



DPS-GPR
MAINE DOT
2019

I. Summary

I.2 DPS – GPR

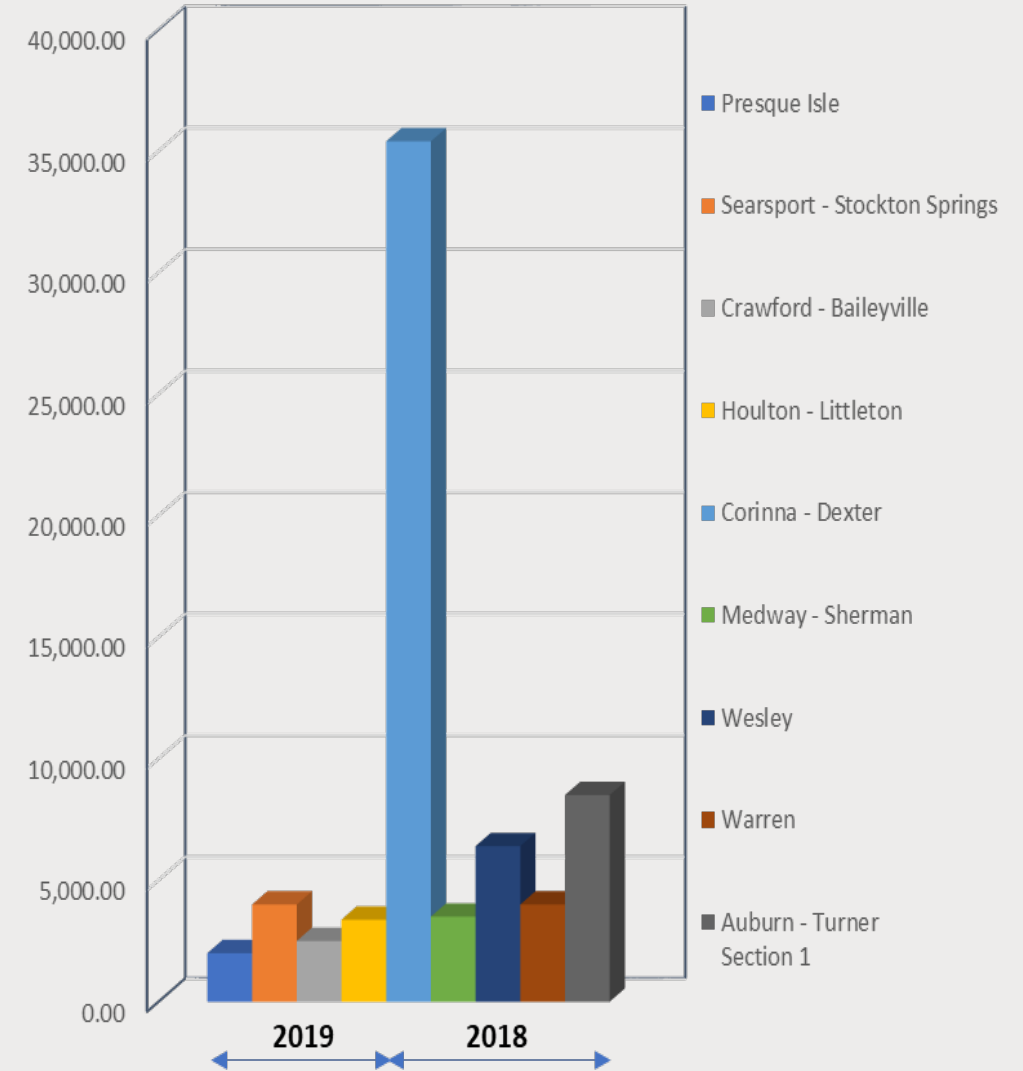
1. Projects Collected & Coverage
2. Results
3. Calibration
4. Findings

I.3 Conclusions & Suggestions

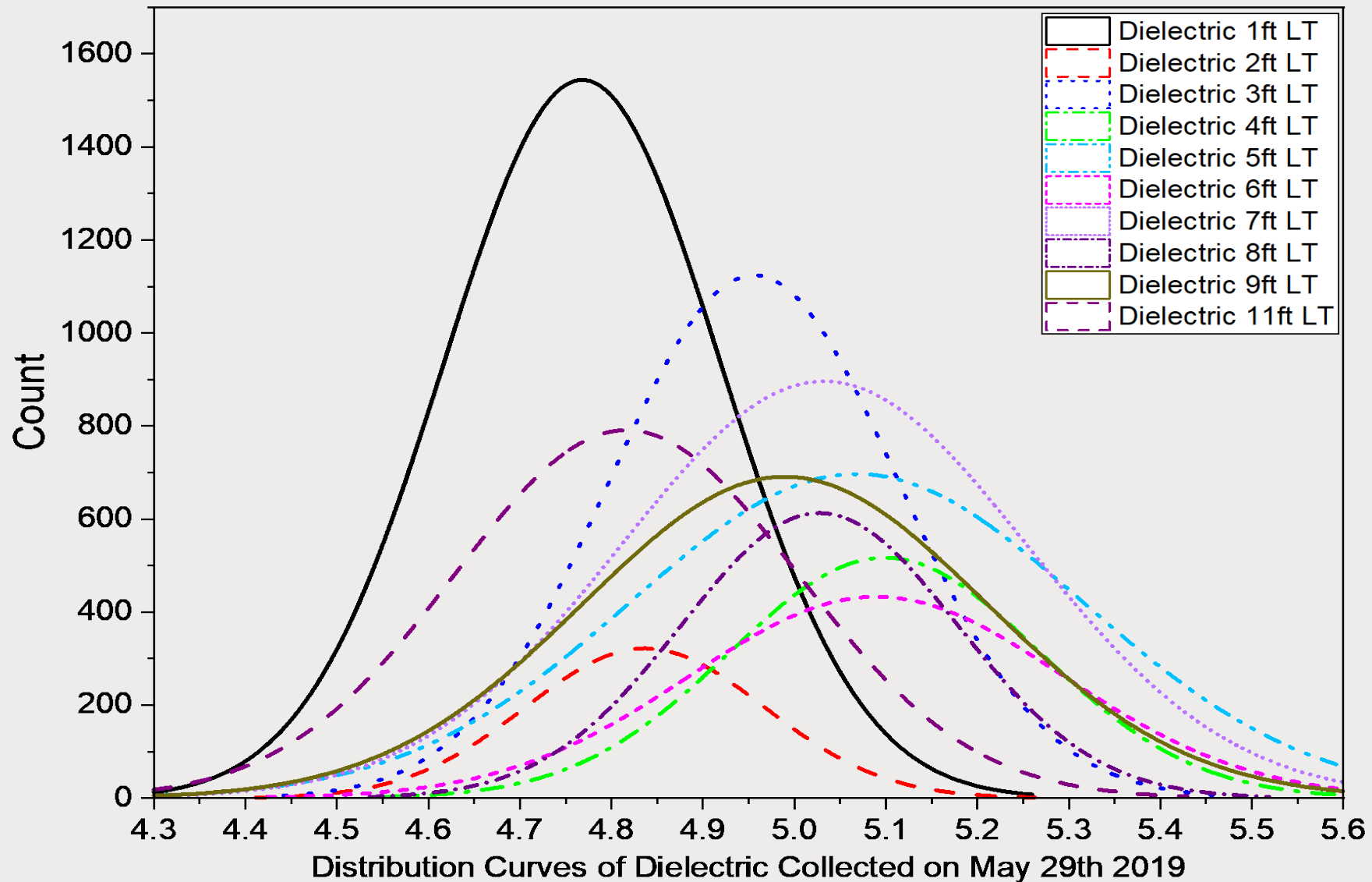
DPS - Projects Collected

Summary of DPS / GPR data collected							
Year	Project WIN	Treatment	Towns	Route	Total Project length (Miles)	Total Length Collected (ft.) / project	Contractor
2019	006462.91	New Construction - Wearing 1-1/2" & Base 2-1/2"- Polymer Modified HMA	Presque Isle	Bypass section II	1.48	2,000.00	Steelstone
	022468.00	1-1/4" Polymer Modified HMA	Searsport - Stockton Springs	1	4.38	4,000.00	Northeast Paving
	022400.00	1-1/4" Polymer Modified HMA	Crawford - Baileyville	9	13.27	2,500.00	Northeast Paving
	022426.00	2" Mill & Fill, Polymer Modified HMA	Houlton - Littleton	1	5.03	3,375.00	Northeast Paving
2018	22571.00	HIPR + 1" HMA Overlay	Corinna - Dexter	7	6.51	35,400.00	Pike Industries
	18797.00	1-1/2" Base pavement	Medway - Sherman	I-95 SB	22.91	3,500.00	Pike Industries
	20884.00	HIPR + 1" HMA Overlay	Wesley	9	17.90	6,400.00	Lane Construction
	22472.00 & 20888.00	1-1/2" Mill & 1-1/2" HMA Overlay	Warren	1 & 90	1.78	4,000.00	Pike Industries
	20853.00	1-1/2 Mill & 1-1/2" HMA Overlay	Auburn - Turner Section 1	4	0.72	8,500.00	Lane Construction

DPS / GPR data collected in 2019 & 2018

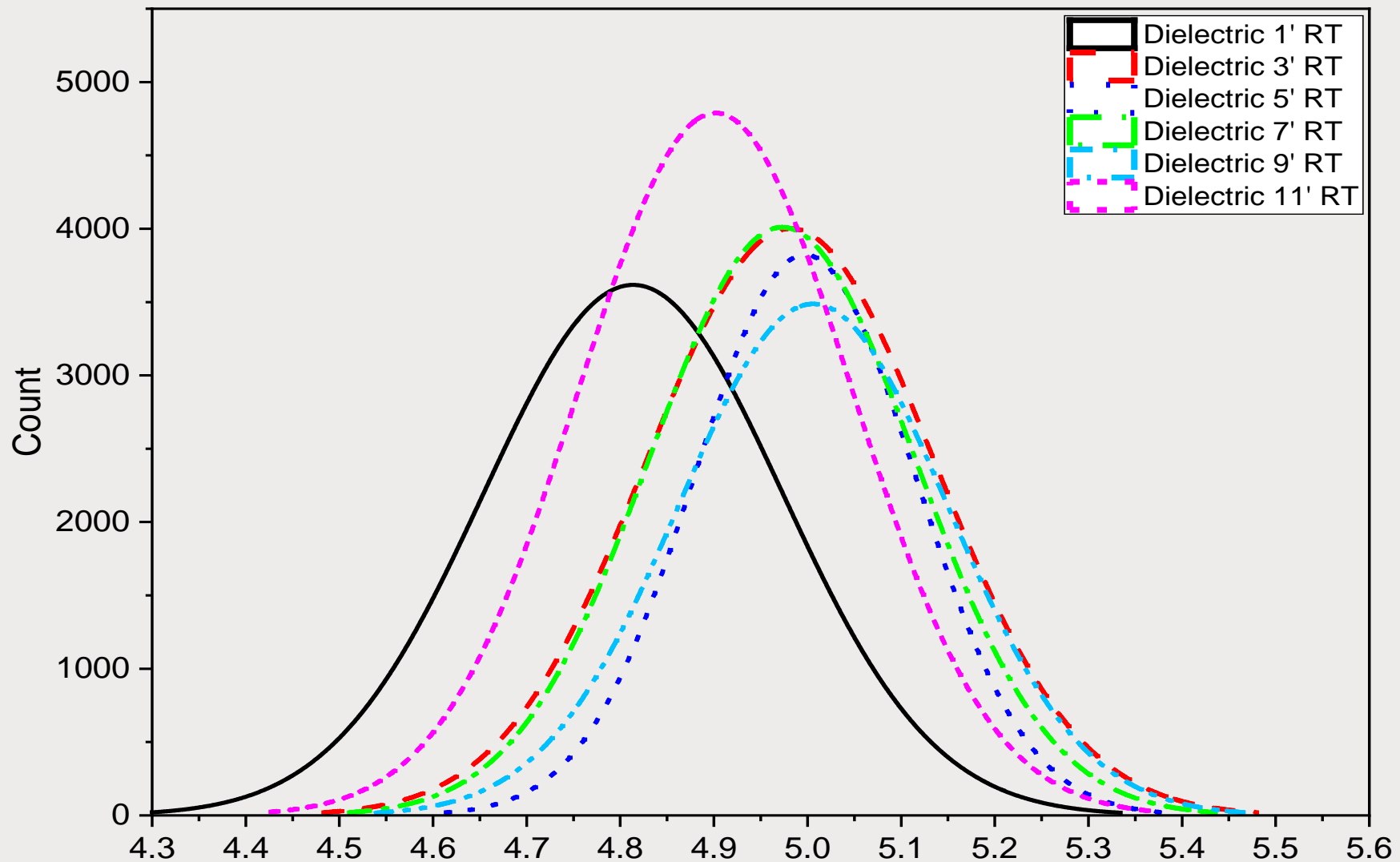


GPR – Results: Distribution Curves – PI Bypass



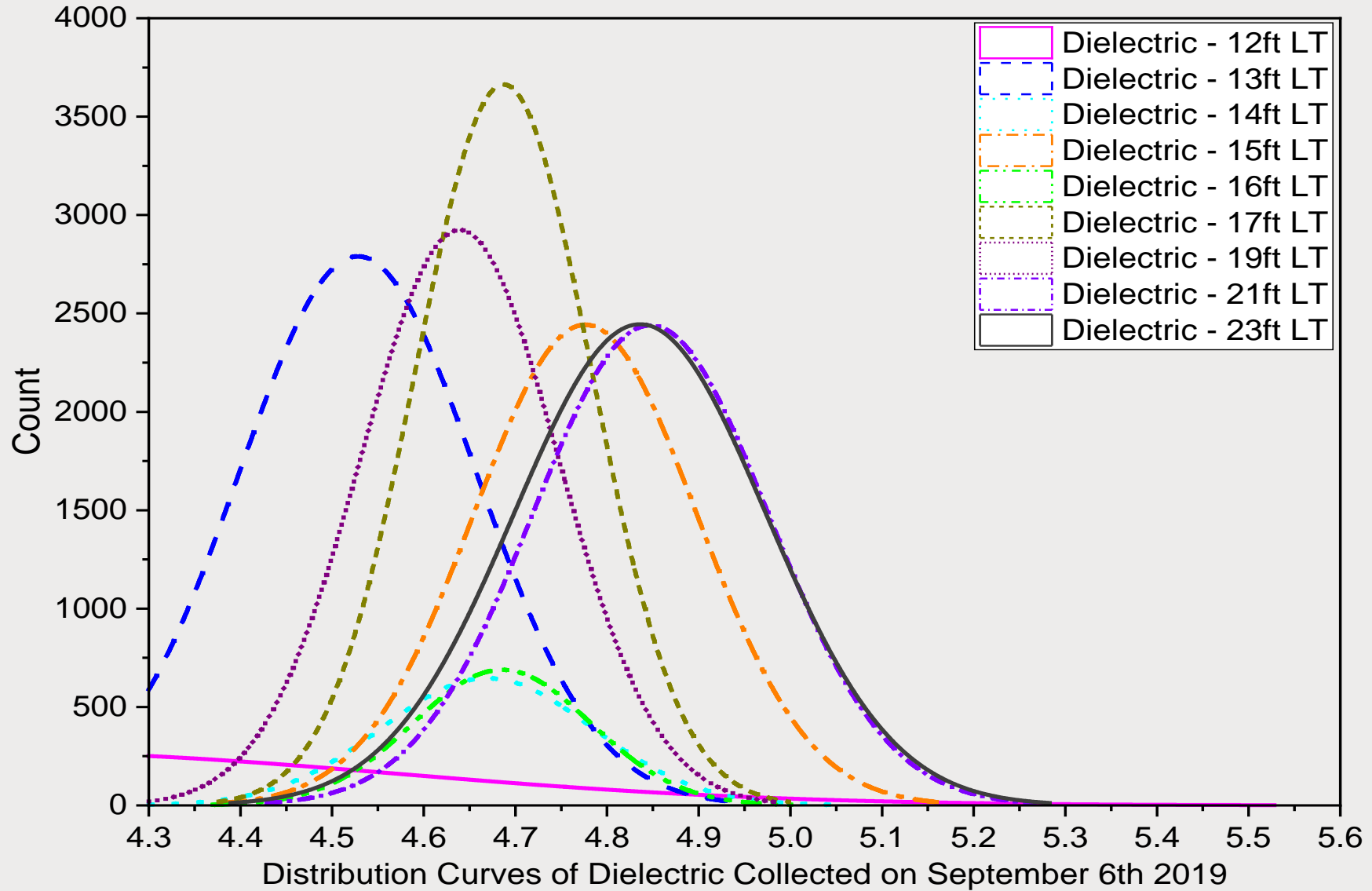
Presque Isle Bypass - Southband Lane - Sta 2637+50 to Sta 7668+50 (All Sections)

GPR – Results: Distribution Curves–Searsport - Stockton



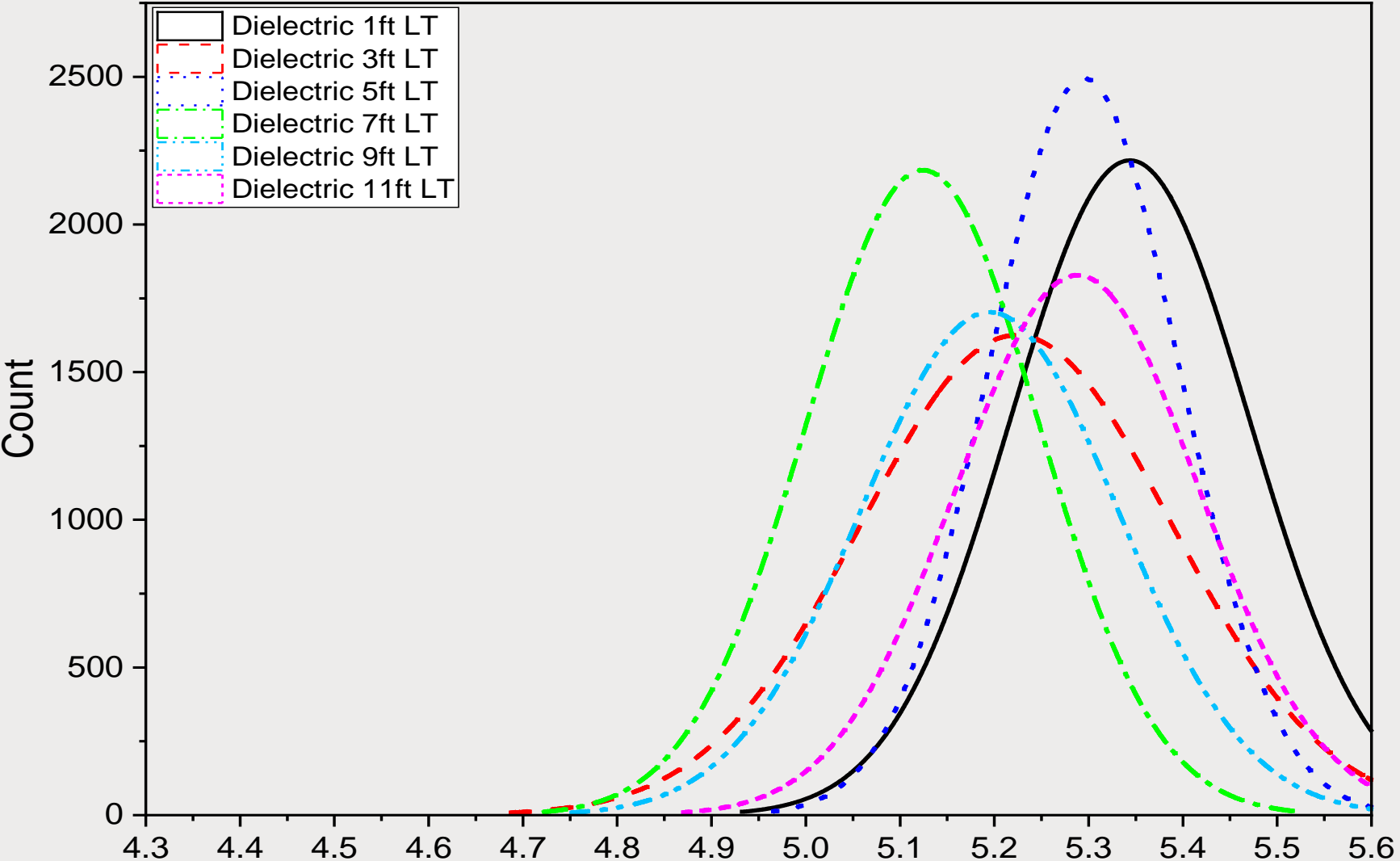
Distribution Curves of Dielectric Collected on August 11th 2019
Searsport - Stockton - Eastbound Lane - Sta 62+50 to Sta 102+50 (All data)

GPR – Results: Distribution Curves – Alexander



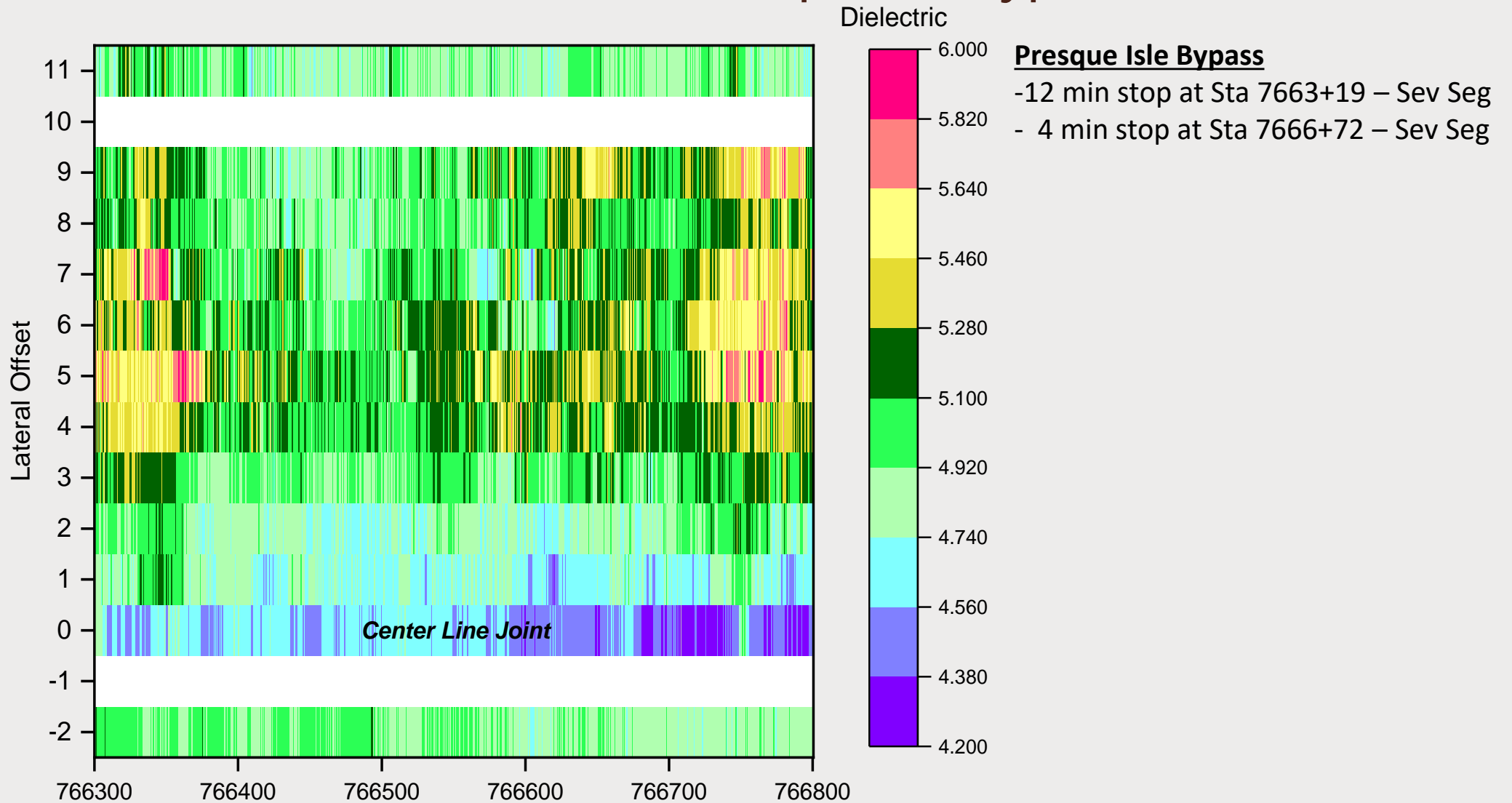
Alexander Rte 9 - WB Truck Lane - Sta 334+00 to Sta 349+00 & Sta 354+00 to Sta 364+00

GPR – Results: Distribution Curves – Houlton - Littleton



Distribution Curves of Dielectric on September 19th 2019
Houlton Rte 1 - Southbound Lane - Sta 127+00 to Sta 162+50

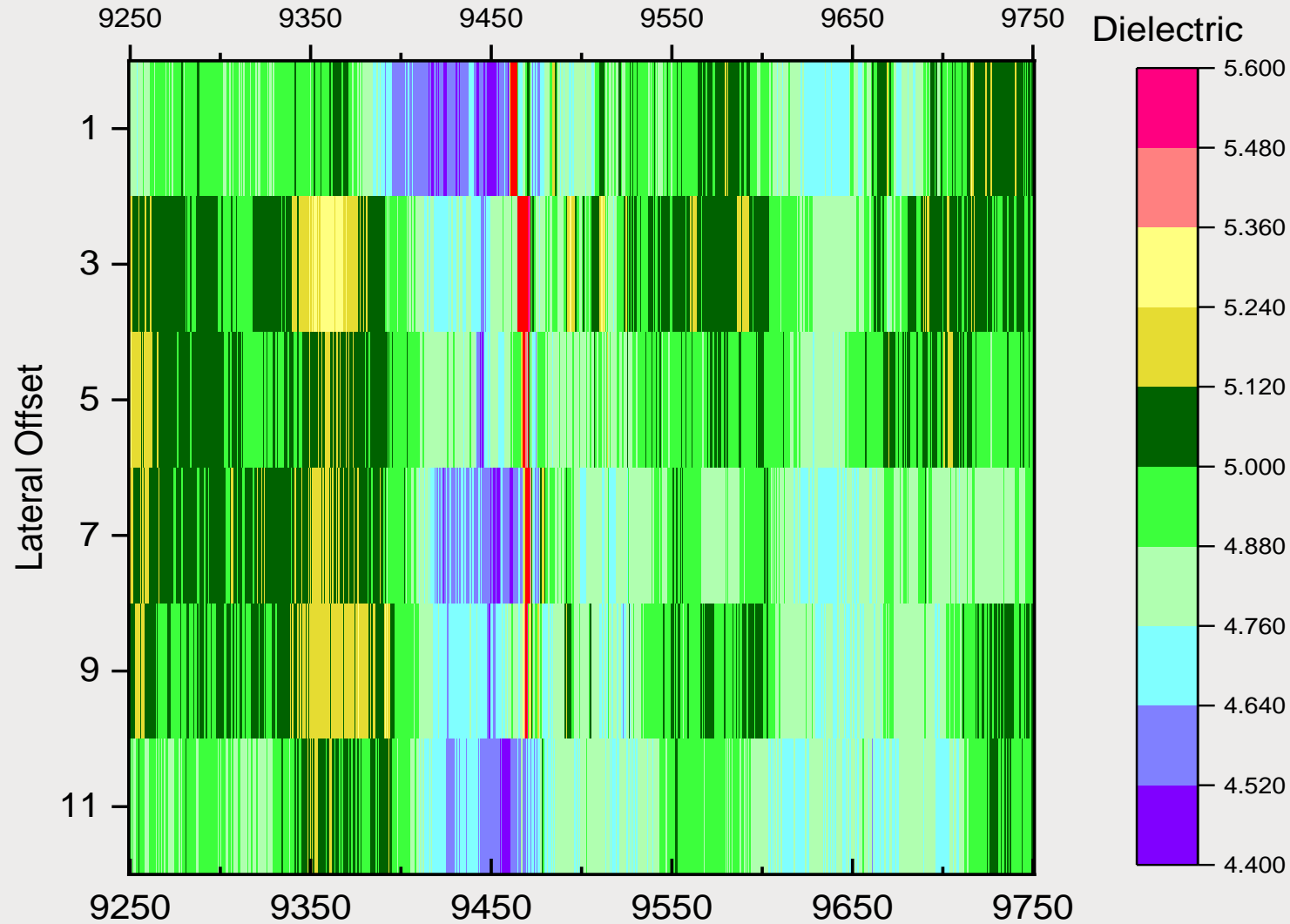
GPR – Results: Contour Map – PI Bypass



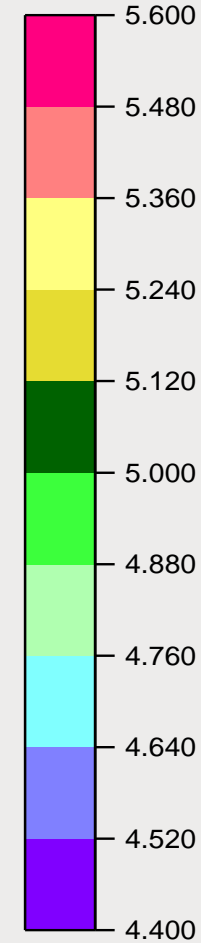
Contour Map of Dielectric Collected on May 29th 2019

Presque Isle Bypass - Southband - Test Section: Sta 7663+00 to Sta 7668+00

GPR – Results: Contour Map – Searsport



Dielectric

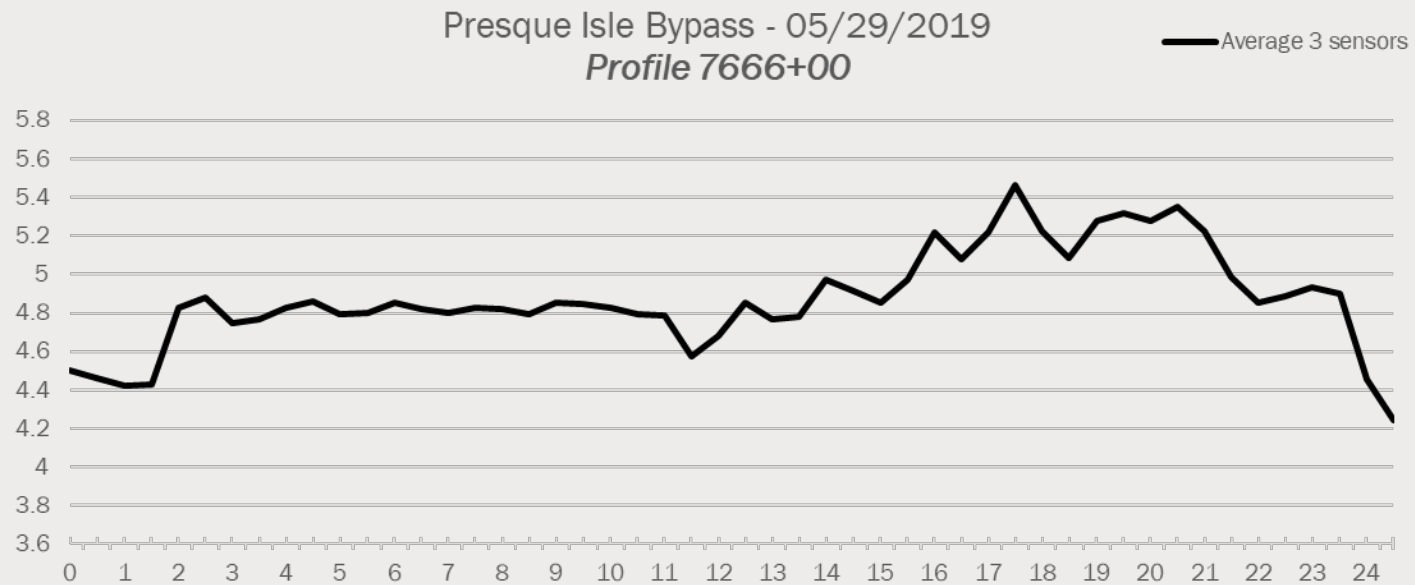
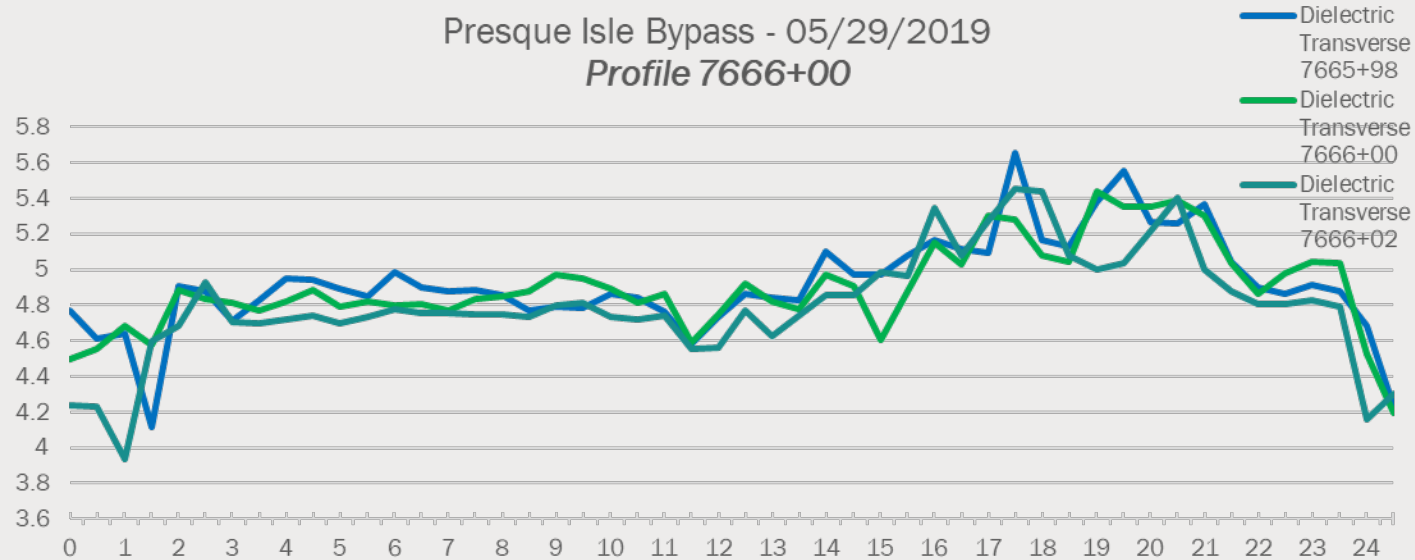


Searsport – Stockton Rt 1

- 2 min stop at Sta 93+82 – Mod Seg
- 5 min stop at Sta 94+32 – Sev Seg
- 2 min stop at Sta 96+20 – Sev Seg

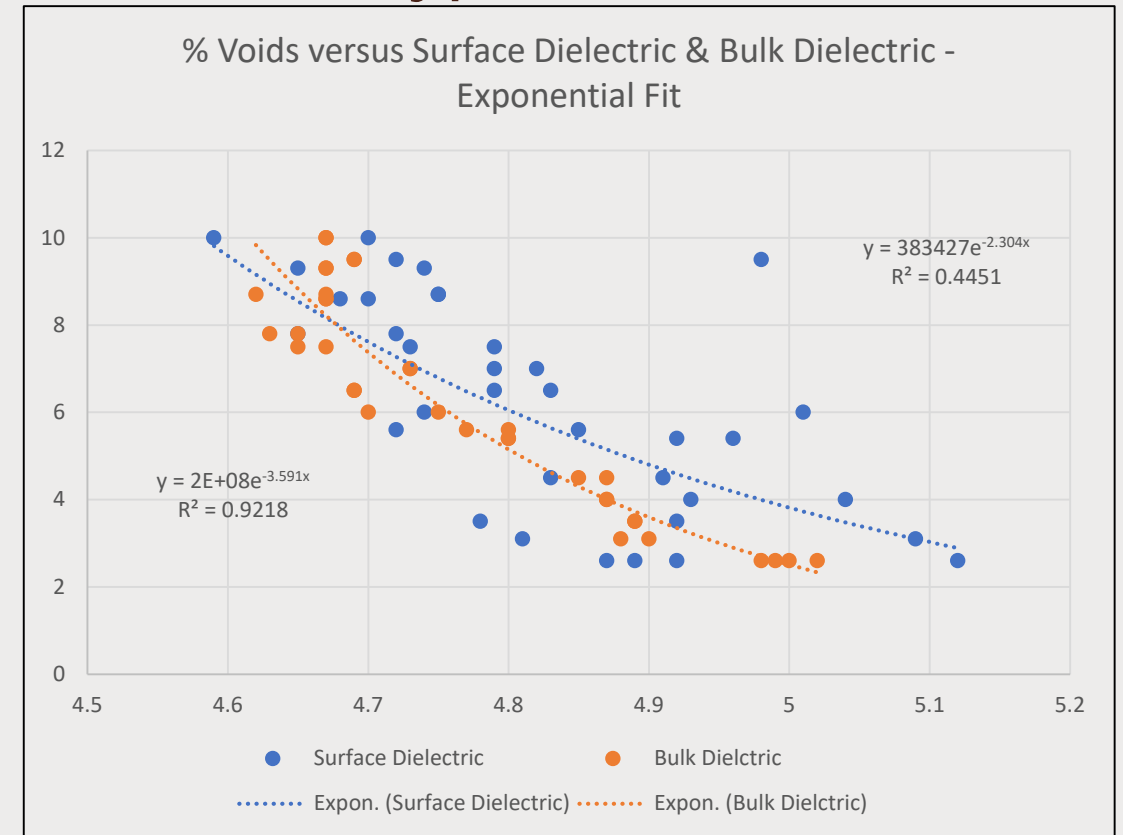
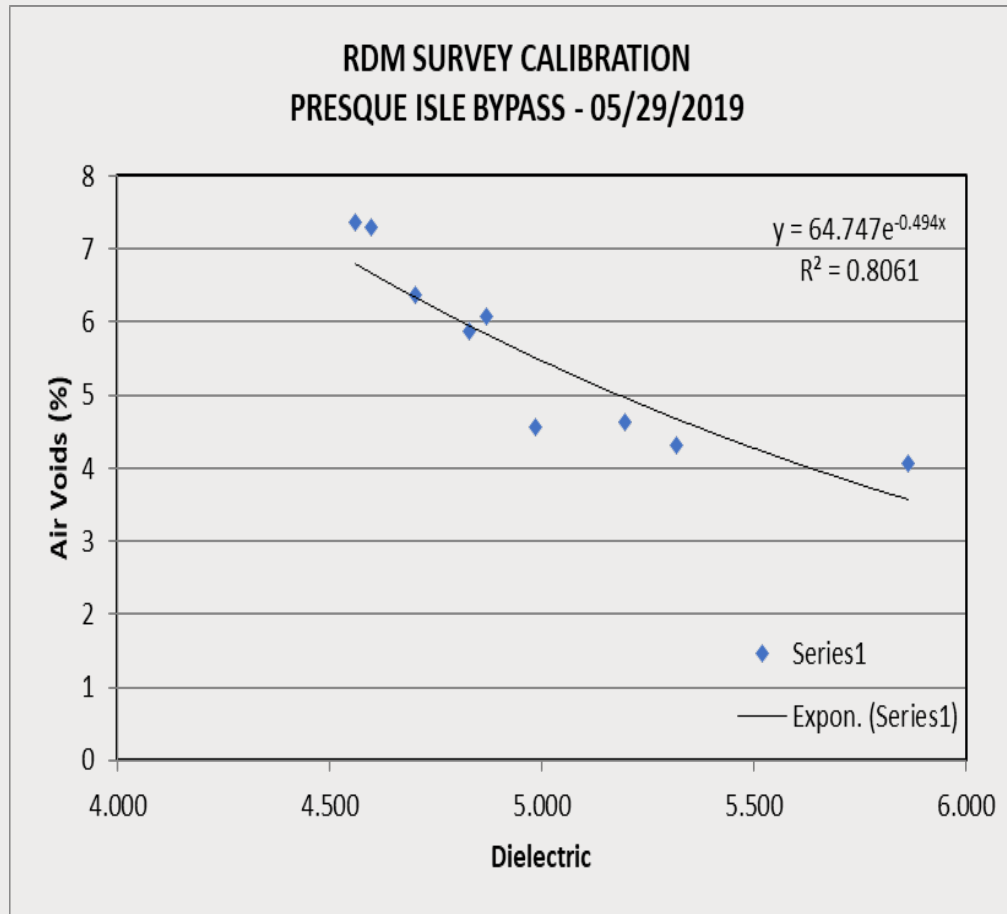
Contour Map of Dielectric Collected on August 11th 2019
Searsport - Stockton - Northbound Lane - Sta 92+50 to Sta 97+50
Section 7

GPR – Results: Transverse Profile – PI Bypass

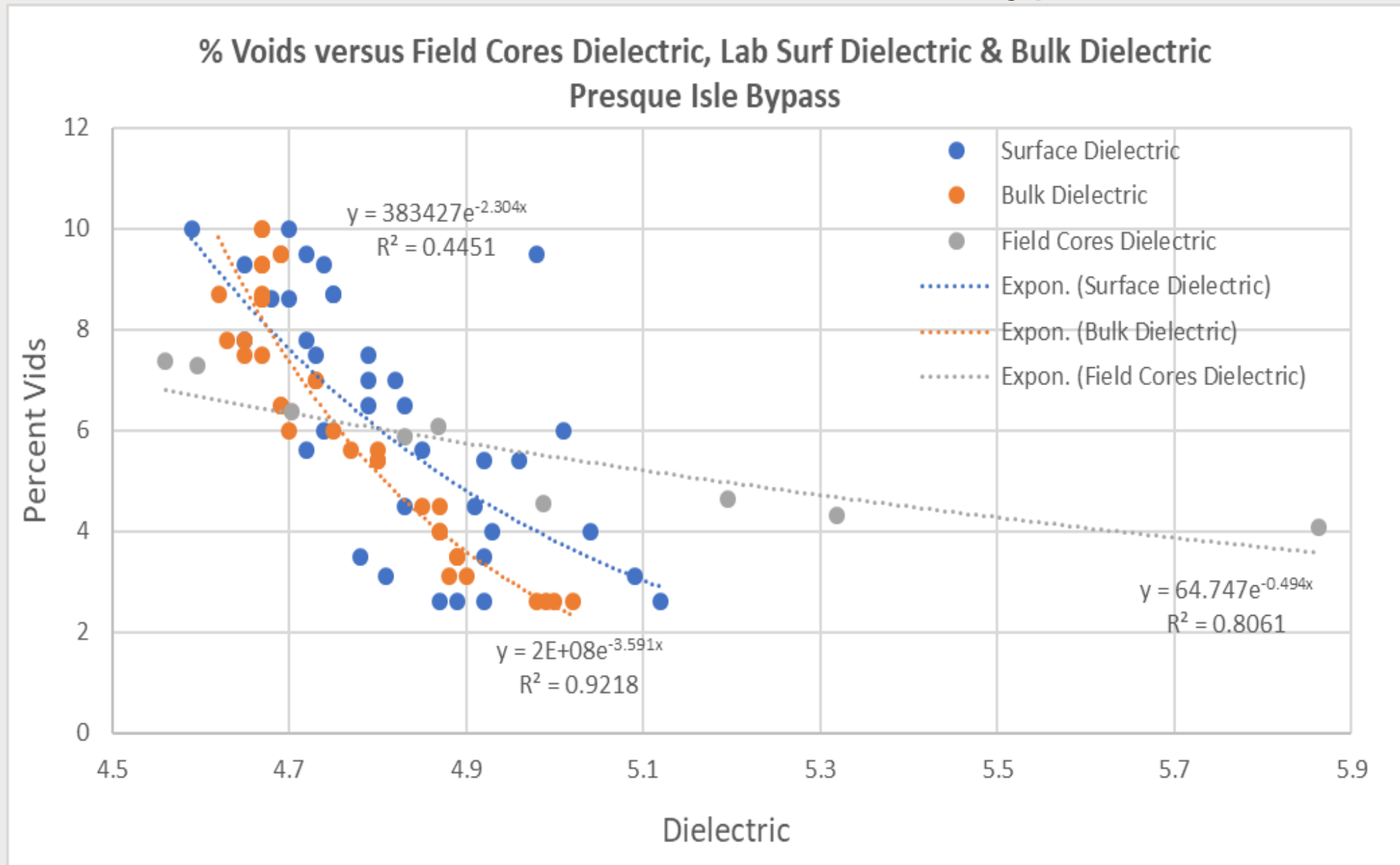


	Dielectric Transverse 7665+98	Dielectric Transverse 7666+00	Dielectric Transverse 7666+02	Average 3 sensors
Minimum:	4.1173	4.1953	3.9348	4.2429
Maximum:	5.6556	5.4385	5.4543	5.4639
Average NB:	4.7888	4.7882	4.6536	4.7436
Average SB:	5.0525	5.0108	4.9482	5.0038
Difference between SB & NB:				<u>0.2603</u>

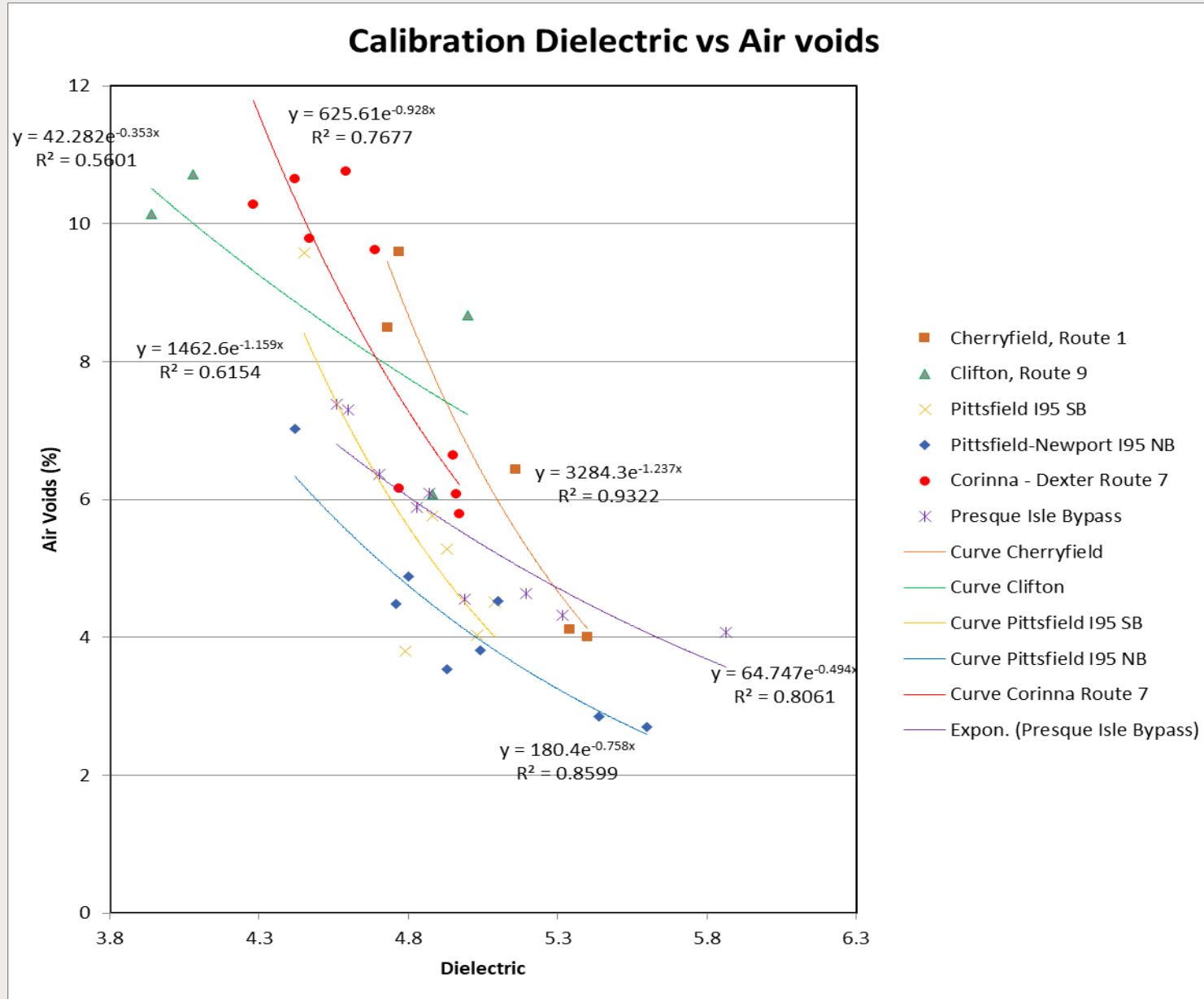
GPR – Results: Calibration – PI Bypass



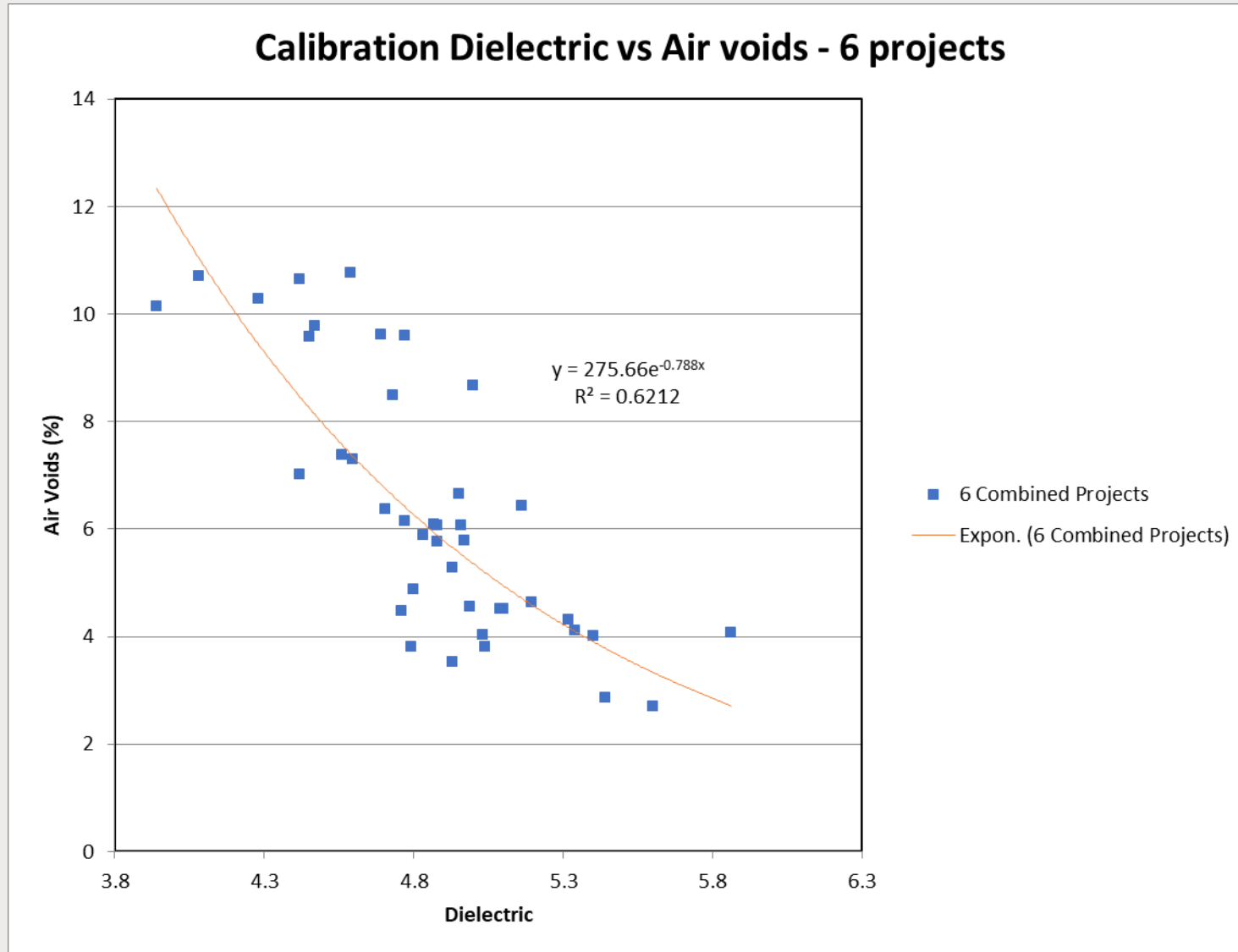
GPR – Results: Calibration – PI Bypass



Calibration Dielectric vs Air voids – 6 Projects included 2019

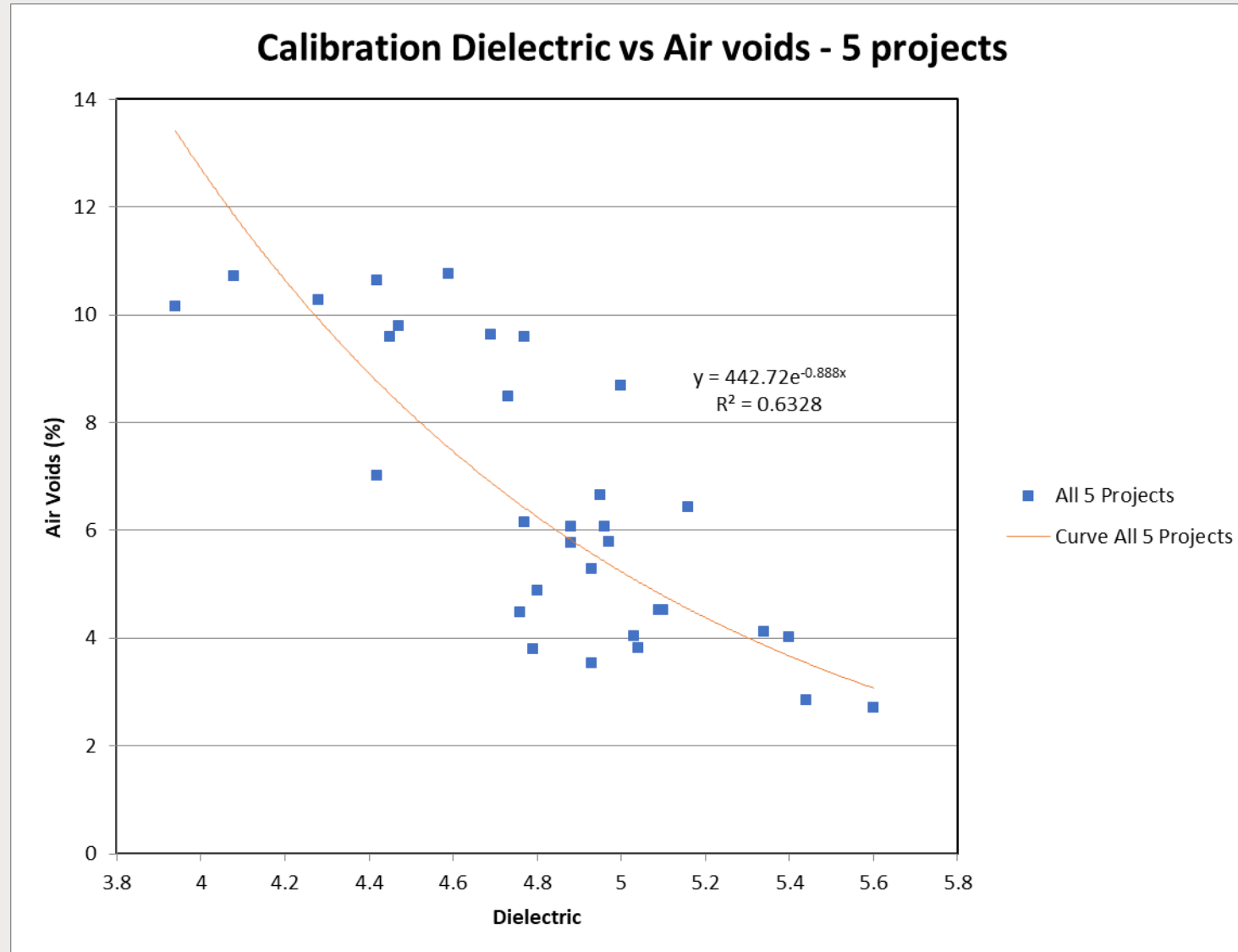


Calibration Dielectric vs Air voids – 6 Projects combined



		Dielectric	Air Voids (%)	Density
		3.8	13.80%	86.20%
		4.2	10.07%	89.93%
		4.4	8.60%	91.40%
Range of dielectric	↑ ↓	4.6	7.35%	92.65%
		4.7	6.79%	93.21%
		4.83	6.13%	93.87%
		4.98	5.45%	94.55%
		5.4	3.91%	96.09%
		5.6	3.34%	96.66%

Calibration Dielectric vs Air voids – 5 Projects (up to 2018)



		Dielectric	Air Voids (%)	Density
		3.8	15.16%	84.84%
		4.2	10.63%	89.37%
		4.4	8.90%	91.10%
Range of dielectric	↑	4.6	7.45%	92.55%
		4.7	6.82%	93.18%
		4.83	6.07%	93.93%
		4.98	5.32%	94.68%
	↓	5.4	3.66%	96.34%
		5.6	3.07%	96.93%

Core Vs Survey Dielectric: PI Bypass

Recap of Data - Dielectric vs Thermal Segregation

Station	Type	Offset (ft)	Lane	Density	Dielectric from Core collection	RDM Survey Closest Line Dielectric (ft)	RDM Survey Closest Line Dielectric value	Standard deviation from RDM survey	Difference between Core diel & Survey diel	Thermal Segregation	Profile Temp. Diff. (°F)
7652+50	Acceptance	9.4	LT	93.6	4.703	9	-	-	-	Severe Segregation	65.9
7664+30	Informational	8	LT	95.4	4.987	8	4.987	0.176	0	Severe Segregation	72.7
7665+15	Informational	10	LT	95.4	5.196	9	4.933	0.246	0.263	Moderate Segregation	33.1
7666+00	Informational	2	LT	93.9	4.869	2	4.696	0.131	0.173	Moderate Segregation	33.1
7666+85	Informational	4	LT	95.7	5.318	4	5.352	0.167	-0.034	Severe Segregation	66.6
7667+70	Informational	6	LT	95.9	5.863	6	5.524	0.223	0.339	Severe Segregation	66.6
7675+00	Acceptance	3.1	LT	92.7	4.597	3	-	-	-	Severe Segregation	61

Core & Sample Vs Survey Dielectric: PI Bypass

Recap of Data - Dielectric vs Thermal Segregation (included Paver Stops)

Station	Thermal Profile Number	Begin Profile	End Profile	Type of Test / Stops	Offset (ft)	Lane	Density	Dielectric from Core collection	RDM Survey Closest Line Dielectric (ft)	RDM Survey Closest Line Dielectric value	Standard deviation from RDM survey for data within thermal profile		Standard deviation from RDM survey (all data for the lane excluded CL)	Standard deviation from RDM survey (for one line)	Difference between Core diel & Survey diel	Thermal Segregation	Profile Temp. Diff. (°F)
7652+50	4	7651+27	7652+75	Acceptance	9.4	LT	93.6	4.703	Average line 1,3 & 5	4.664	0.148		0.162	-	0.039	Severe Segregation	65.9
7653+96	5	7652+76	7654+25	Paver stop	-	LT	-	-	Average	No data	-		-	-	-	Severe Segregation	100.4
7658+65	8	7657+26	7658+76	Paver stop	-	LT	-	-	Average	No data	-		-	-	-	Severe Segregation	54.4
7663+19	11	7661+76	7663+26	Sample / Paver stop	-	LT	-	-	Average line 1,2,3,4,5,6,7,8,9&11	5.240	0.251	Based on 25ft data	0.255	-	-	Severe Segregation	71.5
7664+30	12	7663+27	7664+75	Informational	8	LT	95.4	4.987	8	4.987	0.241		0.255	0.176	0	Severe Segregation	72.7
7665+15	13	7664+76	7666+26	Informational	10	LT	95.4	5.196	9	4.933	0.206		0.255	0.246	0.263	Moderate Segregation	33.1
7666+00	13	7664+76	7666+26	Informational	2	LT	93.9	4.869	2	4.696	0.206		0.255	0.131	0.173	Moderate Segregation	33.1
7666+72	14	7666+27	7667+75	Paver stop	-	LT	-	-	Average line 1,2,3,4,5,6,7,8,9&11	5.101	0.265		0.255	-	-	Severe Segregation	66.6
7666+85	14	7666+27	7667+75	Informational	4	LT	95.7	5.318	4	5.352	0.265		0.255	0.167	-0.034	Severe Segregation	66.6
7667+70	14	7666+27	7667+75	Informational	6	LT	95.9	5.863	6	5.524	0.265		0.255	0.223	0.339	Severe Segregation	66.6
7669+16	15	7667+76	7669+25	Paver stop	-	LT	-	-	Average	No data	0.328	Based on 25ft data	-	-	-	Severe Segregation	92.0
7671+92	16	7669+26	7670+76	Paver stop	-	LT	-	-	Average	No data	-		-	-	-	Severe Segregation	108.5
7675+00	19	7673+77	7675+25	Acceptance	3.1	LT	92.7	4.597	3	-	-		-	-	-	Severe Segregation	61

GPR data in comparison to PMTP data

GPR data collected in comparison to Thermal Profile data & Density

Year	Project WIN	Projects	Dielectric			Acceptance Cores for One Lot		Acceptance Cores on day of Dielectric Data collection		Day / Night Work	MTV / No MTV	Paver Mounted Thermal Profiler results
			Mean Range	Overall Data Mean	Overall Data Standard Deviation	Mean density	Standard Deviation	Mean density	Standard Deviation			
2019	006462.91	<u>Presque Isle Bypass</u> New Construction - Wearing 1-1/2" & Base 2-1/2"- Polymer Modified HMA	4.77-5.10	4.96	0.22	94.0	1.0	93.2	0.6	Day	No MTV	Only 50% of the area surveyed with the DPS was scanned using the PMTP. - 8 profiles of PMTP - 2 profiles with moderate segregation (25%) - 6 profiles with severe segregation (75%)
2019	022468.00	<u>Searsport - Stockton Springs Rte 1</u> 1-1/4" Polymer Modified HMA	4.81-5.01	4.92	0.23	94.7	1.7	94.8	1.7	Night	No MTV	- 27 profiles of PMTP within the area with DPS data. - 1 profile without thermal segregation (3.7%) - 9 profiles with moderate segregation (33.3%) - 17 profiles with severe segregation (63%)
2019	022400.00	<u>Crawford - Baileyville Rte 9</u> 1-1/4" Polymer Modified HMA	4.52-4.85	4.72	0.16	93.7	2.1	93.2	2.4	Day	MTV	- 17 profiles of PMTP within the area with DPS data. - 10 profiles without thermal segregation (58.8%) - 7 profiles with moderate segregation (41.2%) - 0 profile with severe segregation (0%)
2019	022426.00	<u>Houlton - Littleton Rte 1</u> 2" Mill & Fill, Polymer Modified HMA	5.12-5.34	5.25	0.15	95.40	0.75	95.1	0.7	Day	No MTV	- 24 profiles of PMTP within the area with DPS data - 3 profiles without thermal segregation (12.5%) - 13 profiles with moderate segregation (54.2%) - 8 profiles with severe segregation (33.3%)

GPR – Findings

1. 80% less data collected in 2019 in comparison to 2018.
2. The overall trend for the calibration dielectric – air voids didn't change after adding PI Bypass curve (2019).
3. Lab measurement for pucks didn't show any correlation between field dielectric and bulk dielectric. (pavement thickness & calibration equation!!!!)
4. No relation was found between the lab surface dielectric and bulk dielectric (PI Bypass) performed in the lab in Bangor. An update of the antennas is expected and should fix the low signal quality issue. More testing will be conducted in the future regarding this.
5. The test section (southbound lane) for PI bypass shows higher dielectric than the northbound lane paved the previous day. This indicates that the contractor paid more attention for the compaction in the test section.
6. More generally, dielectrics collected over wheel path (3-ft & 9-ft offset from center) are higher than dielectrics collected over the center of the lane (5-ft & 7-ft Offset) which are higher than data collected near the edges (1-ft & 11-ft offset). Even this is not always the case (Confined vs. Unconfined).
7. The paver stops locations are visible on the contour map and indicate low dielectric values.
8. Profiles with severe segregation are showing higher dielectric standard deviation than profiles with moderate segregation (for PI Bypass project).
9. Projects with overall higher dielectric standard deviation (PI Bypass & Searsport) have the higher percentage of profiles with severe segregation: PI:75%, Searsport: 63% vs Houlton: 33%)
10. The dielectric data (Mean & Standard Deviation) couldn't predict the Density data (Regression analysis) (In line with Finding No 3).

Conclusions & Suggestions

- The use of a Material Transfer Vehicle decreases significantly the number of profiles with thermal segregations. This has been confirmed by studies, other agencies, etc.
- Paver stops more likely to be in profiles with thermal segregation
- No correlation between field dielectric and bulk dielectric (***Most accurate, stable and reliable method for measuring pucks***). Still investigating why since Minnesota found a strong relation. This would allow to use pucks produced from mixes sampled in the field or at plant for calibration instead of cores.
 - Minimum lift thickness: 1.5” & Max lift thickness: 4” (Pool Fund)
 - Calibration Equation used different from Exponential
 - Antennas updates to fix low signal issues (lab surface dielectric).
- The Contractors are getting familiar to the use of the PMTP and were able to setup the equipment and collect data.