



Revision of the South African Pavement Design Method

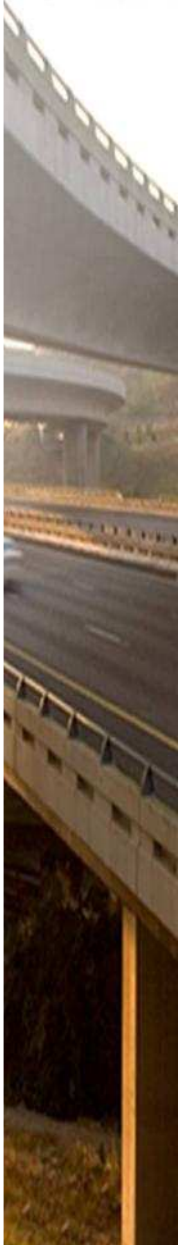
Moisture and temperature monitoring

RPF, Gordon's Bay
11 May 2011
Project SAPDM/E-1

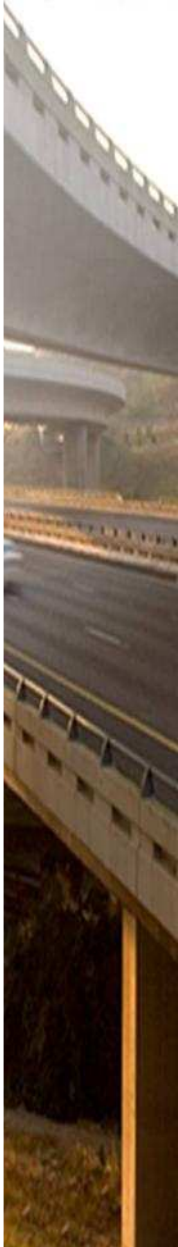
P Paige-Green

Objectives

- Monitor seasonal road/air temperature & moisture changes
 - Status
 - Matrix developed
 - Sites selected, inspected and 43 (41) installed
 - Still some gaps – problem with failed/poor sites
 - Test pitting
 - LVR sites – 2 installed



Current matrix (Granular)



Climate				
	Good		Poor	
	Deep	Shallow	Deep	Shallow
Arid		N1-8 (24) Beaufort North	N00106N (25) Leeu-Gamka	N01402 (8) Kakamas
Semi-arid	N00808E (27) Kimberly	N00125N (19) (Pietersburg) (actually dry sub humid outlier but Semi-arid region)	N00112S (23) Colesberg	N00113S (22) Gariepdam
Dry sub Humid	N4 01E (1) Pretoria N1-18N (12) Kroonvaal	N00412E (2) Pelindaba	N01217N (11) Potch SS91 (42) Bethlehem	N01217N (10) Potchefstroom
Moist sub humid	N00229N	N00222N N01103N		N01103N,
Humid	N00228N	N00125N (18) (Potgietersrus)		P10/2 (43) Bergville

Current matrix (Treated)



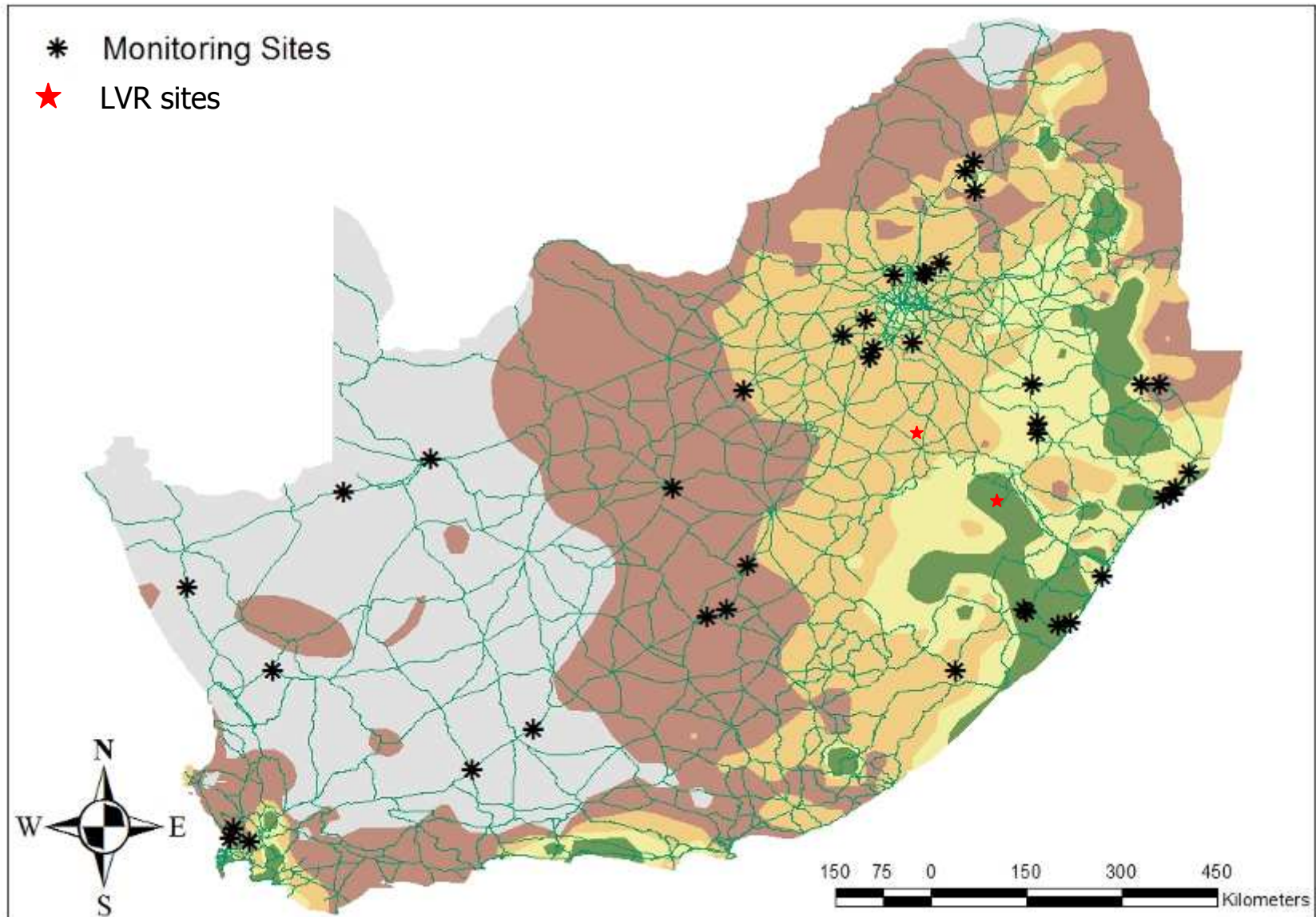
Climate	Young		Old	
	Good	Poor	Good	Poor
Arid	R27-8 (6) Niewoudtville		N7-7 (7) Kamieskroon	N01405E (9) (Upington)
Semi-arid	N00114S (Trompsburg FS) EBT/cem?		N7-1 (4) Malmesbury	N011-12N (20) (Roedtan) Actually Dry sub humid but close)
Dry sub humid			N00401 on ramp (3) (Pretoria) P243/1 (16) Vereeniging LTPP R2388 (17) Cullinan LTPP	N00101 (5) Paarl
Moist sub humid			N00224N (14) (Amanzimtoti)	
Humid	N00222N (15) (Paddock KZN)			

Current matrix (Asphalt)

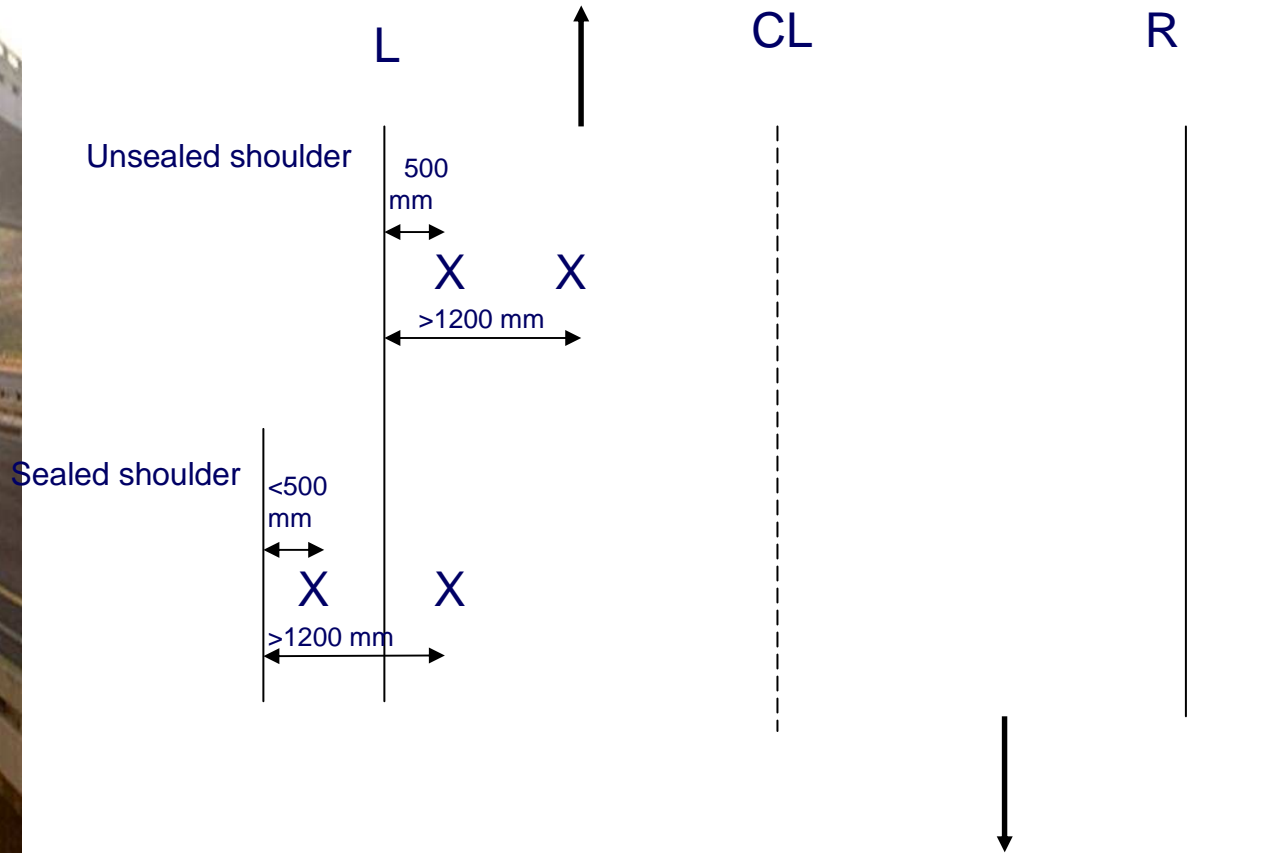
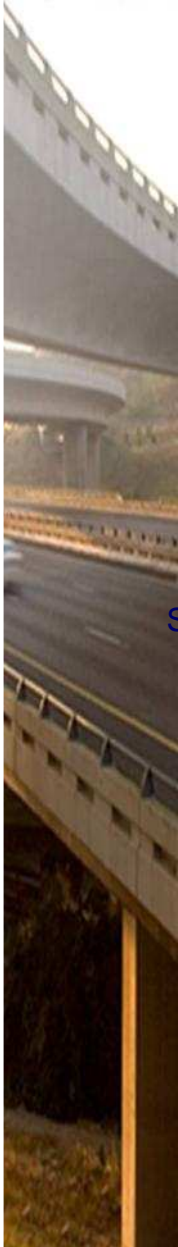


Climate				
	Good		Poor	
	Deep	Shallow	Deep	Shallow
Arid				
Semi-arid		N00701N (26) Malmesbury		N01214N (28) Bloemhof (very close to dry sub humid)
Dry sub Humid		N00118N (13) Vaal plaza		N00219E
Moist sub humid		N00229N		
Humid		N00221N		N00221N

Current sites (LVR)



Layout (MC & Temp)



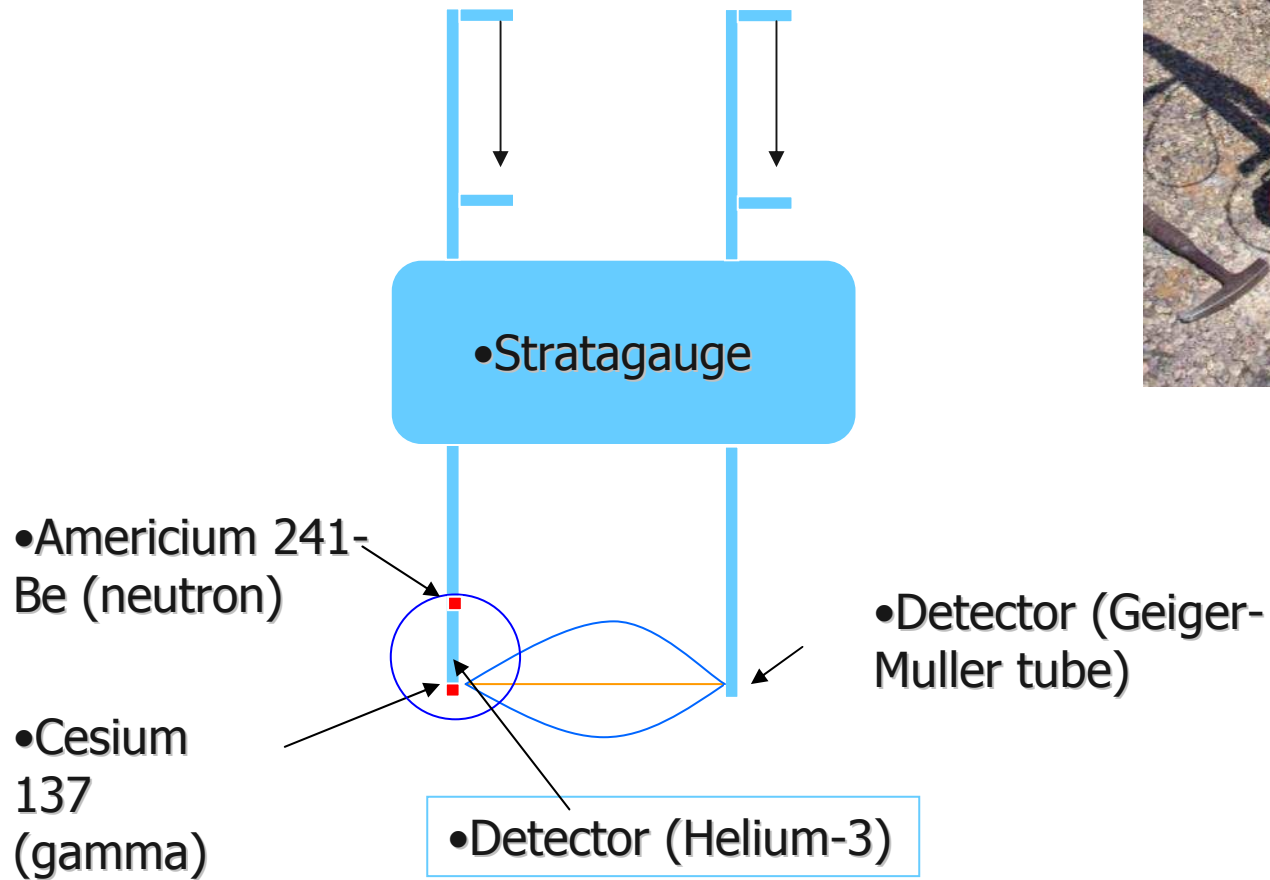
Moisture equilibrium zone > 600 mm to 1000 mm from edge
 OWT < 1 m from edge if seal width < 7 m

Monitoring

- About once every 5 weeks
- Moisture content and wet density using Stratagauge
- Temperature button download



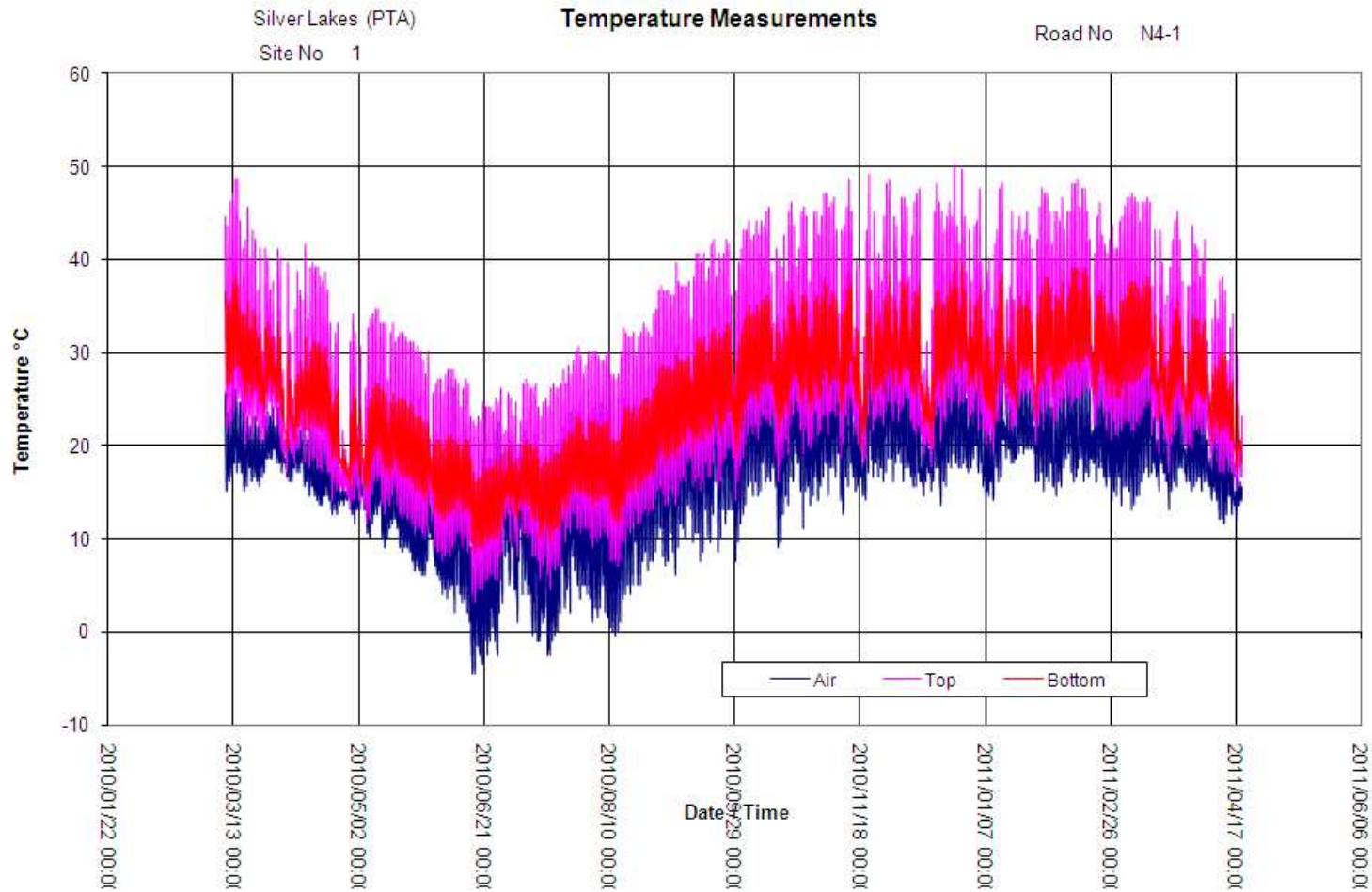
Stratagauge





SANRAL MONITORING SITES				PTA area	Day trip	Cape trip	KZN trip	Follow up Dates						
Site No.	Nearest Town	Road No.	Kilo Post	Elevation Metres	Date Installed									
1	Silver lakes	N4-1	24.0E	1300	2010/01/15	2010/03/09	2010/04/14	2010/06/08	2010/08/12	2010/09/29	2010/11/18	2011/01/14	2011/03/04	2011/04/19
2	Pelindaba	N4-12	11.9E	1200	2010/03/09	2010/04/15	2010/06/08	2010/08/11	2010/09/30	2010/11/05	2011/01/13	2011/02/25	2011/04/20	
3	Hans Strydom	N4-1 (onramp)	20.6E	1300	2010/04/14	2010/06/08	2010/08/12	2010/09/29	2010/11/18	2011/01/14	2011/03/04	2011/04/19		
4	Cape Town (WB)	N7	South	62.8	2010/05/25	2010/07/20	2010/08/31	2010/11/15	2011/01/23	2011/03/06	2011/04/13			
5	Paarl	N1-1	35.0S	162.1	2010/05/25	2010/07/20	2010/08/31	2010/11/15	2011/01/23	2011/03/06	2011/04/13			
6	Nieuwoutville	R27-8	3.2E	732.9	2010/05/26	2010/07/21	2010/08/31	2010/11/11	2011/01/23	2011/03/09	2011/04/13			
7	Kammieskroon	N7-7	47.1N	757.6	2010/05/27	2010/07/21	2010/09/01	2010/11/11	2011/01/23	2011/03/09	2011/04/12			
8	Kakamas	N14-2	83.0E	853.3	2010/05/27	2010/07/22	2010/09/01	2010/11/10	2011/01/22	2011/03/10	2011/04/12			
9	Upington	N14-5	16.4E	851.8	2010/05/28	2010/07/22	2010/09/02	2010/11/10	2011/01/22	2011/03/10	2011/04/12			
10	Potchefstroom (1)	N12-17	59.758W	1600	2010/06/01	2010/07/23	2010/09/03	2010/11/09	2011/01/21	2011/03/11	2011/04/11			
11	Potchefstroom (2)	N12-17	14.2W	1400	2010/06/01	2010/07/23	2010/09/03	2010/11/09	2011/01/21	2011/03/11	2011/04/11			
12	Kroonvaal Plaza	N1-18	56.6N	1500	2010/06/01	2010/07/18	2010/08/29	2010/11/17	2011/01/25	2011/03/04	2011/04/15			
13	Vaal Plaza	N1-18	71.1N	1500	2010/06/01	2010/07/18	2010/08/29	2010/11/17	2011/01/25	2011/03/04	2011/04/15			
14	Amanzimtoti	N2-24	19.2N	35.4	2010/06/23	2010/08/03	2010/09/14	2010/11/03	2011/01/11	2011/02/23	2011/04/07			
15	Paddock	N2-22	10.5N	481.6	2010/06/23	2010/08/02	2010/09/13	2010/11/03	2011/01/10	2011/02/22	2011/04/06			
16	Vereeniging	P243	14.5W	1500	2010/06/24	2010/08/01	2010/09/12	2010/11/17	2011/01/09	2011/02/21	2011/04/03			
17	Brandbach	R2388	3.2W	1300	2010/06/24	2010/08/12	2010/09/29	2010/11/18	2011/01/14	2011/03/04	2011/04/19			
18	Potgietersrus	N1-25	52.4N	1100	2010/06/25	2010/08/11	2010/09/30	2010/11/05	2011/01/13	2011/02/25	2011/04/20			
19	Pietersburg	N1-25	72.4N	1300	2010/06/25	2010/08/11	2010/09/30	2010/11/05	2011/01/13	2011/02/25	2011/04/20			
20	Roedan	N11-12	53.0S	958.5	2010/06/25	2010/08/11	2010/09/30	2010/11/05	2011/01/13	2011/02/25	2011/04/20			
21	Trompsburg North	N1-14	37.2S	1400	2010/07/19	2010/08/30	2010/11/16	2011/01/24	2011/03/05	2011/04/14				
22	Gariep Dam	N1-13	16.2S	1300	2010/07/19	2010/08/30	2010/11/16	2011/01/24	2011/03/05	2011/04/14				
23	Colesburg	N1-12	24.98S	1200	2010/07/19	2010/08/30	2010/11/16	2011/01/24	2011/03/05	2011/04/14				
24	Beaufort North	N1-8	30.2N	972.8	2010/07/20	2010/08/30	2010/11/16	2011/01/24	2011/03/05	2011/04/14				
25	Leeu-Gamka	N1-6	38.03N	547.8	2010/07/20	2010/08/30	2010/11/16	2011/01/24	2011/03/05	2011/04/14				
26	Malmesbury	N7-1	30.4N	89.7	2010/07/21	2010/08/31	2010/11/15	2011/01/23	2011/03/06	2011/04/13				
27	Kimberley (to Bloem)	N8-8	5.6E	1200	2010/07/23	2010/09/02	2010/11/09	2011/01/22	2011/03/10	2011/04/11				
28	Bloemhof	N12-14	34.0S	1300	2010/07/23	2010/09/03	2010/11/09	2011/01/21	2011/03/11	Site Gone				
29	Umtata (Mthatha)	N2-19	26.0N	1100	2010/08/02	2010/09/13	2010/11/02	2011/01/10	2011/02/22	2011/04/06				
30	Staffords Post 1	N2-21	45.8N	1100	2010/08/02	2010/09/13	2010/11/02	2011/01/10	2011/02/22	2011/04/06				
31	Staffords Post 2	N2-21	50.8N	997.4	0208/2010	2010/09/13	2010/11/02	2011/01/10	2011/02/22	2011/04/06				
32	Marburg	N2-22	35.0N	44.6	2010/08/03	2010/09/14	2010/11/03	2011/01/10	2011/02/22	2011/04/06				
33	Mtunzini 1	N2-28	43.2N	33.3	2010/08/03	2010/09/14	2010/11/03	No more a Site						
34	Mtunzini 2	N2-28	56.04N	41.7	2010/08/03	2010/09/14	2010/11/03	2011/01/11	2011/02/23	2011/04/07				
35	Mhlatuzi	N2-29	4.087	34.1	2010/08/03	2010/09/14	2010/11/03	2011/01/11	2011/02/23	2011/04/07				
36	Mapelane	N2-29	39.8N	77.6	2010/08/04	2010/09/15	2010/11/03	2011/01/11	2011/02/23	2011/04/07				
37	Pongola 1	N2-32	16.35N	257.7	2010/08/04	2010/09/15	2010/11/04	2011/01/11	2011/02/23	2011/04/07				
38	Pongola 2	N2-32	49.51N	577.3	2010/08/04	2010/09/15	2010/11/04	2011/01/11	2011/02/23	2011/04/07				
39	Kalabas River	N11-3	25.4N	1300	2010/08/05	2010/09/16	2010/11/01	2011/01/12	2011/02/24	2011/04/08				
40	Newcastle	N11-3	40.2N	1200	2010/08/05	2010/09/16	2010/11/01	2011/01/12	2011/02/24	2011/04/08				
41	Volkstrust	N11-5	5.2N	1800	2010/08/05	2010/09/16	2010/11/01	2011/01/12	2011/02/24	2011/04/08				
42	Bethlehem	S191	8.2S	1600	2011/01/09	2011/02/21	2011/04/04							
43	Bergville	P10/2	10.55E	1200	2011/01/09	2011/02/21	2011/04/05							

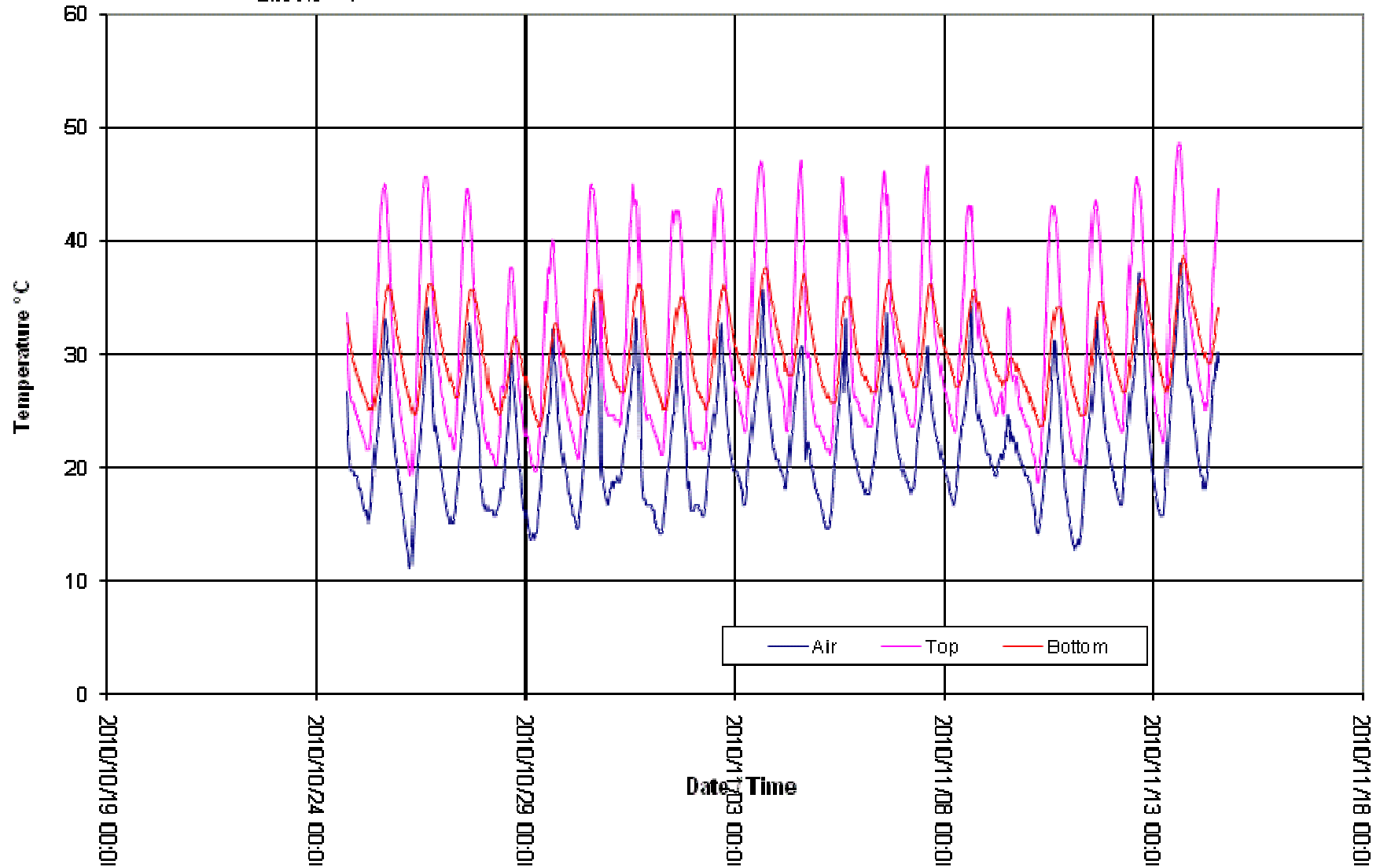
Temperature (N4-1) (19 500 readings)



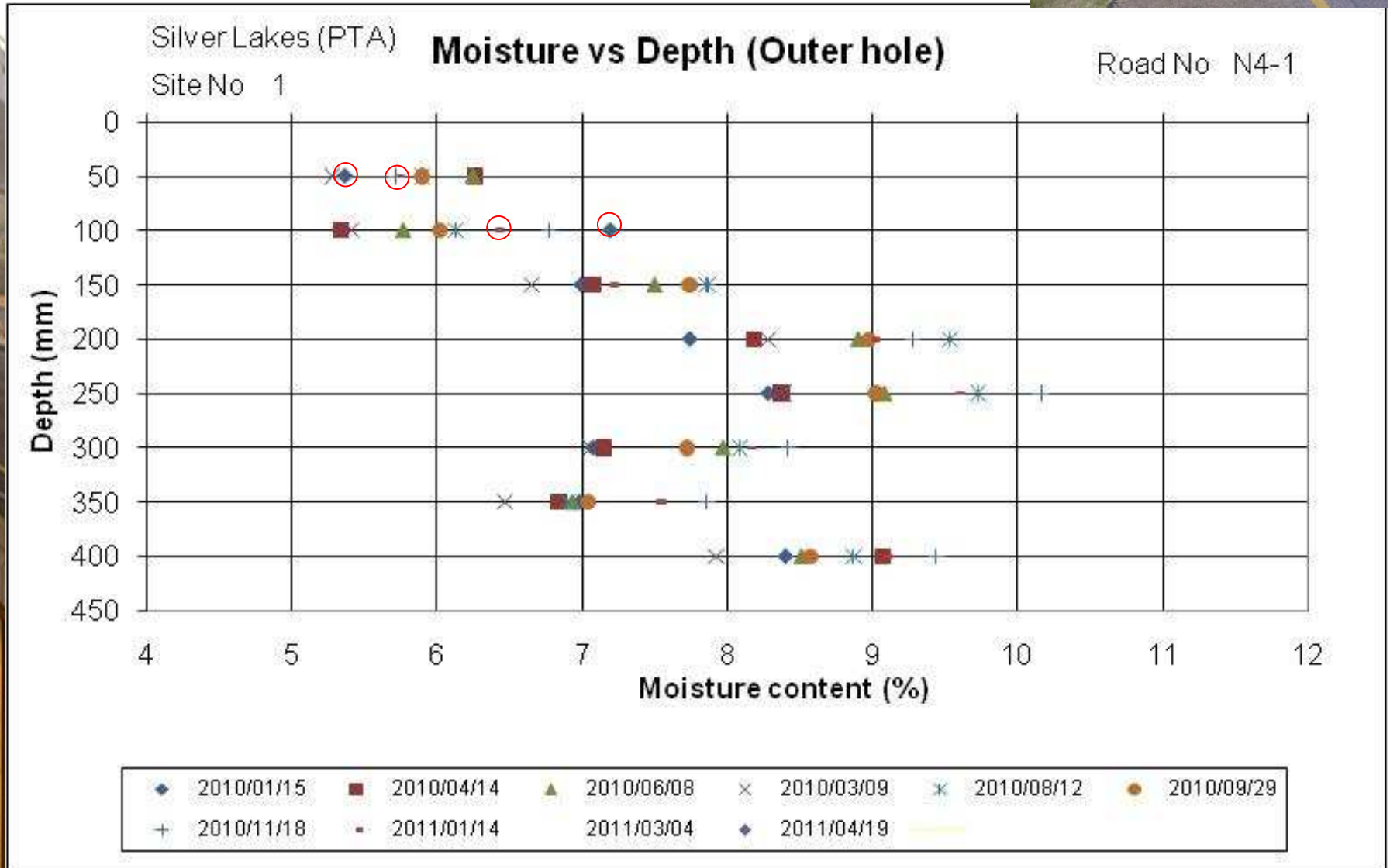
Silver Lakes (PTA)
Site No 1

Temperature Measurements

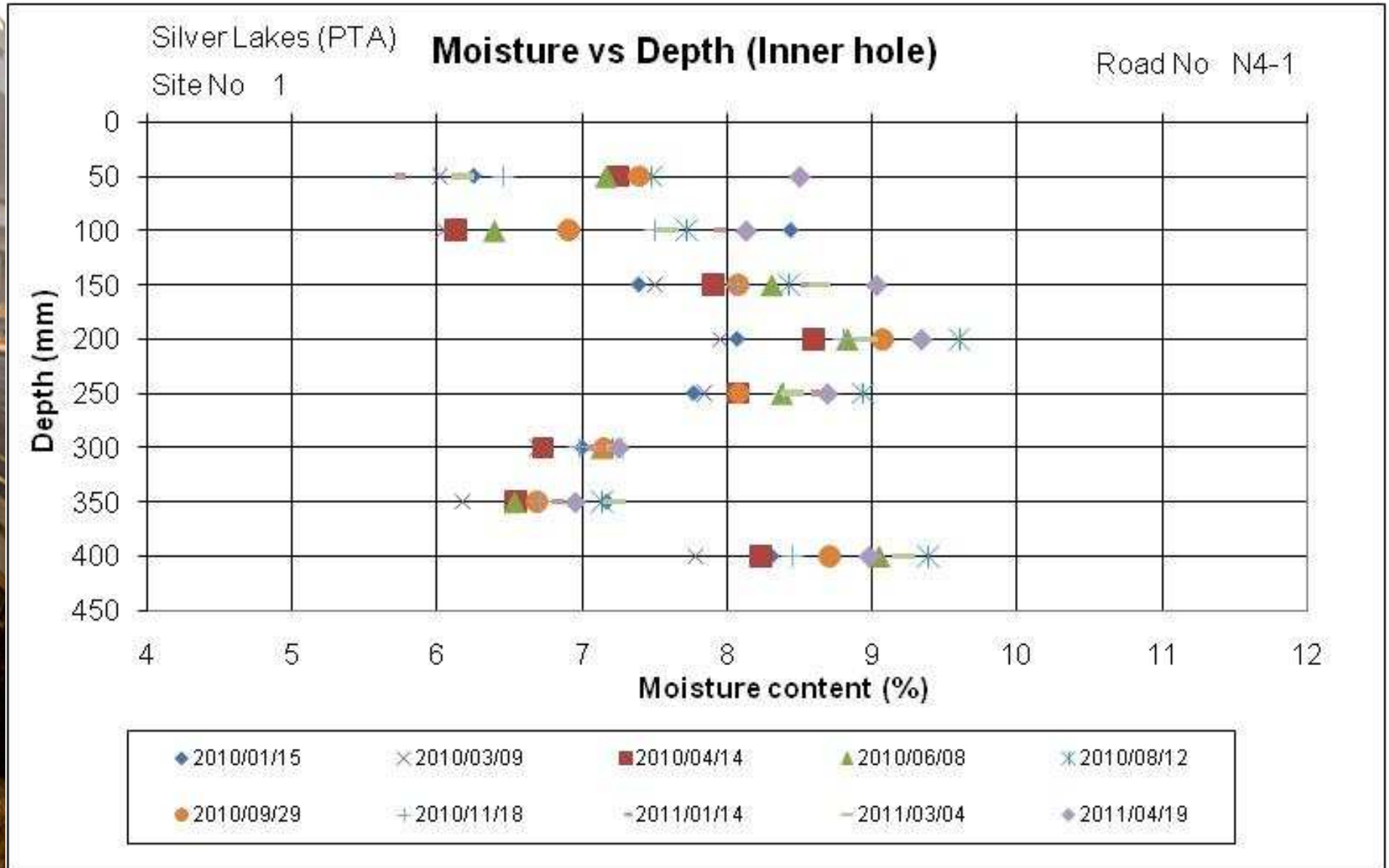
Road No N4-1



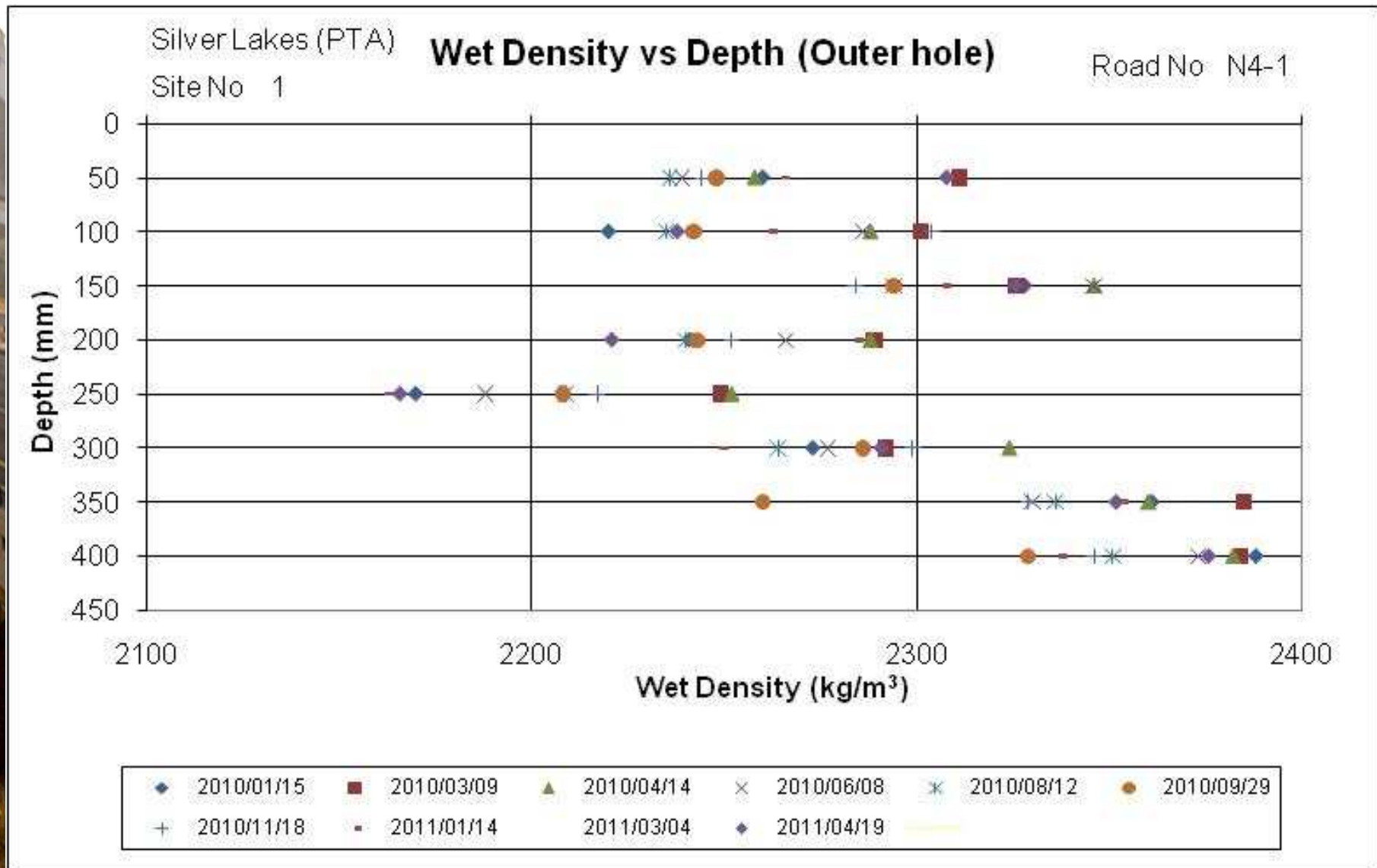
Moisture (N4-1)



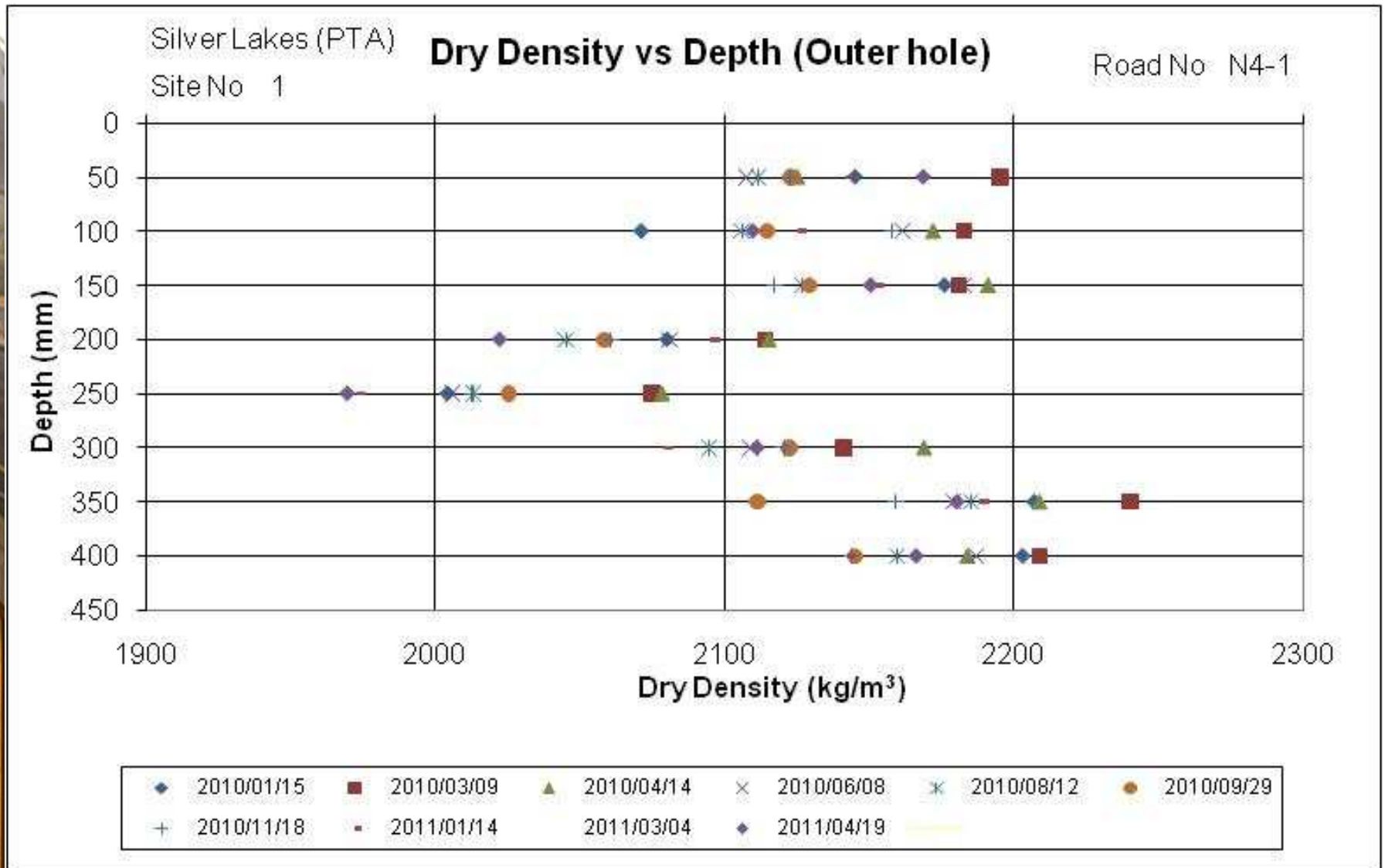
Moisture (N4-1)



Wet density (N4-1)



Dry density (N4-1)



Analysis

- Fairly meaningless as the results stand
- Need to relate them to the actual material properties of each layer
- Primarily Maximum Dry Density (MDD) and Optimum Moisture Content (OMC)
- Waiting for test results
- Will calibrate moisture content with gravimetric during sampling



•30 mm AC

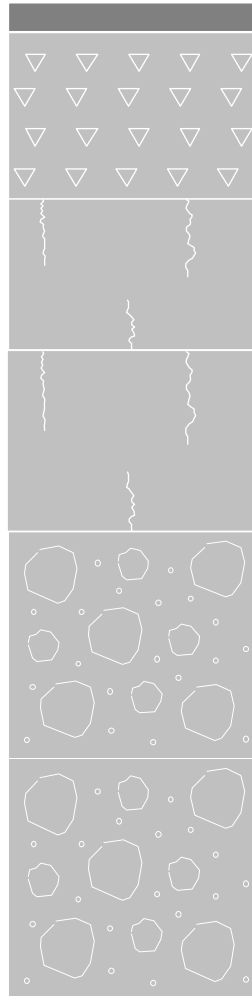
•125 mm
G1

•125 mm C2

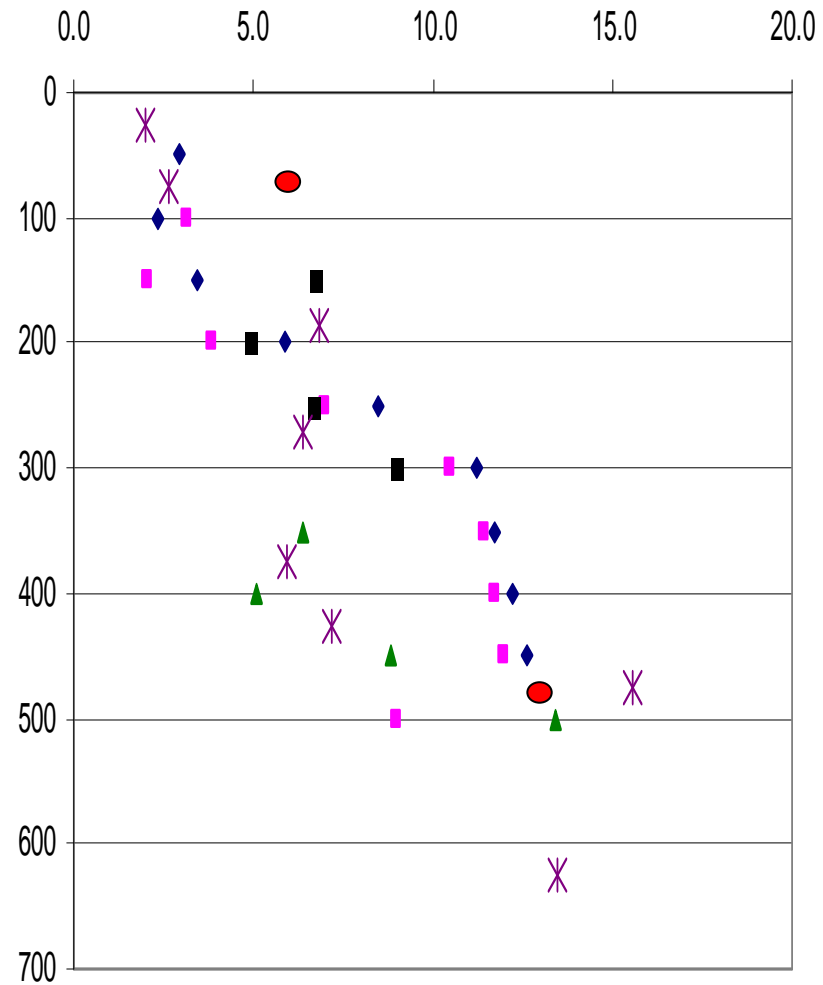
•125 mm C2

•150 mm
G5

•150 mm
G5



•Stratagauge & grav MC



- ◆ Surface
- Top of base
- ▲ 350 mm
- Top of subbase 160
- * Grav moisture

Moisture (N14-2)

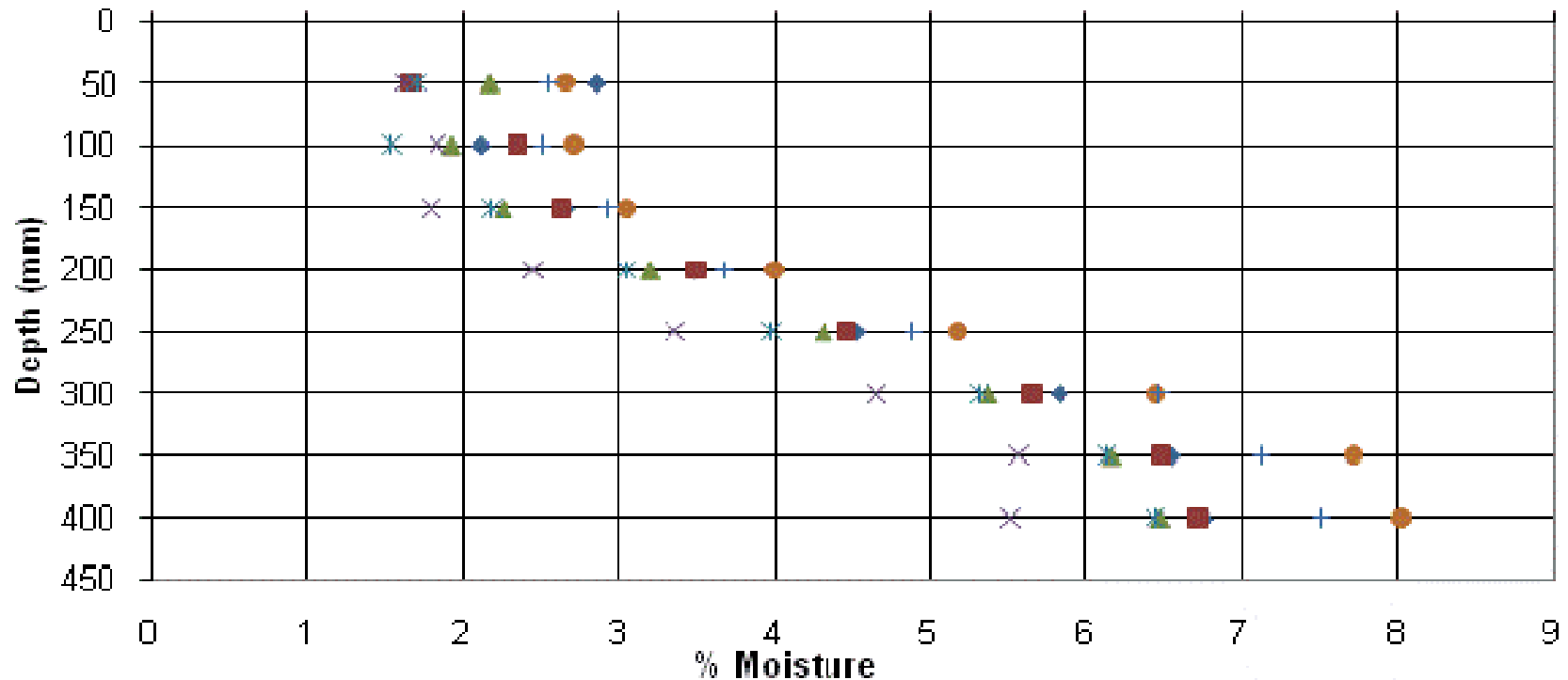


Kakamas

% Moisture Content vs Depth (Outer hole)

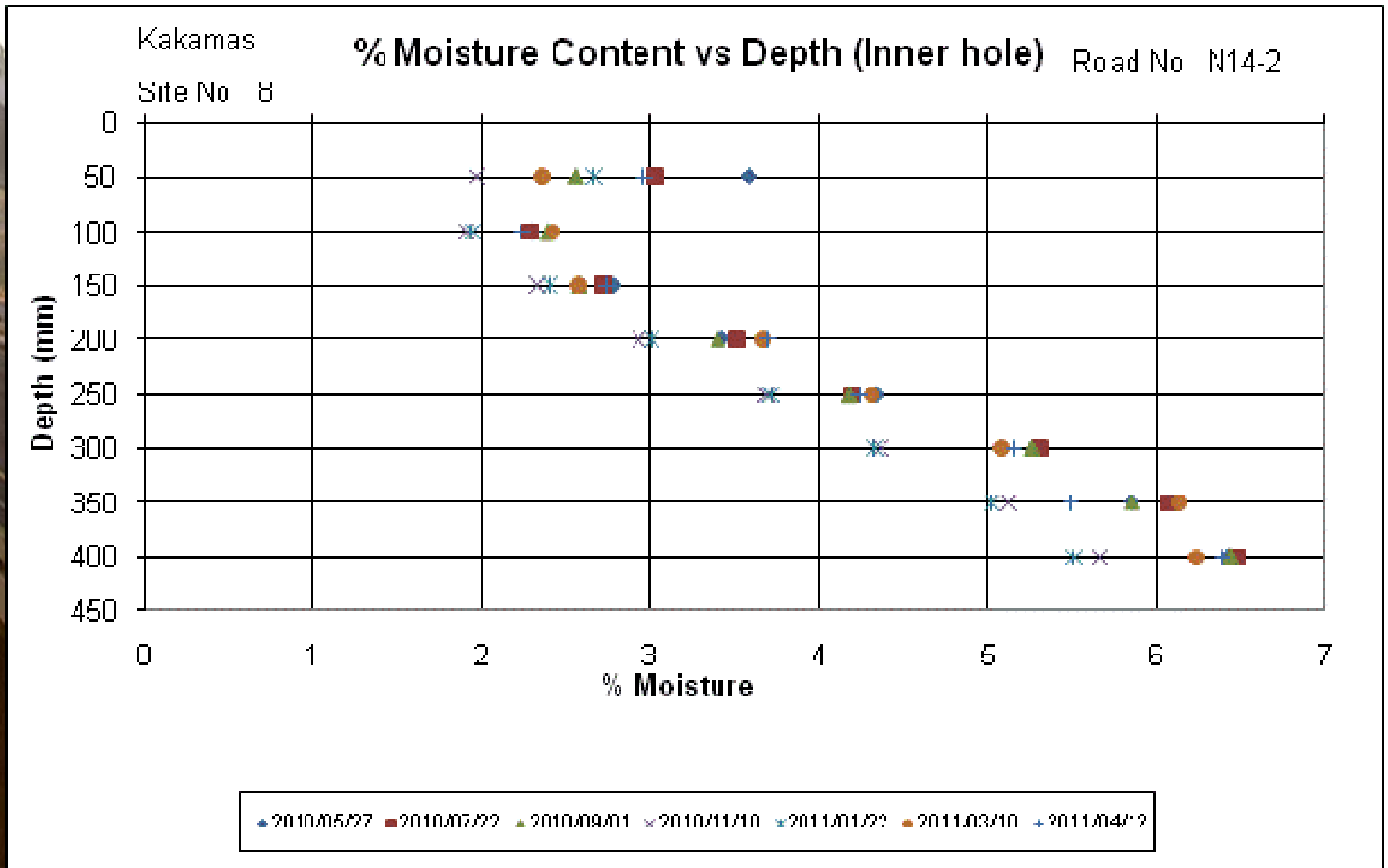
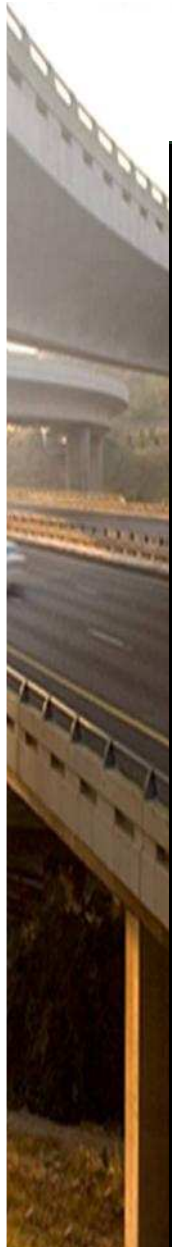
Road No N14-2

Site No 8

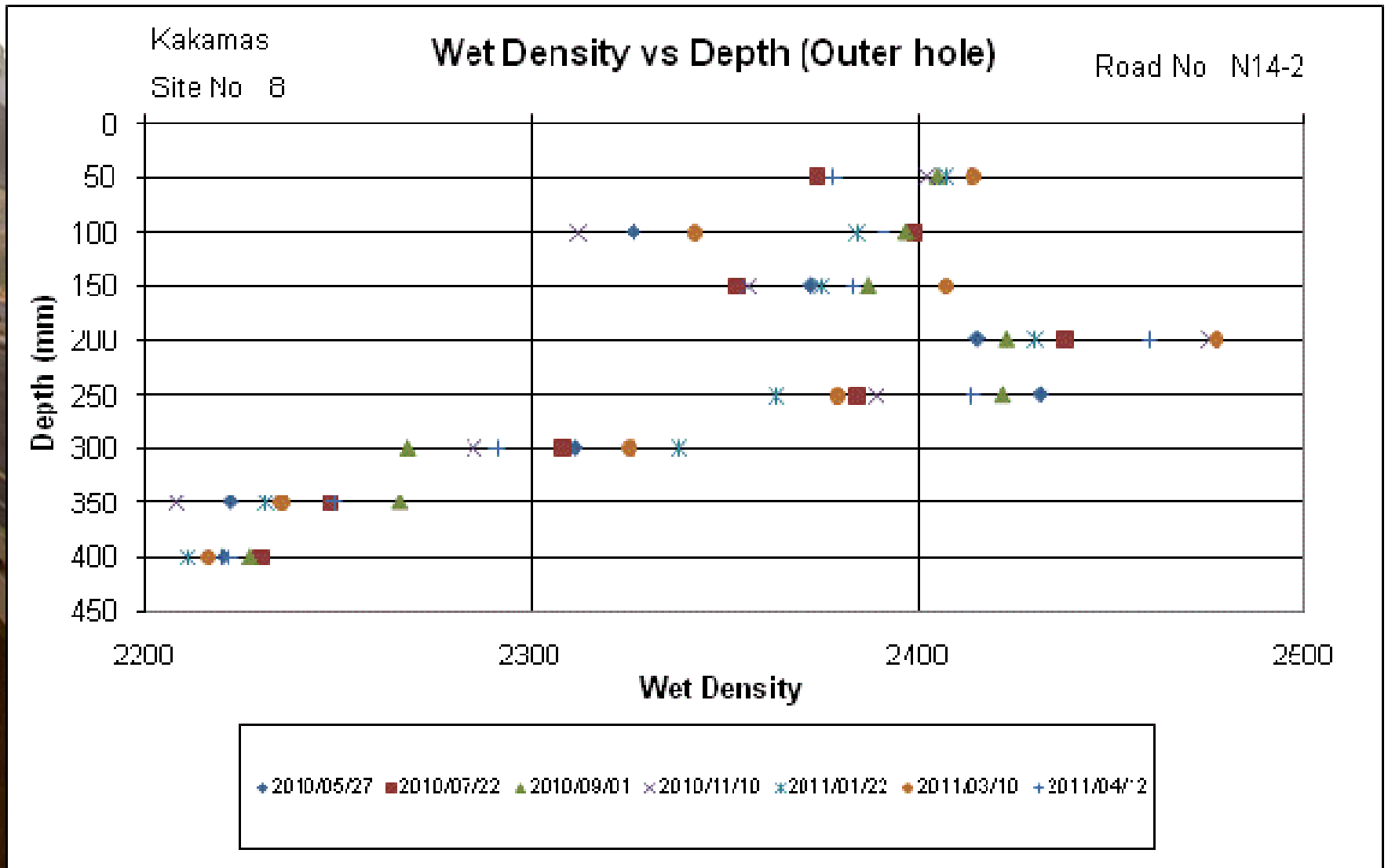


+ 2010/05/27
 ■ 2010/07/22
 ▲ 2010/09/01
 x 2010/11/10
 x 2011/01/22
 ● 2011/03/10
 + 2011/04/12

Moisture (N14-2)

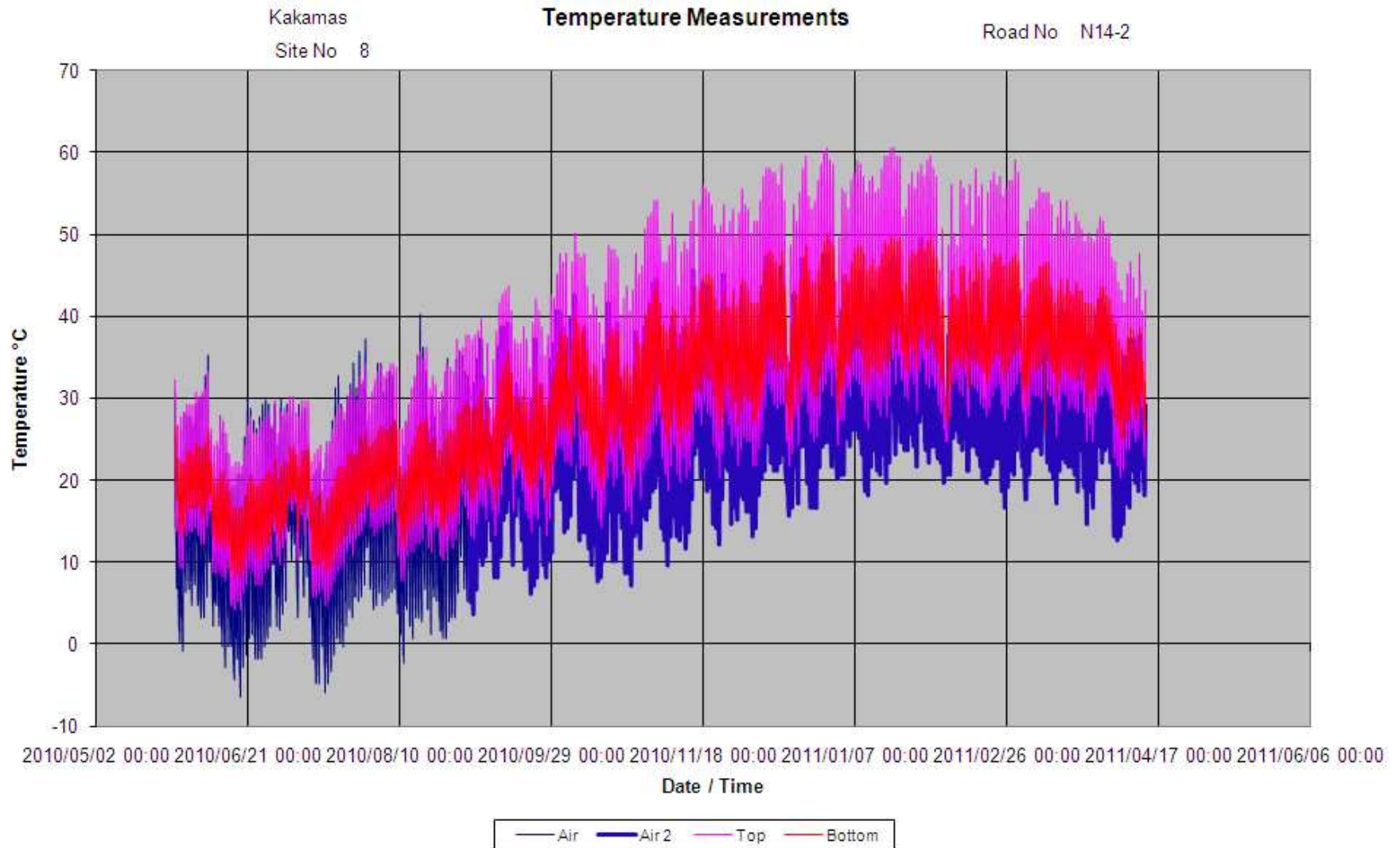
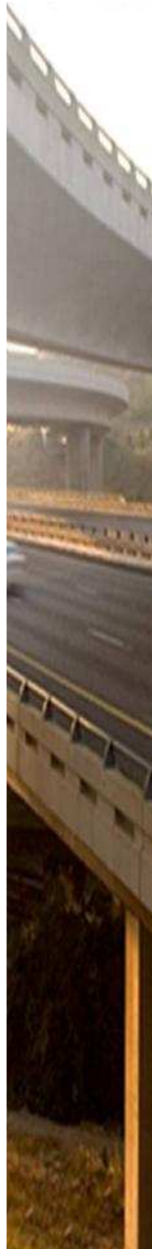


Density (N14-2)

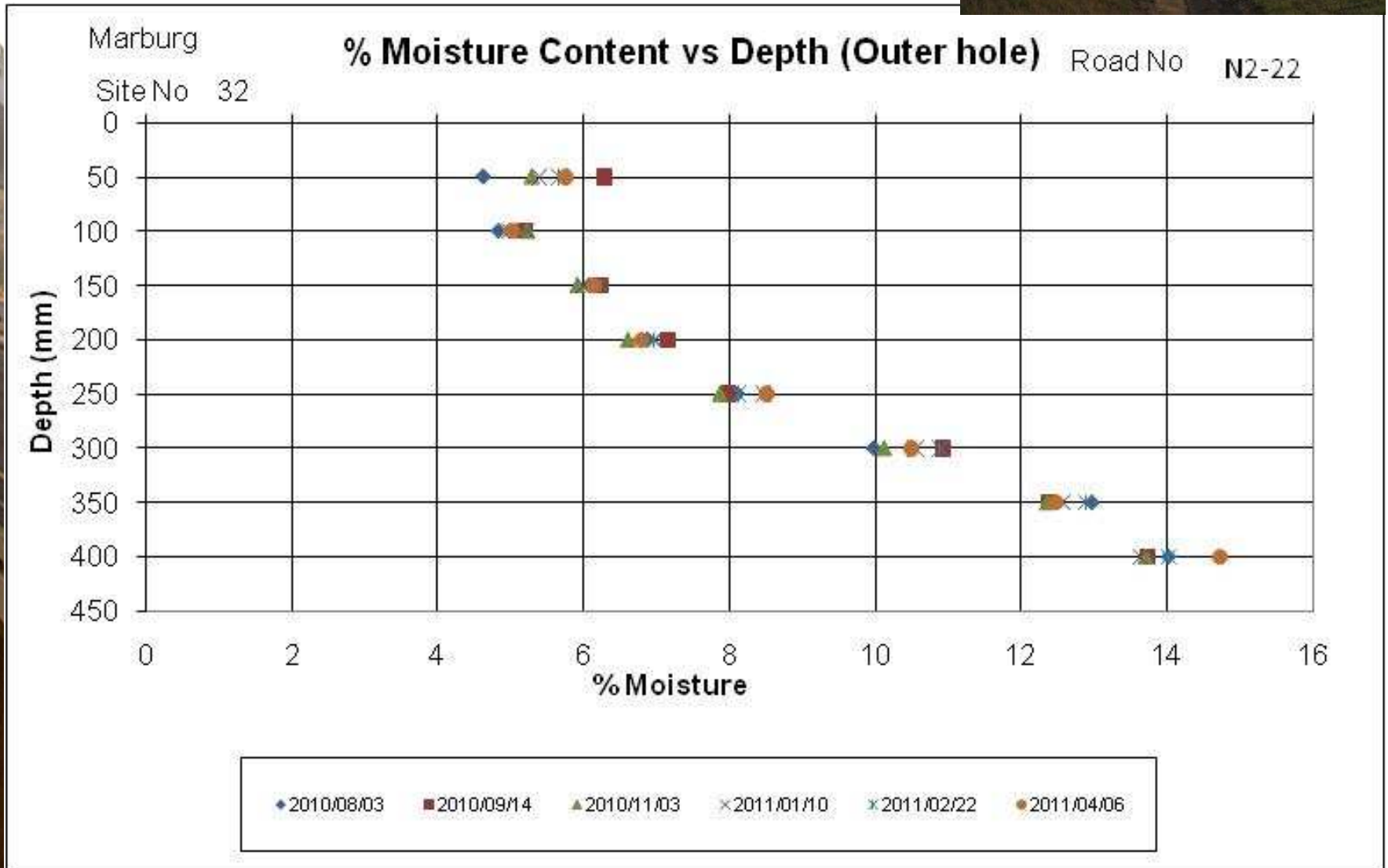
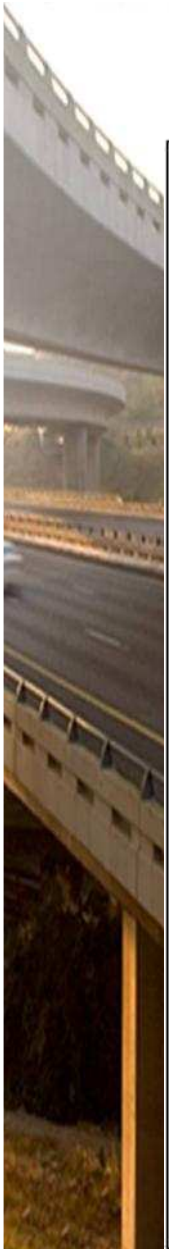


Temperature (N14-2)

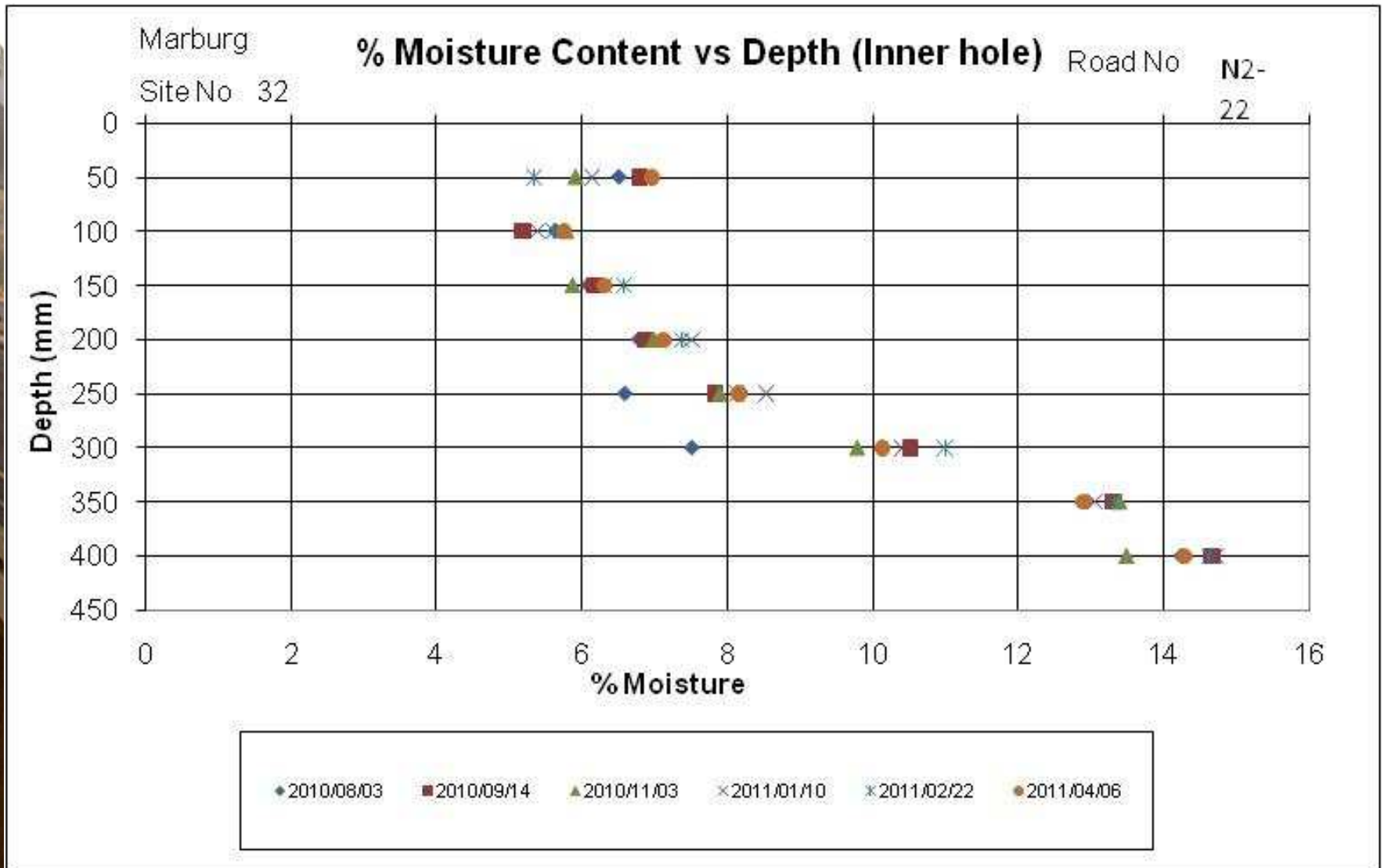
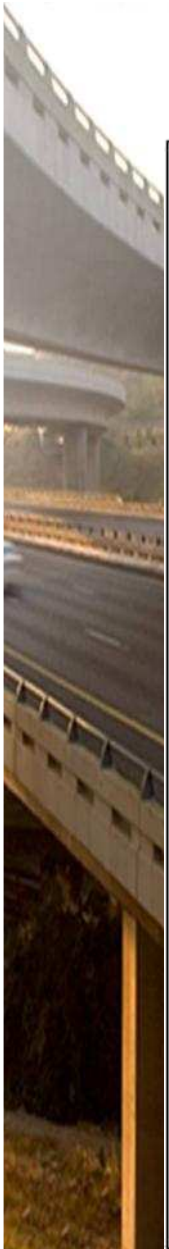
15 350 readings (every 30 mins)



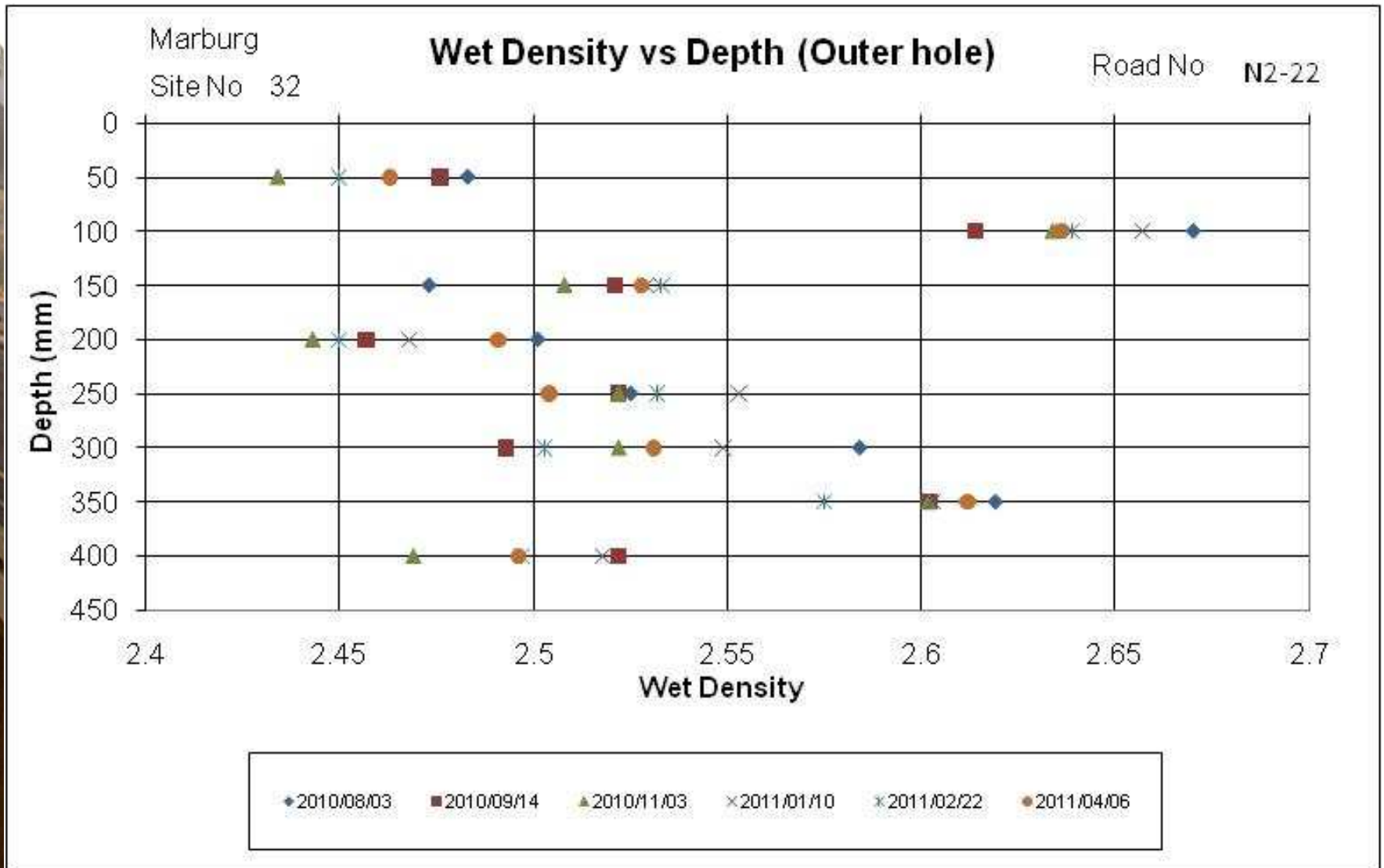
Moisture (N2-22)



Moisture (N2-22)

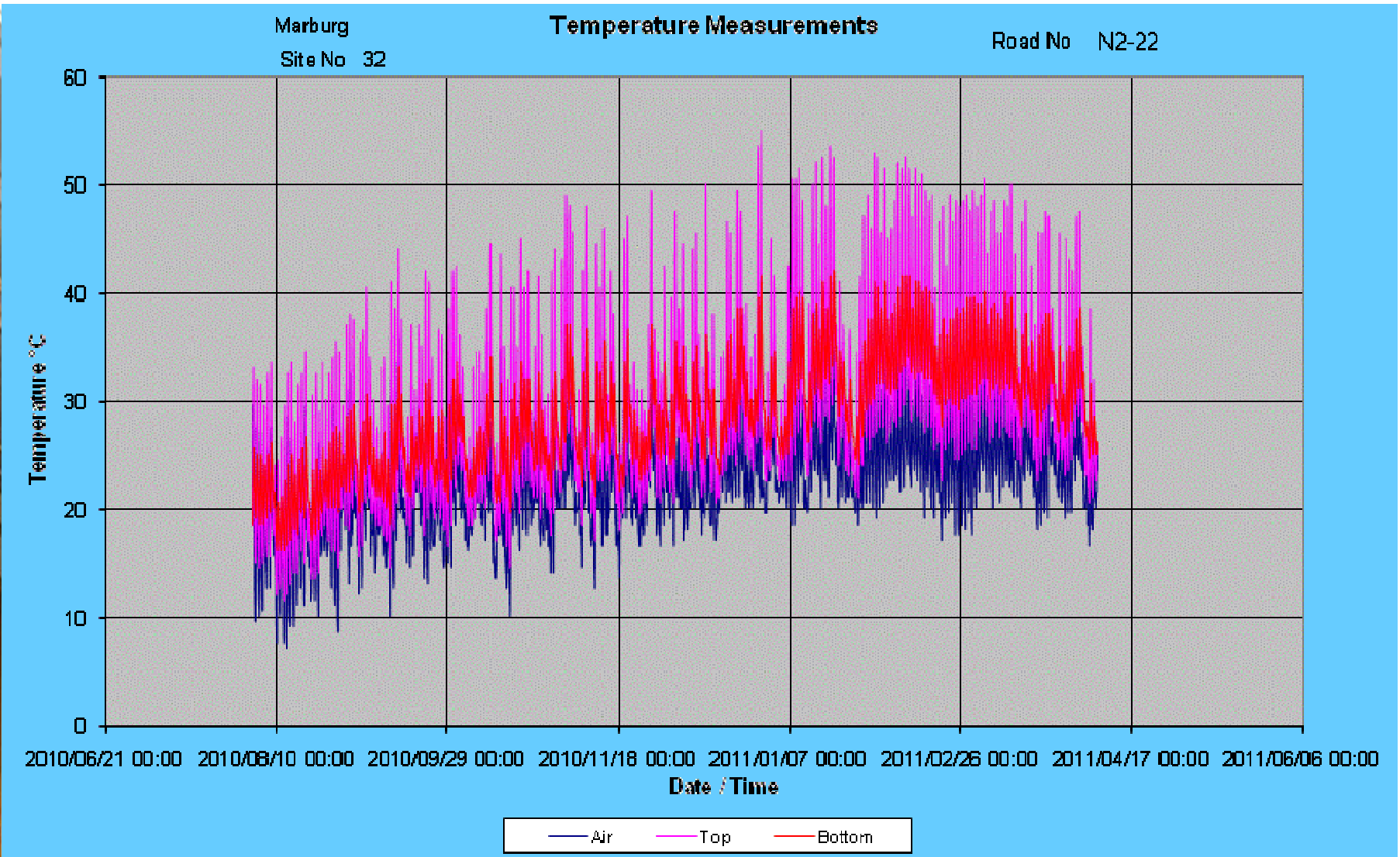


Density (N2-22)



Temperature (N2-22)

11 800 readings (every 30 mins)



Planned activities

- Continue monitoring sites
- Start test pitting, sampling and testing
- Start processing/analysing results
- Possibly install more sections
 - Failed/cracked
 - Interlocking block
 - Concrete
- More intensive monitoring at selected sites

