                           |  |      |           |                     |                           |  |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|            |             |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|------------|-------------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID         |             | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| EAU CLAIRE | TP2<br>GC-3 | 1 | 11/21/07 | 9.26                | 340.7                     | 0.35                                   | 0.33 | 1.5E-02   | 53.16               | 415.1                     | 0.37                                   | 0.35 | 1.1E-02   |
|            |             |   |          | 11.73               | 415.3                     | 0.33                                   |      |           | 47.52               | 360.2                     | 0.36                                   |      |           |
|            |             |   |          | 14.48               | 506.5                     | 0.33                                   |      |           | 42.43               | 319.2                     | 0.35                                   |      |           |
|            |             |   |          | 15.24               | 511.3                     | 0.32                                   |      |           | 39.39               | 290.2                     | 0.35                                   |      |           |
|            |             |   |          | 14.25               | 464.4                     | 0.31                                   |      |           | 46.78               | 337.5                     | 0.34                                   |      |           |
|            |             | 2 | 11/21/07 | 10.98               | 398.8                     | 0.34                                   | 0.32 | 1.4E-02   | 51.87               | 394.5                     | 0.36                                   | 0.35 | 7.7E-03   |
|            |             |   |          | 7.98                | 276.6                     | 0.33                                   |      |           | 48.37               | 365.2                     | 0.36                                   |      |           |
|            |             |   |          | 8.99                | 306.4                     | 0.32                                   |      |           | 47.27               | 350.6                     | 0.35                                   |      |           |
|            |             |   |          | 9.61                | 323.0                     | 0.32                                   |      |           | 46.06               | 336.4                     | 0.34                                   |      |           |
|            |             |   |          | 10.28               | 330.9                     | 0.30                                   |      |           | 39.87               | 287.6                     | 0.34                                   |      |           |
|            |             | 3 | 11/21/07 | 10.39               | 244.0                     | 0.22                                   | 0.21 | 6.6E-03   | 53.94               | 344.2                     | 0.30                                   | 0.29 | 4.7E-03   |
|            |             |   |          | 12.12               | 276.2                     | 0.21                                   |      |           | 51.68               | 322.2                     | 0.29                                   |      |           |
|            |             |   |          | 23.43               | 552.6                     | 0.22                                   |      |           | 53.27               | 331.0                     | 0.29                                   |      |           |
|            |             |   |          | 20.24               | 449.1                     | 0.21                                   |      |           | 50.28               | 311.2                     | 0.29                                   |      |           |
|            |             |   |          | 12.61               | 278.6                     | 0.21                                   |      |           | 50.92               | 310.8                     | 0.29                                   |      |           |
|            |             | 4 | 11/21/07 | 19.04               | 415.4                     | 0.21                                   | 0.19 | 1.2E-02   | 61.63               | 297.1                     | 0.23                                   | 0.22 | 5.3E-03   |
|            |             |   |          | 15.43               | 319.7                     | 0.19                                   |      |           | 63.08               | 298.0                     | 0.22                                   |      |           |
|            |             |   |          | 15.47               | 305.6                     | 0.19                                   |      |           | 58.12               | 270.3                     | 0.22                                   |      |           |
|            |             |   |          | 15.96               | 305.7                     | 0.18                                   |      |           | 63.15               | 289.7                     | 0.22                                   |      |           |
|            |             |   |          | 13.67               | 254.7                     | 0.18                                   |      |           | 57.23               | 259.7                     | 0.21                                   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|            |             | # | Date     | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|------------|-------------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID         |             |   |          | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| EAU CLAIRE | TP3<br>GC-1 | 1 | 11/21/07 | 21.34               | 394.2                     | 0.17                                   | 0.17 | 3.7E-03   | 81.66               | 487.6                     | 0.28                                   | 0.27 | 8.1E-03   |
|            |             |   |          | 21.98               | 402.2                     | 0.17                                   |      |           | 62.57               | 364.4                     | 0.27                                   |      |           |
|            |             |   |          | 16.73               | 303.7                     | 0.17                                   |      |           | 52.96               | 302.4                     | 0.27                                   |      |           |
|            |             |   |          | 17.73               | 313.8                     | 0.17                                   |      |           | 54.82               | 307.5                     | 0.26                                   |      |           |
|            |             |   |          | 17.00               | 298.7                     | 0.17                                   |      |           | 51.79               | 287.0                     | 0.26                                   |      |           |
|            |             | 2 | 11/21/07 | 20.20               | 336.9                     | 0.16                                   | 0.15 | 4.7E-03   | 60.94               | 276.4                     | 0.21                                   | 0.21 | 5.6E-03   |
|            |             |   |          | 16.95               | 275.7                     | 0.15                                   |      |           | 58.39               | 261.3                     | 0.21                                   |      |           |
|            |             |   |          | 19.62               | 311.5                     | 0.15                                   |      |           | 56.28               | 246.0                     | 0.21                                   |      |           |
|            |             |   |          | 18.00               | 281.1                     | 0.15                                   |      |           | 58.82               | 253.8                     | 0.20                                   |      |           |
|            |             |   |          | 16.81               | 259.9                     | 0.15                                   |      |           | 62.89               | 266.8                     | 0.20                                   |      |           |
|            |             | 3 | 11/21/07 | 8.70                | 367.9                     | 0.40                                   | 0.39 | 5.4E-03   | 49.95               | 536.1                     | 0.50                                   | 0.51 | 6.5E-03   |
|            |             |   |          | 7.44                | 310.5                     | 0.39                                   |      |           | 40.17               | 441.4                     | 0.52                                   |      |           |
|            |             |   |          | 6.76                | 283.6                     | 0.39                                   |      |           | 34.98               | 378.2                     | 0.51                                   |      |           |
|            |             |   |          | 7.85                | 325.1                     | 0.39                                   |      |           | 30.58               | 326.3                     | 0.50                                   |      |           |
|            |             |   |          | 7.50                | 305.8                     | 0.38                                   |      |           | 35.74               | 380.5                     | 0.50                                   |      |           |
|            |             | 4 | 11/21/07 | 10.54               | 440.3                     | 0.39                                   | 0.38 | 1.2E-02   | 45.87               | 433.1                     | 0.44                                   | 0.43 | 8.3E-03   |
|            |             |   |          | 8.66                | 348.8                     | 0.38                                   |      |           | 40.08               | 376.9                     | 0.44                                   |      |           |
|            |             |   |          | 7.90                | 316.3                     | 0.38                                   |      |           | 39.62               | 365.0                     | 0.43                                   |      |           |
|            |             |   |          | 8.31                | 323.1                     | 0.37                                   |      |           | 49.35               | 450.1                     | 0.43                                   |      |           |
|            |             |   |          | 9.51                | 365.4                     | 0.36                                   |      |           | 43.20               | 390.4                     | 0.42                                   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|            |             |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|------------|-------------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID         |             | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| EAU CLAIRE | TP3<br>GC-2 | 1 | 11/21/07 | 14.19               | 575.9                     | 0.38                                   | 0.38 | 2.7E-03   | 80.48               | 1129.8                    | 0.66                                   | 0.63 | 2.1E-02   |
|            |             |   |          | 9.92                | 409.6                     | 0.39                                   |      |           | 49.97               | 683.2                     | 0.64                                   |      |           |
|            |             |   |          | 9.87                | 405.3                     | 0.39                                   |      |           | 39.28               | 525.7                     | 0.63                                   |      |           |
|            |             |   |          | 6.42                | 262.7                     | 0.38                                   |      |           | 34.87               | 456.3                     | 0.62                                   |      |           |
|            |             |   |          | 8.28                | 336.9                     | 0.38                                   |      |           | 30.39               | 393.3                     | 0.61                                   |      |           |
|            |             | 2 | 11/21/07 | 5.87                | 390.9                     | 0.63                                   | 0.60 | 2.0E-02   | 43.56               | 663.2                     | 0.72                                   | 0.73 | 3.0E-02   |
|            |             |   |          | 5.02                | 321.2                     | 0.60                                   |      |           | 35.75               | 540.6                     | 0.71                                   |      |           |
|            |             |   |          | 6.74                | 421.9                     | 0.59                                   |      |           | 23.43               | 351.6                     | 0.71                                   |      |           |
|            |             |   |          | 4.76                | 307.8                     | 0.61                                   |      |           | 22.95               | 378.9                     | 0.78                                   |      |           |
|            |             |   |          | 5.66                | 345.4                     | 0.57                                   |      |           | 21.06               | 333.4                     | 0.74                                   |      |           |
|            |             | 3 | 11/21/07 | 7.50                | 335.0                     | 0.42                                   | 0.41 | 8.0E-03   | 38.62               | 514.9                     | 0.63                                   | 0.61 | 1.1E-02   |
|            |             |   |          | 8.69                | 384.5                     | 0.42                                   |      |           | 26.81               | 355.7                     | 0.62                                   |      |           |
|            |             |   |          | 7.93                | 349.7                     | 0.41                                   |      |           | 26.00               | 336.3                     | 0.61                                   |      |           |
|            |             |   |          | 6.58                | 288.1                     | 0.41                                   |      |           | 27.01               | 349.7                     | 0.61                                   |      |           |
|            |             |   |          | 9.68                | 410.8                     | 0.40                                   |      |           | 23.96               | 307.1                     | 0.60                                   |      |           |
|            |             | 4 | 11/21/07 | 6.90                | 450.2                     | 0.61                                   | 0.58 | 2.8E-02   | 28.85               | 484.9                     | 0.79                                   | 0.78 | 1.4E-02   |
|            |             |   |          | 7.05                | 446.1                     | 0.60                                   |      |           | 21.49               | 360.8                     | 0.79                                   |      |           |
|            |             |   |          | 6.87                | 426.9                     | 0.58                                   |      |           | 20.23               | 337.1                     | 0.78                                   |      |           |
|            |             |   |          | 7.74                | 468.1                     | 0.57                                   |      |           | 54.38               | 881.5                     | 0.76                                   |      |           |
|            |             |   |          | 6.83                | 391.5                     | 0.54                                   |      |           | 21.61               | 350.1                     | 0.76                                   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|            |             |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|------------|-------------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID         |             | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| EAU CLAIRE | TP3<br>GC-3 | 1 | 11/26/07 | 12.67               | 341.3                     | 0.25                                   | 0.24 | 1.2E-02   | 40.67               | 326.7                     | 0.38                                   | 0.36 | 1.6E-02   |
|            |             |   |          | 11.23               | 297.9                     | 0.25                                   |      |           | 33.11               | 259.2                     | 0.37                                   |      |           |
|            |             |   |          | 18.03               | 458.7                     | 0.24                                   |      |           | 47.58               | 353.1                     | 0.35                                   |      |           |
|            |             |   |          | 13.80               | 340.2                     | 0.23                                   |      |           | 49.67               | 367.5                     | 0.35                                   |      |           |
|            |             |   |          | 13.37               | 319.3                     | 0.22                                   |      |           | 43.89               | 317.1                     | 0.34                                   |      |           |
|            |             | 2 | 11/26/07 | 11.37               | 464.8                     | 0.38                                   | 0.37 | 1.6E-02   | 45.17               | 424.2                     | 0.44                                   | 0.42 | 1.3E-02   |
|            |             |   |          | 10.23               | 410.8                     | 0.38                                   |      |           | 39.15               | 361.6                     | 0.43                                   |      |           |
|            |             |   |          | 9.23                | 362.7                     | 0.37                                   |      |           | 43.95               | 396.1                     | 0.42                                   |      |           |
|            |             |   |          | 8.36                | 316.9                     | 0.36                                   |      |           | 40.77               | 361.5                     | 0.42                                   |      |           |
|            |             |   |          | 9.87                | 363.3                     | 0.35                                   |      |           | 42.61               | 369.9                     | 0.41                                   |      |           |
|            |             | 3 | 11/26/07 | 7.87                | 570.5                     | 0.68                                   | 0.66 | 2.3E-02   | 25.92               | 528.8                     | 0.96                                   | 0.93 | 2.1E-02   |
|            |             |   |          | 7.43                | 530.3                     | 0.67                                   |      |           | 21.67               | 432.1                     | 0.94                                   |      |           |
|            |             |   |          | 5.11                | 356.6                     | 0.66                                   |      |           | 22.11               | 433.9                     | 0.92                                   |      |           |
|            |             |   |          | 6.37                | 437.3                     | 0.65                                   |      |           | 15.92               | 309.2                     | 0.91                                   |      |           |
|            |             |   |          | 6.05                | 401.1                     | 0.62                                   |      |           | 17.20               | 332.0                     | 0.91                                   |      |           |
|            |             | 4 | 11/26/07 | 17.73               | 1114.4                    | 0.59                                   | 0.57 | 2.6E-02   | 22.02               | 295.5                     | 0.63                                   | 0.65 | 1.4E-02   |
|            |             |   |          | 6.14                | 384.9                     | 0.59                                   |      |           | 26.08               | 367.4                     | 0.66                                   |      |           |
|            |             |   |          | 6.80                | 413.8                     | 0.57                                   |      |           | 25.37               | 354.2                     | 0.66                                   |      |           |
|            |             |   |          | 7.20                | 423.6                     | 0.55                                   |      |           | 22.30               | 308.8                     | 0.65                                   |      |           |
|            |             |   |          | 7.45                | 420.2                     | 0.53                                   |      |           | 26.67               | 358.4                     | 0.63                                   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|            |             |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|------------|-------------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID         |             | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| EAU CLAIRE | TP3<br>GC-4 | 1 | 11/26/07 | 10.92               | 486.9                     | 0.42                                   | 0.39 | 1.9E-02   | 31.03               | 473.5                     | 0.72                                   | 0.68 | 2.9E-02   |
|            |             |   |          | 10.58               | 451.4                     | 0.40                                   |      |           | 22.43               | 330.4                     | 0.69                                   |      |           |
|            |             |   |          | 8.98                | 374.6                     | 0.39                                   |      |           | 41.98               | 606.9                     | 0.68                                   |      |           |
|            |             |   |          | 8.61                | 347.0                     | 0.38                                   |      |           | 38.70               | 540.0                     | 0.66                                   |      |           |
|            |             |   |          | 8.92                | 351.9                     | 0.37                                   |      |           | 22.95               | 314.5                     | 0.64                                   |      |           |
|            |             | 2 | 11/26/07 | 11.89               | 265.4                     | 0.21                                   | 0.23 | 2.1E-02   | 57.08               | 325.5                     | 0.27                                   | 0.25 | 1.9E-02   |
|            |             |   |          | 10.92               | 302.5                     | 0.26                                   |      |           | 71.02               | 399.9                     | 0.26                                   |      |           |
|            |             |   |          | 11.31               | 300.8                     | 0.25                                   |      |           | 60.37               | 305.6                     | 0.24                                   |      |           |
|            |             |   |          | 12.34               | 308.1                     | 0.23                                   |      |           | 61.61               | 306.9                     | 0.23                                   |      |           |
|            |             |   |          | 14.48               | 336.4                     | 0.22                                   |      |           | 96.77               | 468.3                     | 0.23                                   |      |           |
|            |             | 3 | 11/26/07 | 10.36               | 240.8                     | 0.22                                   | 0.23 | 8.0E-03   | 45.67               | 387.0                     | 0.40                                   | 0.38 | 1.6E-02   |
|            |             |   |          | 21.96               | 556.6                     | 0.24                                   |      |           | 40.55               | 338.8                     | 0.39                                   |      |           |
|            |             |   |          | 10.52               | 261.2                     | 0.23                                   |      |           | 42.18               | 339.8                     | 0.38                                   |      |           |
|            |             |   |          | 12.45               | 304.4                     | 0.23                                   |      |           | 40.61               | 321.2                     | 0.37                                   |      |           |
|            |             |   |          | 12.77               | 302.5                     | 0.22                                   |      |           | 37.89               | 289.3                     | 0.36                                   |      |           |
|            |             | 4 | 11/26/07 | 18.80               | 414.7                     | 0.21                                   | 0.19 | 1.1E-02   | 35.42               | 447.8                     | 0.59                                   | 0.49 | 5.7E-02   |
|            |             |   |          | 15.08               | 319.6                     | 0.20                                   |      |           | 19.80               | 193.3                     | 0.46                                   |      |           |
|            |             |   |          | 16.86               | 347.7                     | 0.19                                   |      |           | 22.70               | 230.4                     | 0.48                                   |      |           |
|            |             |   |          | 15.20               | 300.3                     | 0.19                                   |      |           | 32.12               | 323.0                     | 0.47                                   |      |           |
|            |             |   |          | 22.78               | 436.6                     | 0.18                                   |      |           | 27.30               | 268.7                     | 0.46                                   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|            |          |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|------------|----------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID         |          | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| EAU CLAIRE | TP4 GC-1 | 1 | 11/26/07 | 5.89                | 392.9                     | 0.63                                   | 0.60 | 2.6E-02   | 54.14               | 1154.5                    | 1.00                                   | 0.94 | 4.7E-02   |
|            |          |   |          | 5.48                | 355.8                     | 0.61                                   |      |           | 26.30               | 542.3                     | 0.97                                   |      |           |
|            |          |   |          | 5.30                | 335.7                     | 0.60                                   |      |           | 24.05               | 479.5                     | 0.94                                   |      |           |
|            |          |   |          | 5.95                | 373.0                     | 0.59                                   |      |           | 25.98               | 503.4                     | 0.91                                   |      |           |
|            |          |   |          | 7.08                | 419.9                     | 0.56                                   |      |           | 27.61               | 518.1                     | 0.88                                   |      |           |
|            |          | 2 | 11/26/07 | 11.96               | 842.8                     | 0.66                                   | 0.59 | 5.4E-02   | 27.83               | 356.0                     | 0.60                                   | 0.57 | 2.2E-02   |
|            |          |   |          | 9.08                | 596.4                     | 0.62                                   |      |           | 29.42               | 368.1                     | 0.59                                   |      |           |
|            |          |   |          | 9.95                | 616.7                     | 0.58                                   |      |           | 26.61               | 324.3                     | 0.57                                   |      |           |
|            |          |   |          | 9.11                | 527.3                     | 0.54                                   |      |           | 27.12               | 322.3                     | 0.56                                   |      |           |
|            |          |   |          | 7.36                | 415.9                     | 0.53                                   |      |           | 28.92               | 335.6                     | 0.55                                   |      |           |
|            |          | 3 | 11/26/07 | 7.70                | 547.7                     | 0.67                                   | 0.63 | 2.8E-02   | 28.89               | 628.5                     | 1.02                                   | 0.98 | 3.3E-02   |
|            |          |   |          | 6.42                | 433.6                     | 0.64                                   |      |           | 20.11               | 430.6                     | 1.01                                   |      |           |
|            |          |   |          | 7.45                | 489.8                     | 0.62                                   |      |           | 18.08               | 380.1                     | 0.99                                   |      |           |
|            |          |   |          | 6.48                | 423.3                     | 0.61                                   |      |           | 21.11               | 430.8                     | 0.96                                   |      |           |
|            |          |   |          | 7.81                | 493.9                     | 0.59                                   |      |           | 20.05               | 401.4                     | 0.94                                   |      |           |
|            |          | 4 | 11/26/07 | 6.70                | 445.6                     | 0.63                                   | 0.58 | 3.7E-02   | 20.42               | 299.5                     | 0.69                                   | 0.64 | 2.8E-02   |
|            |          |   |          | 6.61                | 431.4                     | 0.61                                   |      |           | 27.92               | 386.9                     | 0.65                                   |      |           |
|            |          |   |          | 7.03                | 438.6                     | 0.59                                   |      |           | 24.05               | 322.2                     | 0.63                                   |      |           |
|            |          |   |          | 6.27                | 376.4                     | 0.56                                   |      |           | 23.48               | 313.3                     | 0.63                                   |      |           |
|            |          |   |          | 6.37                | 361.0                     | 0.53                                   |      |           | 22.52               | 296.9                     | 0.62                                   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|            |          | # | Date     | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|------------|----------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID         |          |   |          | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| EAU CLAIRE | TP4 GC-2 | 1 | 11/27/07 | 5.02                | 419.2                     | 0.79                                   | 0.76 | 1.3E-02   | 28.40               | 711.2                     | 1.18                                   | 1.18 | 7.1E-03   |
|            |          |   |          | 5.34                | 430.6                     | 0.76                                   |      |           | 15.75               | 397.3                     | 1.19                                   |      |           |
|            |          |   |          | 6.33                | 508.6                     | 0.76                                   |      |           | 12.58               | 316.2                     | 1.18                                   |      |           |
|            |          |   |          | 8.80                | 703.3                     | 0.75                                   |      |           | 12.11               | 308.1                     | 1.20                                   |      |           |
|            |          |   |          | 5.84                | 475.3                     | 0.77                                   |      |           | 13.05               | 328.0                     | 1.18                                   |      |           |
|            |          | 2 | 11/27/07 | 11.02               | 494.2                     | 0.42                                   | 0.42 | 2.4E-03   | 30.12               | 442.4                     | 0.69                                   | 0.71 | 1.3E-02   |
|            |          |   |          | 11.34               | 506.3                     | 0.42                                   |      |           | 31.55               | 483.7                     | 0.72                                   |      |           |
|            |          |   |          | 8.27                | 366.1                     | 0.42                                   |      |           | 27.05               | 413.2                     | 0.72                                   |      |           |
|            |          |   |          | 9.77                | 436.3                     | 0.42                                   |      |           | 20.23               | 309.7                     | 0.72                                   |      |           |
|            |          |   |          | 8.08                | 357.7                     | 0.42                                   |      |           | 22.75               | 347.8                     | 0.72                                   |      |           |
|            |          | 3 | 11/27/07 | 10.55               | 727.5                     | 0.65                                   | 0.64 | 4.8E-03   | 46.39               | 1068.2                    | 1.08                                   | 1.07 | 1.3E-02   |
|            |          |   |          | 9.40                | 640.7                     | 0.64                                   |      |           | 27.39               | 629.2                     | 1.08                                   |      |           |
|            |          |   |          | 6.53                | 447.0                     | 0.64                                   |      |           | 20.23               | 458.6                     | 1.07                                   |      |           |
|            |          |   |          | 5.67                | 384.0                     | 0.64                                   |      |           | 22.67               | 509.3                     | 1.06                                   |      |           |
|            |          |   |          | 5.33                | 361.3                     | 0.64                                   |      |           | 21.20               | 475.7                     | 1.06                                   |      |           |
|            |          | 4 | 11/27/07 | 14.89               | 372.5                     | 0.24                                   | 0.23 | 6.1E-03   | 43.77               | 310.0                     | 0.33                                   | 0.27 | 4.6E-02   |
|            |          |   |          | 9.58                | 242.1                     | 0.24                                   |      |           | 47.15               | 306.5                     | 0.31                                   |      |           |
|            |          |   |          | 11.64               | 288.8                     | 0.23                                   |      |           | 46.14               | 243.9                     | 0.25                                   |      |           |
|            |          |   |          | 11.61               | 283.6                     | 0.23                                   |      |           | 47.17               | 236.3                     | 0.24                                   |      |           |
|            |          |   |          | 15.98               | 377.1                     | 0.22                                   |      |           | 50.92               | 248.3                     | 0.23                                   |      |           |



Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|                |             | # | Date     | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|----------------|-------------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| Identification |             |   |          | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| EAU CLAIRE     | TP4<br>GC-3 | 1 | 11/27/07 | 8.77                | 434.4                     | 0.47                                   | 0.44 | 2.9E-02   | 33.53               | 693.3                     | 0.97                                   | 0.92 | 3.9E-02   |
|                |             |   |          | 8.78                | 425.0                     | 0.46                                   |      |           | 14.27               | 288.2                     | 0.95                                   |      |           |
|                |             |   |          | 8.33                | 391.8                     | 0.44                                   |      |           | 18.42               | 360.0                     | 0.92                                   |      |           |
|                |             |   |          | 7.55                | 338.1                     | 0.42                                   |      |           | 19.36               | 368.7                     | 0.90                                   |      |           |
|                |             |   |          | 10.61               | 444.6                     | 0.39                                   |      |           | 17.89               | 333.4                     | 0.88                                   |      |           |
|                |             | 2 | 11/27/07 | 7.95                | 558.2                     | 0.66                                   | 0.62 | 3.8E-02   | 29.55               | 559.4                     | 0.89                                   | 0.89 | 3.6E-03   |
|                |             |   |          | 6.92                | 474.0                     | 0.64                                   |      |           | 25.67               | 484.5                     | 0.89                                   |      |           |
|                |             |   |          | 6.15                | 405.9                     | 0.62                                   |      |           | 20.23               | 379.8                     | 0.88                                   |      |           |
|                |             |   |          | 7.15                | 444.7                     | 0.58                                   |      |           | 17.89               | 336.2                     | 0.88                                   |      |           |
|                |             |   |          | 7.70                | 468.4                     | 0.57                                   |      |           | 17.52               | 328.5                     | 0.88                                   |      |           |
|                |             | 3 | 11/27/07 | 7.17                | 362.9                     | 0.48                                   | 0.46 | 1.5E-02   | 29.67               | 598.5                     | 0.95                                   | 0.89 | 3.9E-02   |
|                |             |   |          | 17.36               | 839.2                     | 0.45                                   |      |           | 19.23               | 375.3                     | 0.92                                   |      |           |
|                |             |   |          | 10.48               | 515.6                     | 0.46                                   |      |           | 22.30               | 421.1                     | 0.89                                   |      |           |
|                |             |   |          | 7.14                | 343.3                     | 0.45                                   |      |           | 17.77               | 327.2                     | 0.87                                   |      |           |
|                |             |   |          | 8.05                | 371.4                     | 0.43                                   |      |           | 18.33               | 332.4                     | 0.85                                   |      |           |
|                |             | 4 | 11/27/07 | 7.08                | 485.2                     | 0.64                                   | 0.60 | 3.6E-02   | 22.87               | 391.8                     | 0.81                                   | 0.81 | 6.4E-03   |
|                |             |   |          | 7.09                | 478.7                     | 0.63                                   |      |           | 22.20               | 384.0                     | 0.81                                   |      |           |
|                |             |   |          | 8.05                | 503.7                     | 0.59                                   |      |           | 20.15               | 352.7                     | 0.82                                   |      |           |
|                |             |   |          | 6.92                | 421.5                     | 0.57                                   |      |           | 22.30               | 385.4                     | 0.81                                   |      |           |
|                |             |   |          | 5.55                | 333.7                     | 0.57                                   |      |           | 27.42               | 476.4                     | 0.82                                   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|            |             |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|------------|-------------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID         |             | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| EAU CLAIRE | TP4<br>GC-4 | 1 | 11/27/07 | 8.62                | 401.6                     | 0.44                                   | 0.41 | 1.6E-02   | 33.23               | 541.6                     | 0.77                                   | 0.71 | 4.8E-02   |
|            |             |   |          | 16.55               | 727.5                     | 0.41                                   |      |           | 20.30               | 321.0                     | 0.74                                   |      |           |
|            |             |   |          | 9.09                | 392.9                     | 0.41                                   |      |           | 22.95               | 354.6                     | 0.73                                   |      |           |
|            |             |   |          | 8.05                | 345.8                     | 0.40                                   |      |           | 17.81               | 249.5                     | 0.66                                   |      |           |
|            |             |   |          | 8.73                | 367.3                     | 0.40                                   |      |           | 23.02               | 326.2                     | 0.67                                   |      |           |
|            |             | 2 | 11/27/07 | 11.61               | 718.8                     | 0.58                                   | 0.54 | 3.7E-02   | 21.20               | 333.9                     | 0.74                                   | 0.71 | 3.9E-02   |
|            |             |   |          | 6.98                | 425.4                     | 0.57                                   |      |           | 20.93               | 327.5                     | 0.74                                   |      |           |
|            |             |   |          | 7.95                | 456.5                     | 0.54                                   |      |           | 24.21               | 369.0                     | 0.72                                   |      |           |
|            |             |   |          | 8.92                | 487.9                     | 0.51                                   |      |           | 22.73               | 333.2                     | 0.69                                   |      |           |
|            |             |   |          | 9.05                | 477.8                     | 0.50                                   |      |           | 20.31               | 279.2                     | 0.65                                   |      |           |
|            |             | 3 | 11/27/07 | 11.34               | 286.9                     | 0.24                                   | 0.22 | 1.3E-02   | 39.61               | 439.1                     | 0.52                                   | 0.49 | 2.2E-02   |
|            |             |   |          | 15.80               | 369.8                     | 0.22                                   |      |           | 28.02               | 299.3                     | 0.50                                   |      |           |
|            |             |   |          | 15.55               | 351.8                     | 0.21                                   |      |           | 42.98               | 451.3                     | 0.49                                   |      |           |
|            |             |   |          | 15.09               | 332.4                     | 0.21                                   |      |           | 33.59               | 352.2                     | 0.49                                   |      |           |
|            |             |   |          | 12.25               | 265.9                     | 0.20                                   |      |           | 28.14               | 275.8                     | 0.46                                   |      |           |
|            |             | 4 | 11/27/07 | 11.02               | 474.7                     | 0.41                                   | 0.36 | 3.5E-02   | 38.52               | 436.6                     | 0.53                                   | 0.53 | 1.1E-02   |
|            |             |   |          | 9.70                | 397.0                     | 0.38                                   |      |           | 29.17               | 333.9                     | 0.54                                   |      |           |
|            |             |   |          | 9.46                | 354.2                     | 0.35                                   |      |           | 34.39               | 384.4                     | 0.53                                   |      |           |
|            |             |   |          | 8.09                | 289.5                     | 0.34                                   |      |           | 29.45               | 326.4                     | 0.52                                   |      |           |
|            |             |   |          | 12.36               | 418.9                     | 0.32                                   |      |           | 31.39               | 340.2                     | 0.51                                   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|        |         | # | Date     | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|--------|---------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID     |         |   |          | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| HELENA | GC - AB | 1 | 09/11/08 | 16.68               | 630.2                     | 0.36                                   | 0.34 | 2.7E-02   | 28.45               | 535.5                     | 0.89                                   | 0.83 | 4.4E-02   |
|        |         |   |          | 12.48               | 457.5                     | 0.34                                   |      |           | 23.05               | 416.8                     | 0.85                                   |      |           |
|        |         |   |          | 16.87               | 584.5                     | 0.33                                   |      |           | 24.45               | 429.6                     | 0.83                                   |      |           |
|        |         |   |          | 14.61               | 482.0                     | 0.31                                   |      |           | 24.84               | 426.2                     | 0.81                                   |      |           |
|        |         |   |          | 13.67               | 550.8                     | 0.38                                   |      |           | 31.83               | 519.7                     | 0.77                                   |      |           |
|        |         | 2 | 09/11/08 | 12.48               | 921.2                     | 0.69                                   | 0.65 | 3.9E-02   | 26.17               | 644.2                     | 1.16                                   | 1.08 | 5.7E-02   |
|        |         |   |          | 8.02                | 573.9                     | 0.67                                   |      |           | 14.02               | 333.0                     | 1.12                                   |      |           |
|        |         |   |          | 8.20                | 570.2                     | 0.65                                   |      |           | 18.71               | 411.6                     | 1.03                                   |      |           |
|        |         |   |          | 10.55               | 698.8                     | 0.62                                   |      |           | 17.37               | 391.5                     | 1.06                                   |      |           |
|        |         |   |          | 12.56               | 796.6                     | 0.60                                   |      |           | 19.45               | 423.2                     | 1.02                                   |      |           |
|        |         | 3 | 09/11/08 | 15.86               | 462.1                     | 0.27                                   | 0.25 | 1.7E-02   | 10.23               | 514.5                     | 2.36                                   | 2.23 | 1.1E-01   |
|        |         |   |          | 17.33               | 489.5                     | 0.27                                   |      |           | 14.89               | 725.1                     | 2.29                                   |      |           |
|        |         |   |          | 16.52               | 453.8                     | 0.26                                   |      |           | 7.78                | 377.1                     | 2.28                                   |      |           |
|        |         |   |          | 14.53               | 371.6                     | 0.24                                   |      |           | 12.08               | 546.0                     | 2.13                                   |      |           |
|        |         |   |          | 13.40               | 334.4                     | 0.23                                   |      |           | 12.39               | 554.0                     | 2.10                                   |      |           |
|        |         | 4 | 09/11/08 | 8.83                | 734.1                     | 0.78                                   | 0.70 | 6.9E-02   | 20.45               | 327.9                     | 0.75                                   | 0.72 | 2.8E-02   |
|        |         |   |          | 6.42                | 516.2                     | 0.76                                   |      |           | 32.70               | 513.4                     | 0.74                                   |      |           |
|        |         |   |          | 7.39                | 542.7                     | 0.69                                   |      |           | 41.30               | 635.3                     | 0.72                                   |      |           |
|        |         |   |          | 7.40                | 511.4                     | 0.65                                   |      |           | 45.55               | 681.4                     | 0.70                                   |      |           |
|        |         |   |          | 13.17               | 868.7                     | 0.62                                   |      |           | 28.86               | 419.3                     | 0.68                                   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|       |         |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|-------|---------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID    |         | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| OMAHA | GC - CB | 1 | 07/11/08 | 43.05               | 337.8                     | 0.07                                   | 0.07 | 1.1E-03   | 38.08               | 218.5                     | 0.27                                   | 0.23 | 3.2E-02   |
|       |         |   |          | 53.08               | 421.3                     | 0.07                                   |      |           | 51.96               | 283.7                     | 0.26                                   |      |           |
|       |         |   |          | 43.10               | 345.6                     | 0.08                                   |      |           | 39.71               | 190.7                     | 0.23                                   |      |           |
|       |         |   |          | 37.80               | 299.5                     | 0.07                                   |      |           | 41.11               | 182.4                     | 0.21                                   |      |           |
|       |         |   |          | 51.03               | 393.2                     | 0.07                                   |      |           | 43.59               | 181.0                     | 0.20                                   |      |           |
|       |         |   |          |                     |                           |  |      |           |                     |                           |  |      |           |
|       |         | 2 | 07/11/08 | 12.14               | 424.0                     | 0.33                                   | 0.28 | 3.9E-02   | 20.95               | 406.5                     | 0.91                                   | 0.77 | 1.1E-01   |
|       |         |   |          | 12.52               | 407.1                     | 0.31                                   |      |           | 35.83               | 645.1                     | 0.85                                   |      |           |
|       |         |   |          | 15.23               | 446.9                     | 0.28                                   |      |           | 21.25               | 338.7                     | 0.75                                   |      |           |
|       |         |   |          | 17.09               | 450.1                     | 0.25                                   |      |           | 27.11               | 407.0                     | 0.71                                   |      |           |
|       |         |   |          | 9.80                | 246.1                     | 0.24                                   |      |           | 20.95               | 281.3                     | 0.63                                   |      |           |
|       |         |   |          |                     |                           |  |      |           |                     |                           |  |      |           |
|       |         | 3 | 07/11/08 | 22.39               | 771.6                     | 0.32                                   | 0.28 | 3.5E-02   | 40.36               | 271.3                     | 0.32                                   | 0.30 | 1.3E-02   |
|       |         |   |          | 13.80               | 450.6                     | 0.31                                   |      |           | 46.05               | 301.0                     | 0.31                                   |      |           |
|       |         |   |          | 11.17               | 336.9                     | 0.28                                   |      |           | 61.11               | 386.5                     | 0.30                                   |      |           |
|       |         |   |          | 13.02               | 371.1                     | 0.27                                   |      |           | 33.58               | 208.9                     | 0.29                                   |      |           |
|       |         |   |          | 15.30               | 379.6                     | 0.23                                   |      |           | 30.46               | 183.5                     | 0.28                                   |      |           |
|       |         |   |          |                     |                           |  |      |           |                     |                           |  |      |           |
|       |         | 4 | 07/11/08 | 10.36               | 754.2                     | 0.68                                   | 0.60 | 5.8E-02   | 18.45               | 390.5                     | 1.00                                   | 0.96 | 4.2E-02   |
|       |         |   |          | 14.08               | 956.9                     | 0.64                                   |      |           | 13.48               | 283.8                     | 0.99                                   |      |           |
|       |         |   |          | 9.64                | 608.5                     | 0.59                                   |      |           | 15.65               | 325.2                     | 0.98                                   |      |           |
|       |         |   |          | 10.36               | 619.4                     | 0.56                                   |      |           | 15.92               | 313.4                     | 0.93                                   |      |           |
|       |         |   |          | 8.42                | 485.1                     | 0.54                                   |      |           | 12.33               | 236.6                     | 0.90                                   |      |           |
|       |         |   |          |                     |                           |  |      |           |                     |                           |  |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|       |         |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|-------|---------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID    |         | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| OMAHA | GC - CM | 1 | 07/11/08 | 11.42               | 742.4                     | 0.61                                   | 0.52 | 6.5E-02   | 25.23               | 322.5                     | 0.60                                   | 0.58 | 1.4E-02   |
|       |         |   |          | 10.40               | 604.7                     | 0.55                                   |      |           | 23.86               | 297.4                     | 0.59                                   |      |           |
|       |         |   |          | 12.05               | 649.3                     | 0.51                                   |      |           | 18.65               | 231.0                     | 0.58                                   |      |           |
|       |         |   |          | 9.77                | 491.3                     | 0.47                                   |      |           | 20.86               | 252.9                     | 0.57                                   |      |           |
|       |         |   |          | 9.83                | 468.0                     | 0.45                                   |      |           | 23.28               | 279.6                     | 0.56                                   |      |           |
|       |         |   |          | 15.11               | 769.9                     | 0.48                                   |      |           | 24.70               | 407.5                     | 0.78                                   |      |           |
|       |         | 2 | 07/11/08 | 7.05                | 336.3                     | 0.45                                   | 0.43 | 3.8E-02   | 19.80               | 316.1                     | 0.75                                   | 0.74 | 2.6E-02   |
|       |         |   |          | 10.59               | 479.6                     | 0.43                                   |      |           | 24.89               | 381.2                     | 0.72                                   |      |           |
|       |         |   |          | 10.52               | 446.7                     | 0.40                                   |      |           | 19.18               | 298.7                     | 0.73                                   |      |           |
|       |         |   |          | 9.86                | 403.5                     | 0.38                                   |      |           | 20.86               | 314.5                     | 0.71                                   |      |           |
|       |         |   |          | 7.98                | 545.7                     | 0.64                                   |      |           | 23.86               | 372.4                     | 0.73                                   |      |           |
|       |         |   |          | 5.61                | 353.5                     | 0.59                                   |      |           | 22.89               | 350.2                     | 0.72                                   |      |           |
|       |         | 3 | 07/11/08 | 9.02                | 533.3                     | 0.56                                   | 0.56 | 5.8E-02   | 28.21               | 421.3                     | 0.70                                   | 0.71 | 1.9E-02   |
|       |         |   |          | 9.80                | 546.8                     | 0.52                                   |      |           | 27.67               | 404.7                     | 0.69                                   |      |           |
|       |         |   |          | 9.83                | 517.4                     | 0.49                                   |      |           | 22.61               | 351.0                     | 0.73                                   |      |           |
|       |         |   |          | 16.31               | 1079.9                    | 0.62                                   |      |           | 21.46               | 500.7                     | 1.10                                   |      |           |
|       |         |   |          | 6.17                | 376.5                     | 0.57                                   |      |           | 16.02               | 346.2                     | 1.02                                   |      |           |
|       |         |   |          | 8.34                | 484.9                     | 0.55                                   |      |           | 14.09               | 310.8                     | 1.04                                   |      |           |
|       |         | 4 | 07/11/08 | 9.67                | 543.8                     | 0.53                                   | 0.56 | 4.4E-02   | 16.55               | 359.0                     | 1.02                                   | 1.03 | 4.0E-02   |
|       |         |   |          | 10.20               | 551.6                     | 0.51                                   |      |           | 15.78               | 332.2                     | 0.99                                   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|                |          |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|----------------|----------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| Identification |          | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| OMAHA          | GC - A1B | 1 | 07/11/08 | 19.11               | 600.0                     | 0.30                                   | 0.24 | 3.8E-02   | 47.89               | 215.2                     | 0.21                                   | 0.20 | 7.5E-03   |
|                |          |   |          | 14.42               | 394.8                     | 0.26                                   |      |           | 59.36               | 255.1                     | 0.20                                   |      |           |
|                |          |   |          | 14.56               | 366.7                     | 0.24                                   |      |           | 44.30               | 185.5                     | 0.20                                   |      |           |
|                |          |   |          | 15.58               | 357.3                     | 0.22                                   |      |           | 51.58               | 210.8                     | 0.19                                   |      |           |
|                |          |   |          | 15.45               | 325.0                     | 0.20                                   |      |           | 52.11               | 228.2                     | 0.21                                   |      |           |
|                |          | 2 | 07/11/08 | 13.93               | 454.2                     | 0.31                                   | 0.27 | 2.5E-02   | 32.64               | 323.7                     | 0.47                                   | 0.42 | 3.2E-02   |
|                |          |   |          | 12.89               | 391.4                     | 0.29                                   |      |           | 25.11               | 233.4                     | 0.44                                   |      |           |
|                |          |   |          | 18.64               | 530.4                     | 0.27                                   |      |           | 23.11               | 201.6                     | 0.41                                   |      |           |
|                |          |   |          | 11.61               | 314.8                     | 0.25                                   |      |           | 26.90               | 227.9                     | 0.40                                   |      |           |
|                |          |   |          | 11.87               | 308.2                     | 0.24                                   |      |           | 21.15               | 173.3                     | 0.39                                   |      |           |
|                |          | 3 | 07/11/08 | 11.61               | 677.6                     | 0.55                                   | 0.45 | 6.7E-02   | 24.17               | 330.4                     | 0.64                                   | 0.57 | 4.3E-02   |
|                |          |   |          | 9.95                | 506.2                     | 0.48                                   |      |           | 69.08               | 856.6                     | 0.58                                   |      |           |
|                |          |   |          | 9.84                | 455.0                     | 0.43                                   |      |           | 28.81               | 343.3                     | 0.56                                   |      |           |
|                |          |   |          | 7.55                | 329.8                     | 0.41                                   |      |           | 26.92               | 311.3                     | 0.54                                   |      |           |
|                |          |   |          | 9.67                | 384.5                     | 0.37                                   |      |           | 25.64               | 292.1                     | 0.54                                   |      |           |
|                |          | 4 | 07/11/08 | 12.40               | 686.1                     | 0.52                                   | 0.48 | 3.6E-02   | 20.42               | 351.3                     | 0.81                                   | 0.73 | 5.5E-02   |
|                |          |   |          | 8.33                | 450.1                     | 0.51                                   |      |           | 23.28               | 380.2                     | 0.77                                   |      |           |
|                |          |   |          | 11.36               | 585.3                     | 0.48                                   |      |           | 22.18               | 342.4                     | 0.73                                   |      |           |
|                |          |   |          | 14.21               | 679.2                     | 0.45                                   |      |           | 25.37               | 376.4                     | 0.70                                   |      |           |
|                |          |   |          | 9.58                | 444.5                     | 0.44                                   |      |           | 25.05               | 358.4                     | 0.67                                   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|       |          |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |   |      |           |
|-------|----------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|---|------|-----------|
| ID    |          | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permit-tivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| OMAHA | GC - A2B | 1 | 07/11/08 | 15.86               | 521.4                     | 0.31                                   | 0.23 | 5.6E-02   | 23.02               | 204.6                     | 0.42                                    | 0.42 | 1.9E-02   |
|       |          |   |          | 10.52               | 292.8                     | 0.26                                   |      |           | 25.03               | 219.9                     | 0.41                                    |      |           |
|       |          |   |          | 12.77               | 283.9                     | 0.21                                   |      |           | 34.05               | 331.9                     | 0.46                                    |      |           |
|       |          |   |          | 12.80               | 259.9                     | 0.19                                   |      |           | 20.36               | 177.9                     | 0.41                                    |      |           |
|       |          |   |          | 14.48               | 266.9                     | 0.17                                   |      |           | 21.36               | 192.4                     | 0.42                                    |      |           |
|       |          |   |          |                     |                           |  |      |           |                     |                           |   |      |           |
|       |          | 2 | 07/11/08 | 11.45               | 441.9                     | 0.36                                   | 0.32 | 2.9E-02   | 22.45               | 378.6                     | 0.79                                    | 0.71 | 5.7E-02   |
|       |          |   |          | 9.80                | 354.8                     | 0.34                                   |      |           | 20.27               | 323.9                     | 0.75                                    |      |           |
|       |          |   |          | 11.70               | 399.8                     | 0.32                                   |      |           | 24.73               | 367.1                     | 0.70                                    |      |           |
|       |          |   |          | 15.23               | 489.1                     | 0.30                                   |      |           | 34.89               | 501.3                     | 0.68                                    |      |           |
|       |          |   |          | 9.70                | 300.7                     | 0.29                                   |      |           | 15.30               | 212.8                     | 0.65                                    |      |           |
|       |          |   |          |                     |                           |  |      |           |                     |                           |   |      |           |
|       |          | 3 | 07/11/08 | 13.28               | 668.5                     | 0.47                                   | 0.36 | 7.4E-02   | 46.67               | 356.2                     | 0.36                                    | 0.31 | 3.2E-02   |
|       |          |   |          | 8.73                | 366.8                     | 0.40                                   |      |           | 72.48               | 504.7                     | 0.33                                    |      |           |
|       |          |   |          | 9.70                | 360.6                     | 0.35                                   |      |           | 159.80              | 1017.4                    | 0.30                                    |      |           |
|       |          |   |          | 9.67                | 324.5                     | 0.32                                   |      |           | 26.42               | 162.5                     | 0.29                                    |      |           |
|       |          |   |          | 10.68               | 324.0                     | 0.29                                   |      |           | 37.03               | 221.3                     | 0.28                                    |      |           |
|       |          |   |          |                     |                           |  |      |           |                     |                           |   |      |           |
|       |          | 4 | 07/11/08 | 8.78                | 500.0                     | 0.54                                   | 0.48 | 4.7E-02   | 23.36               | 447.6                     | 0.90                                    | 0.81 | 6.3E-02   |
|       |          |   |          | 6.65                | 363.2                     | 0.51                                   |      |           | 21.17               | 381.3                     | 0.85                                    |      |           |
|       |          |   |          | 8.83                | 440.6                     | 0.47                                   |      |           | 21.02               | 362.8                     | 0.81                                    |      |           |
|       |          |   |          | 10.86               | 509.2                     | 0.44                                   |      |           | 16.64               | 273.8                     | 0.77                                    |      |           |
|       |          |   |          | 9.52                | 430.7                     | 0.43                                   |      |           | 19.84               | 312.4                     | 0.74                                    |      |           |
|       |          |   |          |                     |                           |  |      |           |                     |                           |   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|           |          |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|-----------|----------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID        |          | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| UNDERWOOD | GC - CC3 | 1 | 08/07/08 | 13.65               | 462.9                     | 0.32                                   | 0.25 | 5.5E-02   | 30.77               | 625.1                     | 0.96                                   | 0.87 | 1.0E-01   |
|           |          |   |          | 15.89               | 487.8                     | 0.29                                   |      |           | 22.50               | 455.1                     | 0.95                                   |      |           |
|           |          |   |          | 16.14               | 404.2                     | 0.24                                   |      |           | 59.83               | 1154.3                    | 0.91                                   |      |           |
|           |          |   |          | 24.52               | 544.1                     | 0.21                                   |      |           | 24.14               | 431.1                     | 0.84                                   |      |           |
|           |          |   |          | 18.56               | 370.0                     | 0.19                                   |      |           | 25.18               | 382.6                     | 0.71                                   |      |           |
|           |          |   |          | 12.43               | 568.0                     | 0.43                                   |      |           | 27.52               | 240.3                     | 0.41                                   |      |           |
|           |          | 2 | 08/07/08 | 13.14               | 571.0                     | 0.41                                   | 0.37 | 4.7E-02   | 30.09               | 261.5                     | 0.41                                   | 0.40 | 8.0E-03   |
|           |          |   |          | 8.96                | 356.2                     | 0.37                                   |      |           | 28.36               | 245.0                     | 0.41                                   |      |           |
|           |          |   |          | 10.83               | 399.3                     | 0.35                                   |      |           | 44.36               | 373.3                     | 0.40                                   |      |           |
|           |          |   |          | 13.67               | 454.9                     | 0.31                                   |      |           | 45.55               | 380.4                     | 0.39                                   |      |           |
|           |          |   |          | 9.45                | 676.4                     | 0.67                                   |      |           | 44.27               | 987.6                     | 1.05                                   |      |           |
|           |          |   |          | 9.73                | 698.4                     | 0.67                                   |      |           | 22.11               | 473.1                     | 1.01                                   |      |           |
|           |          | 3 | 08/07/08 | 8.92                | 627.2                     | 0.66                                   | 0.65 | 2.8E-02   | 17.14               | 351.3                     | 0.96                                   | 0.98 | 5.2E-02   |
|           |          |   |          | 8.89                | 606.9                     | 0.64                                   |      |           | 19.27               | 388.3                     | 0.95                                   |      |           |
|           |          |   |          | 9.83                | 635.4                     | 0.61                                   |      |           | 17.12               | 333.6                     | 0.92                                   |      |           |
|           |          |   |          | 32.30               | 516.5                     | 0.15                                   |      |           | 16.33               | 356.7                     | 1.03                                   |      |           |
|           |          |   |          | 18.33               | 292.0                     | 0.15                                   |      |           | 14.92               | 314.3                     | 0.99                                   |      |           |
|           |          |   |          | 26.77               | 417.9                     | 0.15                                   |      |           | 18.08               | 381.3                     | 0.99                                   |      |           |
|           |          | 4 | 08/07/08 | 21.71               | 343.4                     | 0.15                                   | 0.15 | 2.2E-03   | 20.20               | 398.7                     | 0.93                                   | 0.97 | 4.2E-02   |
|           |          |   |          | 22.95               | 354.1                     | 0.15                                   |      |           | 16.58               | 329.2                     | 0.93                                   |      |           |



Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|           |          |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|-----------|----------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID        |          | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| UNDERWOOD | GC - CC5 | 1 | 08/07/08 | 6.71                | 441.3                     | 0.62                                   | 0.60 | 2.6E-02   | 29.78               | 760.3                     | 1.20                                   | 1.13 | 4.5E-02   |
|           |          |   |          | 7.48                | 491.3                     | 0.62                                   |      |           | 16.42               | 400.6                     | 1.15                                   |      |           |
|           |          |   |          | 8.80                | 569.9                     | 0.61                                   |      |           | 24.58               | 585.9                     | 1.12                                   |      |           |
|           |          |   |          | 6.83                | 432.4                     | 0.60                                   |      |           | 12.52               | 293.1                     | 1.10                                   |      |           |
|           |          |   |          | 8.70                | 513.2                     | 0.55                                   |      |           | 14.48               | 334.0                     | 1.08                                   |      |           |
|           |          | 2 | 08/07/08 | 6.77                | 485.8                     | 0.67                                   | 0.63 | 4.2E-02   | 19.52               | 335.9                     | 0.81                                   | 0.78 | 1.9E-02   |
|           |          |   |          | 10.77               | 758.6                     | 0.66                                   |      |           | 23.48               | 389.8                     | 0.78                                   |      |           |
|           |          |   |          | 9.61                | 638.0                     | 0.62                                   |      |           | 17.12               | 284.2                     | 0.78                                   |      |           |
|           |          |   |          | 8.05                | 516.1                     | 0.60                                   |      |           | 19.77               | 322.5                     | 0.77                                   |      |           |
|           |          |   |          | 7.58                | 460.9                     | 0.57                                   |      |           | 19.17               | 309.6                     | 0.76                                   |      |           |
|           |          | 3 | 08/07/08 | 7.90                | 412.4                     | 0.49                                   | 0.47 | 2.1E-02   | 23.67               | 433.2                     | 0.86                                   | 0.83 | 3.2E-02   |
|           |          |   |          | 14.68               | 751.2                     | 0.48                                   |      |           | 20.52               | 371.1                     | 0.85                                   |      |           |
|           |          |   |          | 11.33               | 564.8                     | 0.47                                   |      |           | 16.70               | 297.7                     | 0.84                                   |      |           |
|           |          |   |          | 9.64                | 461.6                     | 0.45                                   |      |           | 22.86               | 391.0                     | 0.80                                   |      |           |
|           |          |   |          | 9.11                | 426.5                     | 0.44                                   |      |           | 19.64               | 327.3                     | 0.78                                   |      |           |
|           |          | 4 | 08/07/08 | 9.23                | 787.8                     | 0.80                                   | 0.70 | 8.6E-02   | 22.05               | 370.6                     | 0.79                                   | 0.77 | 2.0E-02   |
|           |          |   |          | 10.83               | 882.7                     | 0.77                                   |      |           | 17.83               | 300.2                     | 0.79                                   |      |           |
|           |          |   |          | 8.40                | 622.4                     | 0.70                                   |      |           | 17.14               | 283.6                     | 0.78                                   |      |           |
|           |          |   |          | 8.68                | 594.5                     | 0.64                                   |      |           | 27.02               | 440.9                     | 0.77                                   |      |           |
|           |          |   |          | 8.14                | 512.2                     | 0.59                                   |      |           | 21.78               | 343.8                     | 0.74                                   |      |           |

Table S2. Permittivity of GDLs (ASTM D 4491) (Continued).

|           |         |   |          | 50 mm constant head |                           |  |      |           | 10 mm constant head |                           |  |      |           |
|-----------|---------|---|----------|---------------------|---------------------------|--|------|-----------|---------------------|---------------------------|--|------|-----------|
| ID        |         | # | Date     | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. | Time (s)            | Volume (cm <sup>3</sup> ) | Permittivity $\psi$ (s <sup>-1</sup> ) | Mean | Std. Dev. |
| UNDERWOOD | GC - ET | 1 | 08/07/08 | 7.53                | 508.7                     | 0.64                                   | 0.53 | 9.3E-02   | 21.08               | 521.4                     | 1.16                                   | 1.13 | 3.4E-02   |
|           |         |   |          | 8.67                | 554.0                     | 0.60                                   |      |           | 11.89               | 282.2                     | 1.12                                   |      |           |
|           |         |   |          | 10.27               | 593.0                     | 0.54                                   |      |           | 15.78               | 366.5                     | 1.09                                   |      |           |
|           |         |   |          | 10.45               | 521.6                     | 0.47                                   |      |           | 16.67               | 412.3                     | 1.16                                   |      |           |
|           |         |   |          | 9.87                | 428.6                     | 0.41                                   |      |           | 17.77               | 415.2                     | 1.10                                   |      |           |
|           |         | 2 | 08/07/08 | 7.73                | 685.8                     | 0.83                                   | 0.77 | 5.6E-02   | 40.05               | 744.0                     | 0.87                                   | 0.74 | 1.1E-01   |
|           |         |   |          | 7.64                | 660.2                     | 0.81                                   |      |           | 25.77               | 445.3                     | 0.81                                   |      |           |
|           |         |   |          | 8.27                | 691.2                     | 0.79                                   |      |           | 22.42               | 361.2                     | 0.76                                   |      |           |
|           |         |   |          | 7.52                | 592.1                     | 0.74                                   |      |           | 21.52               | 297.4                     | 0.65                                   |      |           |
|           |         |   |          | 10.23               | 757.0                     | 0.70                                   |      |           | 24.02               | 315.2                     | 0.62                                   |      |           |
|           |         | 3 | 08/07/08 | 10.83               | 618.3                     | 0.54                                   | 0.52 | 1.9E-02   | 23.95               | 594.4                     | 1.17                                   | 1.08 | 5.6E-02   |
|           |         |   |          | 10.20               | 580.4                     | 0.54                                   |      |           | 16.77               | 392.8                     | 1.10                                   |      |           |
|           |         |   |          | 7.30                | 407.8                     | 0.53                                   |      |           | 16.83               | 385.1                     | 1.08                                   |      |           |
|           |         |   |          | 9.87                | 530.4                     | 0.51                                   |      |           | 14.83               | 327.6                     | 1.04                                   |      |           |
|           |         |   |          | 9.58                | 501.8                     | 0.49                                   |      |           | 16.67               | 364.1                     | 1.03                                   |      |           |
|           |         | 4 | 08/07/08 | 14.31               | 1172.7                    | 0.77                                   | 0.70 | 6.9E-02   | 30.52               | 545.8                     | 0.84                                   | 1.00 | 1.9E-01   |
|           |         |   |          | 5.73                | 465.2                     | 0.76                                   |      |           | 68.45               | 1106.4                    | 0.76                                   |      |           |
|           |         |   |          | 8.73                | 650.5                     | 0.70                                   |      |           | 20.14               | 495.6                     | 1.16                                   |      |           |
|           |         |   |          | 17.05               | 1179.0                    | 0.65                                   |      |           | 13.11               | 317.8                     | 1.14                                   |      |           |
|           |         |   |          | 7.77                | 505.6                     | 0.61                                   |      |           | 11.67               | 274.4                     | 1.11                                   |      |           |

Table S3. Ply adhesion (N/m) of GDLs (ASTM D 7005).

|   | APPLE VALLEY        |      |                  |      | ALTAMONT           |      |
|---|---------------------|------|------------------|------|--------------------|------|
|   | Composite Lys. Base |      | Clay-Lys. Base-1 |      | CMP-GC3            |      |
|   | A                   | B    | A                | B    | A                  | B    |
| 1 | 241                 | 276  | 314              | 388  | 935                | 844  |
| 2 | 383                 | 228  | 312              | 298  | 1168               | 694  |
| 3 | 312                 | 399  | 392              | 274  | 548                | 686  |
| 4 | 325                 | 435  | 378              | 423  | 742                | 976  |
| 5 | 465                 | 438  | 302              | 387  | 564                | 1179 |
|   | BOARDMAN            |      |                  |      |                    |      |
|   | Composite 1 Upper   |      | Thin Cover       |      | Thick Cover 3      |      |
|   | A                   | B    | A                | B    | A                  | B    |
| 1 | 1199                | 1107 | 762              | 1038 | 870                | 947  |
| 2 | 873                 | 796  | 771              | 795  | 724                | 833  |
| 3 | 563                 | 266  | 769              | 755  | 719                | 610  |
| 4 | 288                 | 451  | 696              | 838  | 871                | 779  |
| 5 | 219                 | 763  | 757              | 652  | 576                | 769  |
|   | CEDAR RAPIDS        |      |                  |      |                    |      |
|   | Clay Bottom 1       |      | Composite Bottom |      | Bottom Composite 4 |      |
|   | A                   | B    | A                | B    | A                  | B    |
| 1 | 311                 | 688  | 309              | 276  | 148                | 237  |
| 2 | 293                 | 611  | 330              | 302  | 265                | 142  |
| 3 | 269                 | 522  | 164              | 245  | 223                | 198  |
| 4 | 547                 | 286  | 166              | 283  | 265                | 258  |
| 5 | 471                 | 243  | 172              | 220  | 155                | 219  |
|   | EAU CLAIRE          |      |                  |      |                    |      |
|   | TP1-GC-1            |      | TP1-GC-2         |      | TP1-GC-3           |      |
|   | A                   | B    | A                | B    | A                  | B    |
| 1 | 374                 | -    | 287              | 309  | 228                | 204  |
| 2 | 48                  | -    | 379              | 321  | 222                | 190  |
| 3 | 240                 | 32   | 363              | 428  | 200                | 105  |
| 4 | -                   | -    | 387              | 305  | 124                | 223  |
| 5 | 31                  | 294  | 292              | 373  | 47                 | 238  |

\* All results are in N/m.

\* A and B represent a randomly assigned top and bottom of the sample.

Table S3. Ply adhesion (N/m) of GDLs (ASTM D 7005) (Continued).

|   | EAU CLAIRE |     |          |     |          |     |
|---|------------|-----|----------|-----|----------|-----|
|   | TP2-GC-1   |     | TP2-GC-2 |     | TP2-GC-3 |     |
|   | A          | B   | A        | B   | A        | B   |
| 1 | 439        | 479 | 409      | 767 | 384      | 414 |
| 2 | 505        | 413 | 622      | 322 | 470      | 354 |
| 3 | 575        | 438 | 249      | 850 | 543      | 283 |
| 4 | 538        | 438 | 751      | 260 | 467      | 568 |
| 5 | 693        | 398 | 136      | 726 | 356      | 486 |
|   | EAU CLAIRE |     |          |     |          |     |
|   | TP3-GC-1   |     | TP3-GC-2 |     | TP3-GC-3 |     |
|   | A          | B   | A        | B   | A        | B   |
| 1 | 453        | 331 | 647      | 383 | 316      | 487 |
| 2 | 540        | 454 | 694      | 431 | 442      | 438 |
| 3 | 500        | 494 | 516      | 485 | 601      | 359 |
| 4 | 327        | 401 | 354      | 527 | 607      | 411 |
| 5 | 372        | 516 | 362      | 474 | 551      | 476 |
|   | EAU CLAIRE |     |          |     |          |     |
|   | TP3-GC-4   |     | TP4-GC-1 |     | TP4-GC-2 |     |
|   | A          | B   | A        | B   | A        | B   |
| 1 | 130        | 371 | 593      | 986 | 514      | 490 |
| 2 | 297        | 329 | 973      | 231 | 418      | 524 |
| 3 | 179        | 154 | 686      | 156 | 424      | 318 |
| 4 | 243        | 336 | 414      | 787 | 701      | 428 |
| 5 | 409        | 221 | 241      | 735 | 637      | 356 |
|   | EAU CLAIRE |     |          |     | HELENA   |     |
|   | TP4-GC-3   |     | TP4-GC-4 |     | GC-AB1   |     |
|   | A          | B   | A        | B   | A        | B   |
| 1 | 639        | 640 | 600      | 484 | 171      | 703 |
| 2 | 638        | 397 | 685      | 506 | 109      | 779 |
| 3 | 536        | 848 | 485      | 464 | 1053     | 251 |
| 4 | 561        | 362 | 520      | 535 | 965      | 724 |
| 5 | 648        | 421 | 495      | 404 | 71       | 872 |

\* All results are in N/m.

\* A and B represent a randomly assigned top and bottom of the sample.

Table S3. Ply adhesion (N/m) of GDLs (ASTM D 7005) (Continued).

|   | OMAHA     |     |        |     |        |      |
|---|-----------|-----|--------|-----|--------|------|
|   | GC-CB     |     | GC-A1B |     | GC-A2B |      |
|   | A         | B   | A      | B   | A      | B    |
| 1 | 297       | 216 | 337    | 514 | 312    | 124  |
| 2 | 322       | 226 | 472    | 308 | 395    | 254  |
| 3 | 193       | 287 | 398    | 444 | 260    | 365  |
| 4 | 345       | 217 | 362    | 562 | 415    | 266  |
| 5 | 336       | 218 | 504    | 562 | 359    | 129  |
|   | UNDERWOOD |     |        |     |        |      |
|   | GC-CC3    |     | GC-CC5 |     | GC-ET  |      |
|   | A         | B   | A      | B   | A      | B    |
| 1 | 666       | 338 | 356    | 533 | 1178   | 2065 |
| 2 | 101       | 725 | 270    | 548 | 1532   | 1234 |
| 3 | 533       | 665 | 858    | 379 | 1466   | 1595 |
| 4 | 792       | 962 | 909    | 347 | 1206   | 1252 |
| 5 | 658       | 391 | 647    | 191 | 1095   | 1609 |

\* All results are in N/m.

\* A and B represent a randomly assigned top and bottom of the sample.

|  |  |   |  |   |              |
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| <b>11. ABSTRACT</b> (200 words or less)<br><br>This study demonstrates that engineering properties of cover soils change while in service and that long-term engineering properties should be used as input to models employed for performance assessments. Recommendations for appropriate input are made based on the data that were collected. Increases in the saturated hydraulic conductivity, saturated volumetric water content, and the air entry suction (as characterized by van Genuchten's alpha parameter) occurred due to formation of soil structure, regardless of climate, cover design, or service life. Substantial changes in hydraulic conductivity were observed in some geosynthetic clay liners (GCLs) that did not hydrate completely and underwent cation exchange. Changes in geomembranes and geosynthetic drainage layers were modest or small, and computations based on antioxidant depletion rates suggest that the minimum service life of geomembranes is in the order of 50-125 years (the actual service life will be longer). The findings indicate that covers should be monitored to ensure that they are functioning as intended. Monitoring using pan lysimeters combined with secondary measurements collected for interpretive purposes is recommended. Future research investments should include an evaluation of remote sensing technologies for cover monitoring and analog studies to estimate properties of earthen and geosynthetic cover materials corresponding to service lives of 100s to 1000s of years. |  |   |  |   |              |
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