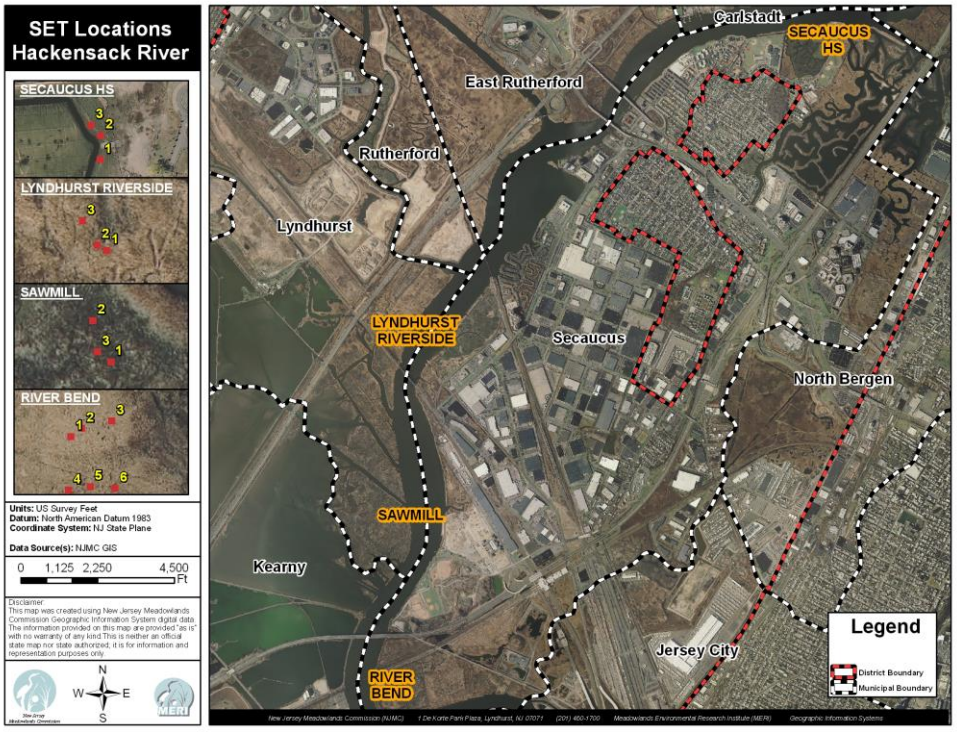
Measuring Elevation Change in Meadowlands Marshes Using Surface Elevation Tables (SETs) and Marker Horizons

Meadowlands Environmental Research Institute (May, 2011)

The surface elevation table (SET) provides a constant plane in space from which the distance to a marsh surface can be measured by means of pins lowered to the surface (USGS 2010). During August of 2008, at five locations in the lower Hackensack River Meadowlands, benchmark rods were established, marker horizons of feldspar were emplaced and baseline readings were taken. Periodic monitoring will determine rates of accretion in marsh areas, and track and compare both shallow and deep subsidence. Each site was revisited and readings were taken in the Spring of 2011. This report is a summary of those measurements.

Figure 1: Study Area



Locations were chosen to span several miles of tidal wetlands and represent different vegetation and marsh regimes. The five sites selected include a restored *Spartina alterniflora* low marsh (SHS), a *Spartina alterniflora* high marsh (SM), a *Spartina patens* dominated high marsh (RBP), a mixed *Spartina patens* and *Phragmites australis* high marsh (RBM) and a *Phragmites australis* dominated high marsh (LR). At each site, three replicate plots were installed. At each plot, nine pins are lowered to the marsh surface. Readings are taken in each of four directions resulting in a total of 108 measurements for each site. At the time of each subsequent reading, results obtained from each pin are compared. The average of the resulting differences becomes one data point that represents the level of the marsh surface elevation.

Table 1: Time Elapsed Between Readings

Location	Initial Date	Subsequent Date	Days	Years
RBP and RBM	8/26/2008	5/3/2011	980	2.68
SM	8/28/2008	5/5/2011	980	2.68
LR	8/29/2008	5/5/2011	979	2.68
SHS	8/28/2008	5/9/2011	991	2.72

Table 1 provides the dates for each reading and the time elapsed in days and years

Table 2: SETs Locations and Measurements – Spring 2011 sampling

SETs Locations				
Location		Marsh Type	DominantVegetation	Rate of Elevation Change from 2008 (mm/yr)
RBP	Riverbend Patens	High Marsh	*Spartina patens*	6.02
RBM	Riverbend Mixed	High Marsh	*Phragmites australis / Spartina patens*	7.58
SM	Sawmill	High Marsh	*Spartina alterniflora*	5.51
LR	Lyndhurst Riverside	High Marsh	*Phragmites australis*	6.38
SHS	Secaucus HS	Low Marsh	*Spartina alterniflora*	5.00

Table 2a: Average Elevation Change (mm)

Riverbend High Marsh	
All Platforms	16.18
Std Error	2.61
RB-1	21.36
Std Error	4.44
RB-2	14.08
Std Error	1.20
RB-3	13.08
Std Error	4.04
RB-1 pos 1	25.67
RB-1 pos 3	28.33
RB-1 pos 5	23.00
RB-1 pos 7	8.44
RB-2 pos 1	14.89
RB-2 pos 3	11.44
RB-2 pos 5	13.00
RB-2 pos 7	17.00
RB-3 pos 1	20.22
RB-3 pos 3	5.22
RB-3 pos 5	7.00
RB-3 pos 7	19.89

Riverbend Mixed Marsh	
All Platforms	20.35
Std Error	4.09
RB-4	21.47
Std Error	3.31
RB-5	26.81
Std Error	3.08
RB-6	12.78
Std Error	4.52
RB-4 pos 1	22.89
RB-4 pos 3	12.44
RB-4 pos 5	22.22
RB-4 pos 7	28.33
RB-5 pos 2	23.33
RB-5 pos 4	23.22
RB-5 pos 6	24.67
RB-5 pos 8	36.00
RB-6 pos 2	11.00
RB-6 pos 4	11.00
RB-6 pos 6	25.33
RB-6 pos 8	3.78

Sawmill	
All Platforms	14.79
Std Error	3.81
SM-1	22.06
Std Error	10.30
SM-2	13.11
Std Error	4.63
SM-3	9.19
Std Error	13.06
SM-1 pos 2	-4.11
SM-1 pos 4	26.22
SM-1 pos 6	20.22
SM-1 pos 8	45.89
SM-2 pos 1	4.00
SM-2 pos 3	15.56
SM-2 pos 5	7.89
SM-2 pos 7	25.00
SM-3 pos 1	32.56
SM-3 pos 3	1.33
SM-3 pos 5	-24.22
SM-3 pos 7	27.11

Lyndhurst Riverside	
All Platforms	17.12
Std Error	6.05
LR-1	13.89
Std Error	7.46
LR-2	8.64
Std Error	4.75
LR-3	28.83
Std Error	6.82
LR-1 pos 1	15.00
LR-1 pos 3	-6.11
LR-1 pos 5	30.00
LR-1 pos 7	16.67
LR-2 pos 1	13.33
LR-2 pos 3	-1.11
LR-2 pos 5	2.78
LR-2 pos 7	19.56
LR-3 pos 1	12.89
LR-3 pos 3	36.33
LR-3 pos 5	43.33
LR-3 pos 7	22.78

Secaucus HS	
All Platforms	13.56
Std Error	12.02
SHS-1	23.8
Std Error	3.66
SHS-2	-10.39
Std Error	4.96
SHS-3	27.3
Std Error	5.3
SHS-1 pos 1	24.0
SHS-1 pos 3	32.2
SHS-1 pos 5	14.3
SHS-1 pos 7	24.44
SHS-2 pos 2	-4.22
SHS-2 pos 4	-21.4
SHS-2 pos 6	-0.11
SHS-2 pos 8	-15.78
SHS-3 pos 2	18.6
SHS-3 pos 4	18.1
SHS-3 pos 6	33.9
SHS-3 pos 8	38.78

The above two tables, Tables 2 and 2A, are summaries of the changes in elevation measured at each location. The complete data set is found in Appendices at the end of the report.

The complete data set for elevation is found in appendices at the end of the report. Values ranged from a subsidence rate of 5.00 mm/yr at Secaucus HS to a maximum rise in elevation of 7.58 mm/yr at the Riverbend Mixed site. All of the sites have around the same increases in elevation. Secaucus and Sawmill sites have erosion problems which explain the lower rates of increase.

Table 3: Feldspar Horizon Measurements 2009/2011

Site	Positive Accretion (Percent)	Accretion Rate (mm/yr)
Riverbend Patens	100	6.0
Riverbend Mixed	100	8.0
Sawmill	89	13.0
Lyndhurst Riverside	100	4.0
Secaucus HS	67	4.0

Table 3a: Average Accretion (mm) – Spring 2011 sampling

Riverbend Patens	
All Platforms	1.64
Std Error	0.16
RB-1	1.77
Std Error	0.50
RB-2	1.33
Std Error	0.38
RB-3	1.83
Std Error	0.75
RB-1	
A	2.3
B	2.0
C	1.0
RB-2	
A	1.0
B	0.9
C	2.1
RB-3	
A	2.5
B	1.0
C	2.0

Riverbend Mixed	
All Platforms	2.07
Std Error	0.12
RB-4	1.97
Std Error	0.15
RB-5	1.93
Std Error	0.43
RB-6	2.30
Std Error	0.10
RB-4	
A	1.8
B	2.2
C	1.9
RB-5	
A	2.8
B	1.5
C	1.5
RB-6	
A	2.2
B	2.4
C	2.3

Sawmill	
All Platforms	3.56
Std Error	0.15
SM-1	3.83
Std Error	0.44
SM-2	3.50
Std Error	0.29
SM-3	3.33
Std Error	1.67
SM-1	
A	3.0
B	4.5
C	4.0
SM-2	
A	3.0
B	3.5
C	4.0
SM-3	
A	5.0
B	0.0
C	5.0

Table 3a (Cont.): Average Accretion (mm)

Lyndhurst Riverside	
All Platforms	1.10
Std Error	0.08
LR-1	0.93
Std Error	0.40
LR-2	1.17
Std Error	0.09
LR-3	1.20
Std Error	0.10
LR-1	
A	1.0
B	1.3
C	0.5
LR-2	
A	1.3
B	1.2
C	1.0
LR-3	
A	1.0
B	1.2
C	1.4

Secaucus HS	
All Platforms	1.19
Std Error	0.33
SHS-1	1.00
Std Error	1.50
SHS-2	1.83
Std Error	0.97
SHS-3	0.75
Std Error	0.25
SHS-1	
A	0.0
B	0.0
C	3.0
SHS-2	
A	2.2
B	0.0
C	3.3
SHS-3	
A	0.5
B	1.0
C	2.5

Tables 3 and 3a are summaries of the accretion measured by use of feldspar horizons emplaced at each benchmark location

Feldspar horizons were emplaced inside three corners of each benchmark plot. The sediment between the white feldspar marker and the horizon is measured. One reading is taken at each of the three corners resulting in a total of nine values associated with each marsh; the average of all readings produces a summary value (Table 3). Not all horizons produced recognizable accretion; it is possible that the feldspar can not be found and will need to be replaced and a new data set generated. Where negligible material accumulated above the horizon, "0.0 accretion" is designated. All recoverable values are included in the calculation for accretion rate.

To obtain a yearly rate, this value is divided by the number of days that have elapsed between establishment of the benchmark and the subsequent reading. Approximately two and a half years elapsed between the readings summarized in this report. Table 3 provides the dates for each reading and the time elapsed in days and years.

Table 4: Elevation Rate and Accretion Rate values – Fall 2008 to Spring 2011

Riverbend High Marsh				
Days	**0**	**632**	**819**	**980**
Sample Date	**8/26/2008**	**5/20/2010**	**11/23/2010**	**5/3/2011**
Elevation Rate mm/yr	0.00	2.48	6.13	6.02
Accretion Rate mm/yr	0.00	0.00	5.35	6.12

Riverbend Mixed Marsh				
Days	**0**	**632**	**819**	**980**
Sample Date	**8/26/2008**	**5/20/2010**	**11/23/2010**	**5/3/2011**
Elevation Rate mm/yr	0.00	5.96	7.25	7.58
Accretion Rate mm/yr	0.00	0.00	5.45	7.70

Sawmill				
Days	**0**	**631**	**813**	**980**
Sample Date	**8/28/2008**	**5/21/2010**	**11/19/2010**	**5/5/2011**
Elevation Rate mm/yr	0.00	-4.66	6.60	5.51
Accretion Rate mm/yr	0.00	0.00	7.70	13.20

Lyndhurst Reserve				
Days	**0**	**630**	**811**	**979**
Sample Date	**8/29/2008**	**5/21/2010**	**11/18/2010**	**5/5/2011**
Elevation Rate mm/yr	0.00	8.79	9.63	6.38
Accretion Rate mm/yr	0.00	2.74	4.63	4.10

Secaucus HS				
Days	**0**	**609**	**810**	**984**
Sample Date	**8/28/2008**	**4/29/2010**	**11/16/2010**	**5/9/2011**
Elevation Rate mm/yr	0.00	13.28	6.71	5.00
Accretion Rate mm/yr	0.00	2.74	5.26	4.43

Table 4 shows the yearly elevation and accretion rate for every sampling event.

Table 5: Marsh Processes (USGS 2010)

2010)SURFACE PROCESSES:
1) Sediment deposition
2) Sediment erosion
SUBSURFACE PROCESSES:
3) Root Growth
4) Decomposition
5) Porewater Flux
6) Compaction

Table 5 explains both surface and subsurface interactions (USGS, 2010).

Discussion

Elevation change measured by the SET is influenced by both surface and subsurface processes occurring within the soil profile (USGS 2010). The marker horizons reveal surface processes only. One can surmise the relative contribution of these processes by looking at the difference between the rates obtained by each.

Like the results of the spring and fall of 2010, both of the sites with *Phragmites australis* (Riverbend mixed and Lyndhurst Riverside) show the highest change in elevation. This is possibly due to the large decomposition of *Phragmites australis* on the marsh surface and the growth of the large root beds under the marsh surface.

The negative elevation change at site SHS-2 is most likely due to erosion. (Table 2a) This is further justified by the fact that only 67% of the sites at SHS-2 displayed positive accretion values. (Table 3a) With the exception of Riverbed mixed marsh, the rates of elevation change have decreased throughout all of the sites from November 2010 to May 2011. (Table 4) This is due to the compaction of the surface from ice as well as the lack of growth over the winter months.

While it is tempting to try to draw conclusions from this data set, one must acknowledge that marsh sediment processes take place slowly over long periods of time. To quote Jim Lynch, USGS SETs methodology expert, "…It will take a long time to get enough data to see what's going on."(2010, personal communication).

Conclusions

The installation of the surface elevation tables and feldspar horizons provides an accurate method for determining changes in the marshes of the Hackensack River. The data derived during the period covered in this report suggest surface and subsurface processes are at work; and the two methods indicate the relative contribution of each. The data also shows that there are seasonal effects on the surfaces of the marsh which cause changes in the readings. A longer timescale is necessary to confirm these initial observations.

References

Cahoon, D., Reed, D., Day, J Jr. 1995. Estimating shallow subsidence in microtidal salt marshes of the southeastern United States: Kaye and Barghoorn revisited. Marine Geology 128, 1-9.

Lynch, J. 2010. USGS Patuxent Wildlife Research Center, Personal Communication.

Roman, C.T., J.W. King, D.R. Cahoon, J.C. Lynch, and P.G. Appleby. July 2007. Evaluation of marsh development processes at Fire Island National Seashore (New York): recent and historic perspectives. Technical Report NPS/NER/NRTR – 2007/089. National Park Service, Boston, MA.

USGS 2010. SET Concepts and Theory, url: http://www.pwrc.usgs.gov/set/theory.html#mh Patuxent Wildlife Research Center.

Weis, P., Barrett, K, Proctor, T., and Bopp, R. 2005. Studies of a contaminated brackish marsh in the Hackensack Meadowlands of northeastern New Jersey: An assessment of natural recovery. Marine Pollution Bulletin 50, 1405–1415.

Appendix 1: Riverbend Patens Surface Elevation Table Readings (mm)

RB-1					RB-2					RB-3				
Position	Pin	8/26/2008	5/3/2011	Difference	Position	Pin	8/26/2008	5/3/2011	Difference	Position	Pin	8/26/2008	5/3/2011	Difference
1	1	197	239	42	1	1	145	154	9	1	1	192	221	29
	2	227	246	19		2	150	164	14		2	179	201	22
	3	213	252	39		3	157	164	7		3	180	198	18
	4	230	246	16		4	159	172	13		4	188	185	-3
	5	228	248	20		5	160	170	10		5	174	183	9
	6	222	253	31		6	160	175	15		6	177	212	35
	7	208	235	27		7	163	176	13		7	164	186	22
	8	226	254	28		8	161	190	29		8	158	171	13
	9	232	241	9		9	150	174	24		9	161	198	37
3	1	201	240	39	3	1	158	156	-2	3	1	167	174	7
	2	203	241	38		2	155	170	15		2	196	197	1
	3	211	243	32		3	157	169	12		3	175	193	18
	4	218	246	28		4	143	162	19		4	182	185	3
	5	202	242	40		5	160	164	4		5	180	199	19
	6	220	243	23		6	162	175	13		6	192	187	-5
	7	221	234	13		7	160	178	18		7	173	177	4
	8	223	240	17		8	165	171	6		8	191	189	-2
	9	214	239	25		9	166	184	18		9	191	193	2
5	1	215	239	24	5	1	162	175	13	5	1	187	209	22
	2	208	243	35		2	165	172	7		2	195	214	19
	3	214	248	34		3	157	168	11		3	195	195	0
	4	208	235	27		4	158	163	5		4	204	191	-13
	5	216	226	10		5	155	180	25		5	193	201	8
	6	221	246	25		6	161	182	21		6	199	201	2
	7	219	241	22		7	143	160	17		7	200	197	-3
	8	216	244	28		8	161	170	9		8	185	190	5
	9	227	229	2		9	165	174	9		9	152	175	23
7	1	216	230	14	7	1	160	170	10	7	1	130	170	40
	2	213	236	23		2	154	181	27		2	178	192	14
	3	215	219	4		3	156	175	19		3	179	198	19
	4	216	227	11		4	155	171	16		4	195	205	10
	5	221	215	-6		5	156	173	17		5	176	195	19
	6	216	224	8		6	155	169	14		6	193	203	10
	7	212	217	5		7	154	164	10		7	195	213	18
	8	217	222	5		8	153	172	19		8	192	213	21
	9	212	224	12		9	151	172	21		9	191	219	28

Appendix 2: Riverbend Mixed Surface Elevation Table Readings (mm)

RB-4					RB-5					RB-6				
Position	Pin	8/26/2008	5/3/2011	Difference	Position	Pin	8/26/2008	5/3/2011	Difference	Position	Pin	8/26/2008	5/3/2011	Difference
1	1	196	211	15	2	1	148	170	22	2	1	180	185	5
	2	196	196	0		2	136	150	14		2	189	192	3
	3	100	220	120		3	146	169	23		3	186	189	3
	4	196	208	12		4	164	149	-15		4	177	157	-20
	5	186	213	27		5	161	171	10		5	185	193	8
	6	206	207	1		6	106	172	66		6	181	195	14
	7	212	216	4		7	136	170	34		7	189	202	13
	8	190	201	11		8	155	193	38		8	178	204	26
	9	180	196	16		9	149	167	18		9	149	196	47
3	1	190	200	10	4	1	153	148	-5	4	1	173	186	13
	2	192	202	10		2	137	169	32		2	182	196	14
	3	196	215	19		3	134	184	50		3	168	193	25
	4	194	211	17		4	140	158	18		4	177	197	20
	5	183	204	21		5	141	186	45		5	176	178	2
	6	193	195	2		6	160	187	27		6	185	180	-5
	7	198	195	-3		7	159	172	13		7	181	176	-5
	8	190	209	19		8	144	174	30		8	192	202	10
	9	190	207	17		9	149	148	-1		9	187	212	25
5	1	198	232	34	6	1	141	179	38	6	1	178	173	-5
	2	172	221	49		2	164	168	4		2	176	179	3
	3	195	215	20		3	149	182	33		3	149	199	50
	4	189	209	20		4	163	189	26		4	154	196	42
	5	198	218	20		5	162	202	40		5	151	187	36
	6	204	234	30		6	160	189	29		6	161	190	29
	7	209	221	12		7	162	183	21		7	168	195	27
	8	208	225	17		8	176	184	8		8	178	192	14
	9	177	175	-2		9	170	193	23		9	148	180	32
7	1	193	230	37	8	1	138	152	14	8	1	134	156	22
	2	203	219	16		2	142	152	10		2	161	163	2
	3	201	229	28		3	145	178	33		3	163	176	13
	4	197	225	28		4	68	172	104		4	178	157	-21
	5	201	236	35		5	126	160	34		5	175	191	16
	6	202	238	36		6	141	162	21		6	191	202	11
	7	199	222	23		7	139	172	33		7	192	196	4
	8	190	222	32		8	120	159	39		8	193	186	-7
	9	203	223	20		9	124	160	36		9	188	182	-6

Appendix 3: Sawmill Surface Elevation Table Readings (mm)

SM-1					SM-2					SM-3				
Position	Pin	8/28/2008	5/5/2011	Difference	Position	Pin	8/28/2008	5/5/2011	Difference	Position	Pin	8/28/2008	5/5/2011	Difference
2	1	171	174	3	1	1	119	170	51	1	1	205	182	-23
	2	178	188	10		2	114	120	6		2	176	242	66
	3	170	197	27		3	145	130	-15		3	196	227	31
	4	172	199	27		4	162	139	-23		4	175	227	52
	5	144	162	18		5	152	125	-27		5	206	237	31
	6	234	155	-79		6	152	150	-2		6	219	255	36
	7	169	138	-31		7	117	119	2		7	205	236	31
	8	182	174	-8		8	144	146	2		8	207	254	47
	9	202	198	-4		9	135	177	42		9	238	260	22
4	1	70	150	80	3	1	149	154	5	3	1	218	182	-36
	2	127	120	-7		2	135	145	10		2	203	192	-11
	3	127	164	37		3	85	121	36		3	200	234	34
	4	155	144	-11		4	111	111	0		4	213	177	-36
	5	160	151	-9		5	91	147	56		5	240	223	-17
	6	156	184	28		6	140	198	58		6	226	221	-5
	7	161	206	45		7	150	139	-11		7	203	213	10
	8	166	210	44		8	153	145	-8		8	222	268	46
	9	167	196	29		9	140	134	-6		9	203	230	27
6	1	164	151	-13	5	1	156	148	-8	5	1	230	211	-19
	2	35	125	90		2	150	177	27		2	215	183	-32
	3	149	149	0		3	145	188	43		3	215	212	-3
	4	146	156	10		4	156	155	-1		4	218	171	-47
	5	109	149	40		5	143	156	13		5	225	208	-17
	6	134	135	1		6	157	164	7		6	225	172	-53
	7	151	129	-22		7	175	173	-2		7	215	181	-34
	8	121	151	30		8	176	172	-4		8	216	210	-6
	9	130	176	46		9	160	156	-4		9	228	221	-7
8	1	155	190	35	7	1	115	151	36	7	1	232	229	-3
	2	172	219	47		2	92	105	13		2	226	224	-2
	3	153	212	59		3	100	125	25		3	205	211	6
	4	122	177	55		4	132	140	8		4	167	236	69
	5	57	115	58		5	107	132	25		5	210	234	24
	6	129	152	23		6	116	185	69		6	185	223	38
	7	50	136	86		7	164	175	11		7	200	205	5
	8	146	188	42		8	144	151	7		8	206	226	20
	9	187	195	8		9	155	186	31		9	147	234	87

Appendix 4: Lyndhurst Riverside Surface Elevation Table Readings (mm)

LR-1					LR-2					LR-3				
Position	Pin	8/29/2008	5/5/2011	Difference	Position	Pin	8/29/2008	5/5/2011	Difference	Position	Pin	8/29/2008	5/5/2011	Difference
1	1	218	252	34	1	1	116	119	3	1	1	226	232	6
	2	241	224	-17		2	90	129	39		2	219	225	6
	3	244	245	1		3	55	109	54		3	219	225	6
	4	248	250	2		4	64	98	34		4	215	216	1
	5	231	250	19		5	103	109	6		5	183	222	39
	6	223	238	15		6	114	122	8		6	234	231	-3
	7	239	244	5		7	113	125	12		7	208	243	35
	8	228	256	28		8	188	154	-34		8	225	246	21
	9	217	265	48		9	168	166	-2		9	215	220	5
3	1	234	256	22	3	1	175	158	-17	3	1	162	193	31
	2	210	207	-3		2	179	160	-19		2	193	186	-7
	3	237	234	-3		3	102	159	57		3	184	200	16
	4	233	235	2		4	137	128	-9		4	118	159	41
	5	242	242	0		5	150	133	-17		5	153	190	37
	6	236	230	-6		6	82	125	43		6	137	180	43
	7	258	225	-33		7	125	130	5		7	138	215	77
	8	230	227	-3		8	185	155	-30		8	145	141	-4
	9	225	194	-31		9	207	184	-23		9	95	188	93
5	1	122	194	72	5	1	190	166	-24	5	1	195	180	-15
	2	182	226	44		2	150	153	3		2	174	160	-14
	3	210	236	26		3	166	140	-26		3	134	173	39
	4	151	246	95		4	135	145	10		4	145	179	34
	5	210	213	3		5	137	155	18		5	72	181	109
	6	224	209	-15		6	148	140	-8		6	120	169	49
	7	208	218	10		7	145	159	14		7	97	181	84
	8	206	228	22		8	122	160	38		8	131	170	39
	9	197	210	13		9	130	130	0		9	114	179	65
7	1	212	224	12	7	1	135	139	4	7	1	165	206	41
	2	219	215	-4		2	123	140	17		2	175	223	48
	3	213	216	3		3	135	152	17		3	222	224	2
	4	211	226	15		4	116	139	23		4	216	220	4
	5	200	235	35		5	100	136	36		5	205	226	21
	6	205	234	29		6	98	122	24		6	220	254	34
	7	207	222	15		7	110	135	25		7	169	226	57
	8	227	230	3		8	115	134	19		8	199	188	-11
	9	190	232	42		9	115	126	11		9	196	205	9

Appendix 5: Secaucus HS Surface Elevation Table Readings (mm)

	SHS-1				SHS-2					SHS-3				
Position	Pin	8/28/2008	5/9/2011	Difference	Position	Pin	8/28/2008	5/9/2011	Difference	Position	Pin	8/21/2008	5/9/2011	Difference
1	1	154	237	83	2	1	122	118	-4	2	1	177	185	8
	2	158	181	23		2	90	125	35		2	165	178	13
	3	172	180	8		3	174	113	-61		3	160	180	20
	4	160	228	68		4	164	122	-42		4	168	185	17
	5	183	182	-1		5	127	138	11		5	160	176	16
	6	172	183	11		6	155	124	-31		6	170	176	6
	7	178	181	3		7	147	130	-17		7	165	191	26
	8	170	165	-5		8	90	145	55		8	170	180	10
	9	150	176	26		9	136	152	16		9	130	181	51
3	1	142	200	58	4	1	141	126	-15	4	1	182	195	13
	2	127	180	53		2	144	125	-19		2	175	199	24
	3	134	178	44		3	156	114	-42		3	174	192	18
	4	165	215	50		4	132	119	-13		4	165	207	42
	5	176	190	14		5	130	121	-9		5	175	194	19
	6	156	172	16		6	135	103	-32		6	174	200	26
	7	148	186	38		7	116	93	-23		7	175	177	2
	8	167	174	7		8	118	94	-24		8	177	184	7
	9	163	173	10		9	120	104	-16		9	175	187	12
5	1	170	176	6	6	1	146	145	-1	6	1	180	185	5
	2	173	173	0		2	145	168	23		2	149	180	31
	3	171	166	-5		3	152	152	0		3	155	189	34
	4	178	167	-11		4	150	154	4		4	174	175	1
	5	181	171	-10		5	156	136	-20		5	160	182	22
	6	165	191	26		6	155	134	-21		6	135	194	59
	7	182	214	32		7	140	134	-6		7	135	194	59
	8	185	226	41		8	120	126	6		8	148	205	57
	9	180	230	50		9	114	128	14		9	170	207	37
7	1	187	193	6	8	1	129	157	28	8	1	191	212	21
	2	183	245	62		2	187	148	-39		2	175	205	30
	3	184	236	52		3	232	150	-82		3	175	220	45
	4	178	214	36		4	180	186	6		4	188	227	39
	5	185	187	2		5	174	162	-12		5	183	230	47
	6	199	195	-4		6	158	163	5		6	190	251	61
	7	182	190	8		7	190	175	-15		7	185	230	45
	8	186	205	19		8	186	162	-24		8	200	229	29
	9	197	236	39		9	175	166	-9		9	175	207	32