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Temperature Buffer Test

Measurements of water content and density of the excavated buffer material

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December 2010

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Summary

TBT (Temperature Buffer Test) is a joint project between SKB/ANDRA and supported by ENRESA (modeling) and DBE (instrumentation), which aims at understanding and modeling the thermo-hydro-mechanical behavior of buffers made of swelling clay submitted to high temperatures (over 100°C) during the water saturation process. The test was carried out at the –420 m level in Äspö HRL in a 8 meters deep and 1.76 m diameter deposition hole, with two heaters (3 m long, 0.6 m diameter), surrounded by a MX-80 bentonite buffer and a confining plug on top anchored with 9 rods. It was installed during spring 2003. The bentonite around upper heater was removed during the period October–December 2009 and the buffer around the lower heater was removed during January–Mars 2010. During dismantling of the buffer, samples were taken on which analyses were made. This report describes the work with the determination of the water content and the density of the taken samples.

Most of the samples were taken from the buffer by core drilling from the upper surface of each installed bentonite block. The cores had a diameter of about 50 mm and a maximum length equal to the original height of the bentonite blocks (about 500 mm).

The water content of the buffer was determined by drying a sample at a temperature of 105°C for 24 h and the bulk density was determined by weighing a sample both in the air and immerged in paraffin oil with known density.

The water content, dry density, degree of saturation and void ratio of the buffer were then plotted. The plots show that all parts of the buffer had taken up water and the degree of saturation of the buffer varied between 90–100%. Large variation in the dry density of the buffer was also observed.

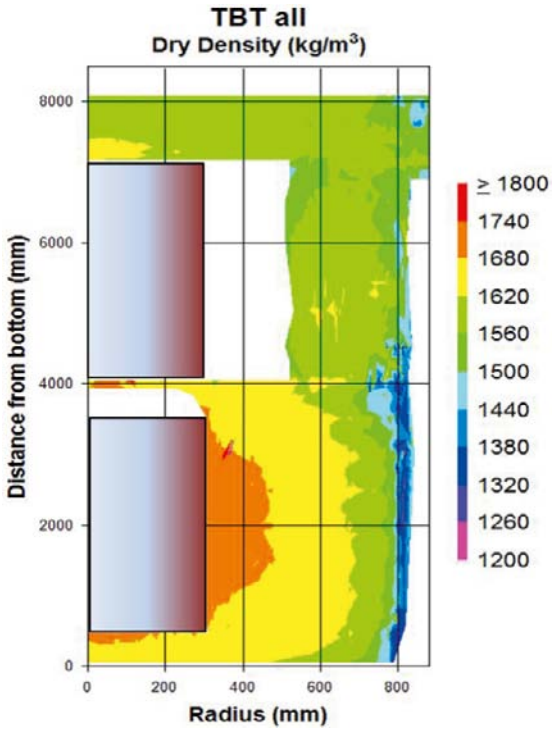


Figure S-1. *The contour plot of the dry density for the buffer in TBT.*

Contents

1 Introduction

TBT (Temperature Buffer Test) is a joint project between SKB/ANDRA and supported by ENRESA (modeling) and DBE (instrumentation), which aims at understanding and modeling the thermo-hydro-mechanical behavior of buffers made of swelling clay submitted to high temperatures (over 100°C) during the water saturation process. The measurements made during the whole test life give a good insight to the processes but all of the chemical evolution understanding will come from the analyses post-mortem of the large amount of samples recovered during the dismantling. The test was carried out at the –420 m level in Äspö HRL in a 8 meters deep and 1.76 m diameter deposition hole, with two heaters (3 m long, 0.6 m diameter), surrounded by a MX-80 bentonite buffer and a confining plug on top anchored with 9 rods. It was installed during spring 2003. Two buffer arrangements were investigated: the lower heater was surrounded by bentonite in the usual way, whereas the upper heater was surrounded by a ring of sand. The latter acted as a thermal protection for the bentonite, and as an important component for the retrievability. The buffer consists of altogether 16 bentonite blocks (see Figure 1-1).

The canisters were heated with 1,500 W power from day 15 to day 1,171, when the power was raised to 1,600 W. Around day 1,700, the power was by steps raised in the lower heater to 2,000 W and reduced in the upper heater to 1,000 W. The heating was terminated around day 2,300 in August 2009.

The bentonite around upper heater was removed during the period October–December 2009 and the buffer around the lower heater was removed during January–March 2010. During dismantling of the buffer, samples were taken for analysis purposes.

There are two phases in the analyses of the samples taken from the buffer.

1. The water content and the density were determined at the Äspö Hard Rock Laboratory just after the samples were taken from the buffer, which minimized the risk of drying and redistribution of the water in the samples. About 2,000 determinations of water content and density were made on the buffer material.
2. More advanced investigations of the buffer will be made at Clay Technology AB in Lund, such as determination of hydraulic conductivity and swelling pressure, mineralogical changes etc. These tests do not require immediate processing of the samples and will be reported separately.

The first analyse phase is described in this report.

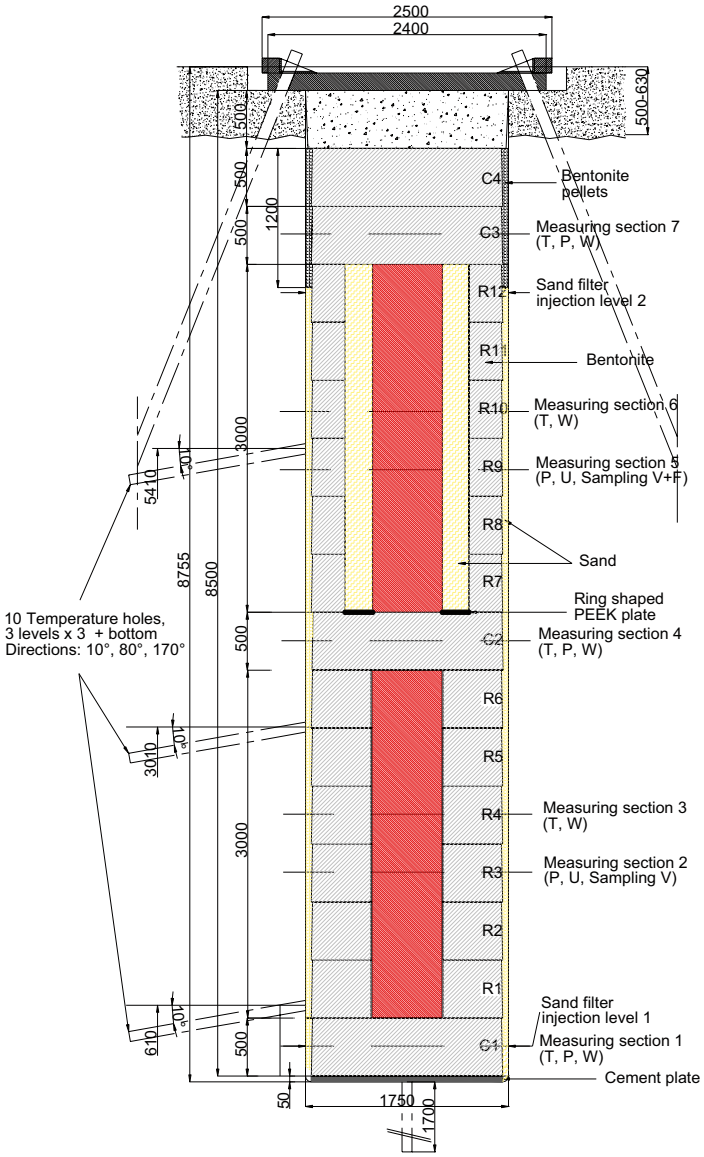


Figure 1-1. *Schematic drawing of the Temperature Buffer Test.*

2 Execution

2.1 Introduction

Most of the samples were taken by core drilling from the upper surface of each installed bentonite block (Figure 2-1). The cores had a diameter of about 50 mm and a maximum length equal to the original height of the bentonite blocks (about 500 mm). Cores were taken in four sections of each block. The radial distance between each core was about 50 mm. In order to avoid overlapping, every second core were taken along two parallel lines.The drilling was made from the top of each block with a rig designed for core drilling in concrete (Figure 2-1).

Samples close to the heaters and the rock wall were taken by stitch drilling and braking pieces from the blocks by hand (Sector samples).

Additional samples were taken close to the installed sensors.

Figure 2-1. *The drilling rig placed on top of block C4.*

2.2 The position of the samples

A coordinate system for the deposition hole was established when the buffer was installed in order to locate installed sensors. This coordinate system was also used to locate samples recovered at the end of the test. The position of each sample is defined by three coordinates

1. r-coordinate. The horizontal distance from the centre of the deposition hole.
2. z-coordinate. The distance from the bottom of the deposition hole to the position of the sample.
3. α-coordinate. The horizontal direction where the 0° direction is defined in Figure 2-2.

The angle α was marked in advance at the upper part of the deposition hole. The markers were used for determining the α-coordinate of the samples. The accuracy of the determination is approximately 2°.

The z-coordinate was determined with a laser levelling instrument. The accuracy of this measurement is approximately 1 mm.

The r-coordinate was determined by measuring the distance to the canister and/or to the wall of the deposition hole. The accuracy of this measurement is approximately 5 mm.

2.3 Preparation of the samples

Most of the samples were taken in 4 main directions as core drilled samples but also larger sectors of the buffer were taken close to the rock surface.

The samples taken from the buffer were split up in smaller pieces before determining their water content and density. The split was made with a band saw according to the following plan:

- In two directions samples were taken with a radial distance of 5 cm at one depth measured from the top of each block (122°, 302°), see Appendix 1. The smaller pieces were named after the core plus a suffix, e.g. C2:122:785:I.
- In one direction samples were taken with a radial distance of 2.5 cm at one depth measured from the top of each block (212°), see Appendix 2. The smaller pieces were named after the core plus a suffix, e.g. C2:212:785:IA.
- In one direction samples were taken with a radial distance of 5 cm at five depths measured from the top of each block (32°), see Appendix 2. The smaller pieces were named after the core plus a suffix, e.g. C2: 32:785:IV.
- The end sectors of the blocks taken close to the wall of the deposition hole will be cut in pieces with a thickness of 1 cm in radial direction. The smaller pieces will be named after the end sectors name plus a suffix e.g. R2:122:rock:I for samples taken close to the wall of the deposition hole or R2:122:heater:III for samples taken close to the heater. The suffix number is related to the radial position of the piece in the end sector. The pieces taken closest to the rock surface or heater respectively have the lowest number (I).

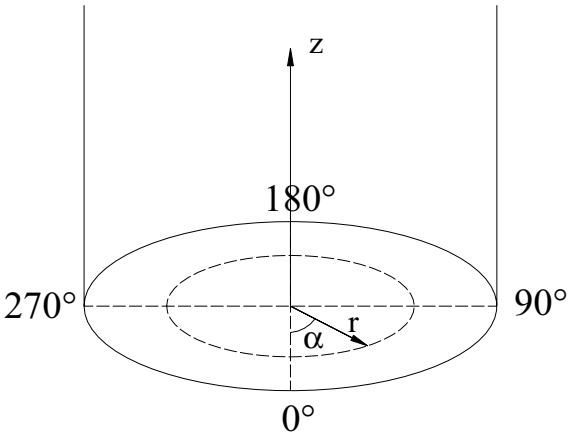


Figure 2-2. *The coordinate system used for describing the position samples. 0°is the direction towards the end of the drift and 180° is the direction almost to the north.*

2.4 Determination of density and water content of the samples

Most of the test for determining the water content and the density of the buffer tests were made immediately after the samples were taken in order to minimize the risk of air drying of the bentonite. The samples were transported to a surface laboratory at Äspö where small pieces were detached to determine the water content and density. The subsamples taken were recorded in a sampling log. The rest of the samples were restored in the aluminium laminate foil for possible use for other analyses and tests.

The following equipment was used in the laboratory:

1. **A bandsaw** for sawing out pieces form the samples.
2. **A precision balance** with 0–2,000 g range of measurement and a resolution of 0.001 g.
3. **Two ovens** for drying samples at 105°C.

Determination of water content.

The determination of the water content was made in the following way:

1. The balance was checked with reference weights before the starting of the measurements.
2. A small baking tin of aluminum was placed on the balance and the weight (m_{bt}) was noted in a protocol.
3. The sample was placed in the baking tin and the weight of sample and tin is noted in a protocol ($m_{bt} + m_{bulk}$).
4. The tin with the sample was placed in an oven with a temperature of 105°C for 24 h.
5. After the drying the weight of the baking thin and the sample ($m_{bt} + m_{solid}$) was measured and noted in a protocol.

The water content of the cut subsamples was determined by drying a sample at a temperature of 105°C for 24 h. The mass of water dried from the sample was determined according to Equation 2-1:

$$m_{water} = m_{bulk} - m_{solid} \quad (2\text{-}1)$$

and the water content (w) was calculated according to Equation 2-2.

$$w = \frac{m_{water}}{m_{solid}} \quad (2\text{-}2)$$

Determination of density

The bulk density of the samples was determined by weighing the samples both in air and immerged in paraffin oil with known density. The determination was made as follows:

1. A piece of thread was weighed.
2. The sample was weighed hanging on the thread underneath the balance (m_{bulk}).
3. The sample was then lowered in the paraffin oil with the density $\rho_{paraffin}$ and the weight ($m_{paraffin}$) was noted.

The volume of the sample (V_{buk}) and the density (ρ_{bulk}) were calculated according to Equations 2-3 and 2-3.

$$V_{bulk} = (m_{bulk} - m_{paraffine}) / \rho_{paraffine} \quad (2\text{-}3)$$

$$\rho_{bulk} = \frac{m_{bulk}}{V_{bulk}} \quad (2\text{-}4)$$

Calculation of other parameters

The dry density (ρ_{dry}) and the degree of saturation (S_r) can be calculated according to Equations 2-5 and 2-6.

$$\rho_{dry} = \frac{\rho_{bulk}}{(1+w)} \quad (2\text{-}5)$$

$$S_r = \frac{w \times \rho_{bulk} \times \rho_s / \rho_w}{\rho_s \times (1+w) - \rho_{bulk}} \quad (2\text{-}6)$$

For calculating the degree of saturation the values of the density of the solid particles ρ_s = 2,780 kg/m^3 and the density of water to ρ_w = 1,000 kg/m^3 are used. The void ratio (e) can be calculated according to Equation 2-7.

$$e = \frac{\rho_s - \rho_{bulk}}{\rho_{bulk} - \rho_w \times S_r} \quad (2\text{-}7)$$

3 Estimation of the density of different parts of the buffer after installation

Three types of large bentonite blocks, ring shaped blocks around the upper heater, ring shaped blocks around the lower heater and solid blocks, were used for the installation in the deposition hole. The outer diameter of the bentonite blocks was initially slightly tapered conical and varied between 1,630–1,650 mm. The ring shaped blocks surrounding the upper heater had initially an inner diameter of 1,070 mm. The ring shaped blocks surrounding the lower heater were compacted as solid blocks and a central hole with a diameter of 630 mm was drilled out from the blocks. The outer diameters of the solid blocks installed under and above the heaters (C1–C4) were machined to an average diameter of about 1,580 mm.

The initial average weight, water content (i.e. the water-solid mass-ratio), density and void ratio of the blocks are listed in Table 3-1.

Table 3-1. Determined parameters for blocks used in TBT.

Block No.	Weight (kg)	Water content (%)	Bulk density (kg/m^3)	Degree of saturation	Void ratio
C1	2,104	17.5	2,015	0.784	0.622
R1	2,116	17.5	2,008	0.776	0.626
R2	2,122	17.5	2,007	0.775	0.628
R3	2,124	17.7	2,004	0.778	0.632
R4	2,108	17.7	2,006	0.779	0.631
R5	2,130	17.4	2,005	0.772	0.629
R6	2,108	17.4	2,009	0.774	0.625
C2	2,112	17.5	2,008	0.776	0.627
R7	1,256	17.5	2,066	0.838	0.581
R8	1,266	17.6	2,075	0.849	0.575
R9	1,266	17.3	2,081	0.848	0.567
R10	1,250	17.7	2,080	0.857	0.573
R11	1,254	17.5	2,077	0.850	0.572
R12	1,258	17.6	2,075	0.849	0.575
C3	2,142	17.5	2,010	0.778	0.625
C4	2,084	17.6	1,997	0.768	0.637

4 Results of measured densities and water content of the buffer

Measurements of density and water content in the 16 investigated blocks were made in 4 radial lines (see Section 2.2). The water content and density of the buffer were determined in more than 2,000 positions in the test parcel. Some errors and mistakes where made during the handling of the samples on site and in the laboratory, causing unreasonable values of the determined parameters. In Table 4.1 those samples for which errors were discovered are listed together with the actions made before the data are plotted and further investigated.

In the following sections the results from the measurements of the density are described along five sections;

1. Below the lower heater (block C1).
2. Around the lower heater (block R1–R6).
3. Above the lower heater (block C2).
4. Around the upper heater (block R7–R12).
5. Above the upper heater (block C3–C4).

Table 4-1. Samples on which errors were discovered during the handling.

Sample No.	Note	Action
R1:212 R575 1B	Unrealistic determined water content	The data are not plotted
R2:32 R625 III	Unrealistic determined water content	The data are not plotted
R2:32 Surface heater I:III	Unrealistic determined water density	The data are not plotted
R3:32 R475 V	Unrealistic determined water density	The data are not plotted
R4:302 R375	Two samples with the same radius (375 mm)	The radius for one sample is changed to 475 mm
R5:32:R475 V	Unrealistic determined water content	The data are not plotted
R5:32:R775 III	Unrealistic determined water density	The data are not plotted
R5:32:R775 I	Unrealistic determined water density	The data are not plotted
R5:302 Surface heater I:III	Unrealistic determined water density	The data are not plotted
R7:122:R725	Unrealistic determined water density	The data are not plotted
R7:302:R675	Unrealistic determined water density	The data are not plotted
R7:Ändprov:302 I:IV	Unrealistic determined water content	The data are not plotted
R9:302:R70	Wrong radius noted	The radius changed to 750 mm
R9:302:R60	Wrong radius noted	The radius changed to 600 mm
R11:122R775	Two samples with the same radius (775 mm)	The radius for one sample is changed to 725 mm
R12:122:R575	Two samples with the same radius (575 mm)	The radius for one sample is changed 775 mm
C3:212:R175 I A-B	Two samples with the same radius	The data are plotted
C3:32:R475 IB	Wrong direction noted	The direction changed to 212°
C3:32:R375 IB	Wrong direction noted	The direction changed to 212°
C3:212:R525 IB	Unrealistic determined water density	The data is not plotted
C4:32:introck:V:III	Unrealistic determined water density	The data is not plotted
C4:302:R175	Wrong radius noted	The radius changed to 675 mm
C4:302:R675	Wrong radius noted	The radius changed to 175 mm
C4:302:R625	Wrong radius noted	The radius changed to725 mm
C4:302:R725	Wrong radius noted	The radius changed to625 mm

The results for all of the investigated blocks are provided in Appendix 4–20.

Furthermore the water content and density were determined on samples taken close to some of the installed sensors. This data is presented in Appendix 21.

4.1 Measurements below the lower heater (block C1)

The measured water content, dry density, degree of saturation and void ratio for block C1 are shown in Appendix 4. The results are plotted as function of the radial distance from the centre of the deposition hole. The initial conditions of the buffer are plotted in the same figures. The following observations can be made:

- Very small differences in the measured/calculated results can be seen between the four directions.
- The water content in the block has increased at all measuring points compared to the initial values.
- The dry density of the buffer has decreased compared to the initial state. This is most pronounced for the buffer close to the sand filter.
- The degree of saturation close to the sand filter is 100%, while the degree of saturation in the central part of the block is about 95%.

4.2 Measurements at the level of the lower heater (Block R1–R6)

The measured water content, dry density, degree of saturation and void ratio for the blocks R1–R6 are shown in Appendix 5–10. The results are plotted as function of the radial distance from the centre of the deposition hole. The initial conditions of the buffer are plotted in the same figures. The following observations can be made:

- Very small differences in the measured/calculated results can be seen between the four directions with one exception and that is in block R6 where direction 122° is showing lower density and higher water content compare to the other three directions. This could be the consequence of passing the power cables to the heater through cuts made inside the block and filling the voids left with powered bentonite compacted in place, close to that direction.
- The water content in the blocks has increased at all measuring points compared to the initial values.
- The dry density of the buffer has decreased compared to the initial state except for the part of the buffer close to the heater where a small increase in density can be observed. An explanation to this might be that there has been an initial shrinkage of the buffer close to the heater due to the heating.
- The degree of saturation close to the sand filter is 100%, while the degree of saturation in the central part of the block is about 95%. The lowest degree of saturation can be observed about 70 mm from the surface of the heater.

4.3 Measurements above the lower heater (block C2)

The measured water content, dry density, degree of saturation and void ratio for block C2 are shown in Appendix 11. The results are plotted as function of the radial distance from the centre of the deposition hole. The initial conditions of the buffer are plotted in the same figures. The following observations can be made:

- Very small differences in the measured/calculated results can be seen between the four directions.
- The water content in the block has increased at all measuring points compared to the initial values.
- The dry density of the buffer has decreased compared to the initial state. This is most pronounced for the buffer close to the sand filter.
- The degree of saturation close to the sand filter is 100%, while the degree of saturation in the central part of the block is about 94%.

4.4 Measurements at the level of the upper heater (Block R7–R12)

The measured water content, dry density, degree of saturation and void ratio for the blocks R7–R12 are shown in Appendix 12–17. The results are plotted as function of the radial distance from the centre of the deposition hole. The initial conditions of the buffer are plotted in the same figures. The following observations can be made:

- Very small differences in the measured/calculated results can be seen between the four directions.
- The water content in the blocks has increased at all measuring points compared to the initial values.
- The dry density of the buffer has decreased compared to the initial state.
- The degree of saturation is close to 100% in all parts of the buffer.

4.5 Measurements above the upper heater (block C3–C4)

The measured water content, dry density, degree of saturation and void ratio for the blocks C3 and C4 are shown in Appendix 18–19. The results are plotted as function of the radial distance from the centre of the deposition hole. The initial conditions of the buffer are plotted in the same figures. The following observations can be made:

- Very small differences in the measured/calculated results can be seen between the four directions.
- The water content in the block has increased at all measuring points compared to the initial values.
- The dry density of the buffer has decreased compared to the initial state. This is most pronounced for the buffer close to outer slot filled with pellets.
- The degree of saturation close to the rock surface is about 100% in both blocks while the central parts of the blocks have a degree of saturation of about 97% and 92%, for block C3 and C4, respectively.

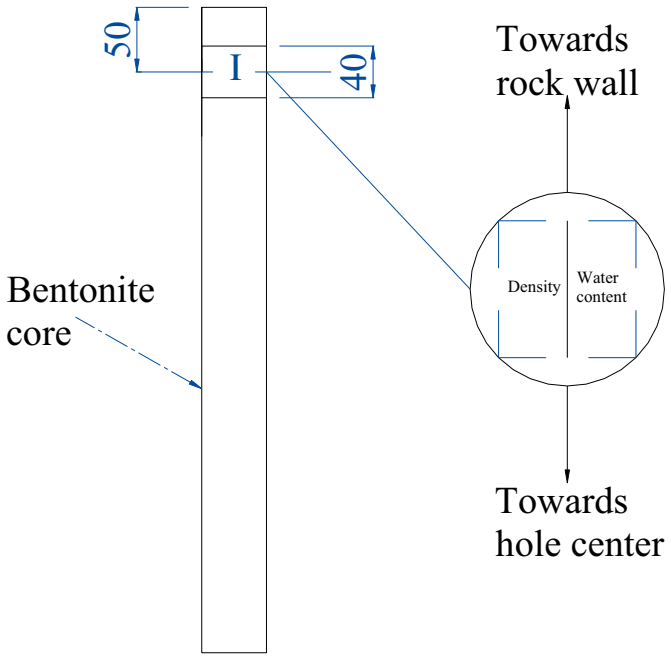
4.6 Contour plots of measured results

Contour plots of the measured and calculated variables water content, dry density, degree of saturation and void ratio were made using an interpolation program. Since the water uptake seems to be axi symmetric, it was possible to use all the data determined from the samples and plot them only as function of the radius and the depth and neglecting the direction angle. These types of plots are shown in Appendix 20.

Samples from cores in directions 122° and 302°

RevNo	Revision note	Date	Signnature	Checked

122° and 302° : Density and water content /5 cm radial direction. One level.



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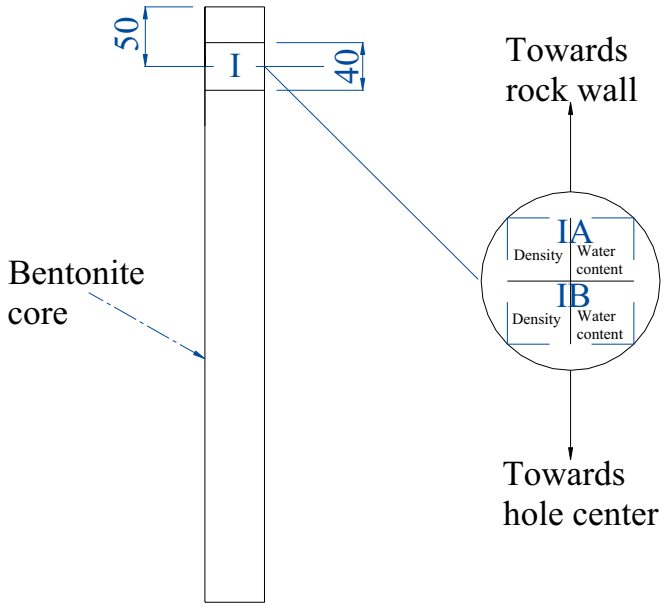
Clay Technology AB Ideon 223 70, Lund Tel: 046-286 2570, Fax: 046-134230		Sampling				
		TBT			Edetion	Sheet

Samples from cores in direction 212°

RevNo	Revision note	Date	Signnature	Checked

212°: Density and water content /2.5 cm radial direction. One level.



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Clay Technology AB
Ideon 223 70, Lund
Tel: 046-286 2570, Fax: 046-134230

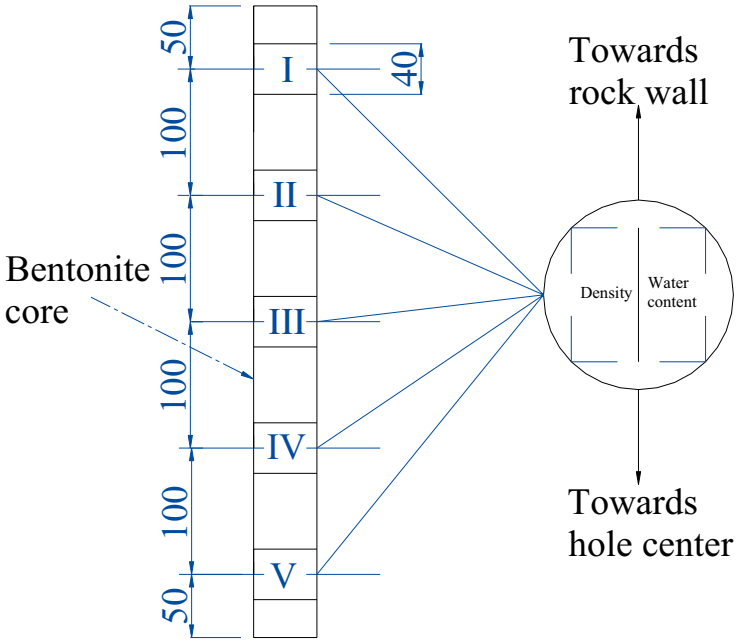
Sampling

TBT | Edetion | Sheet

Samples from cores in direction 32°

RevNo	Revision note	Date	Signnature	Checked

32° : Density and water content /5 cm radial direction. Five levels.



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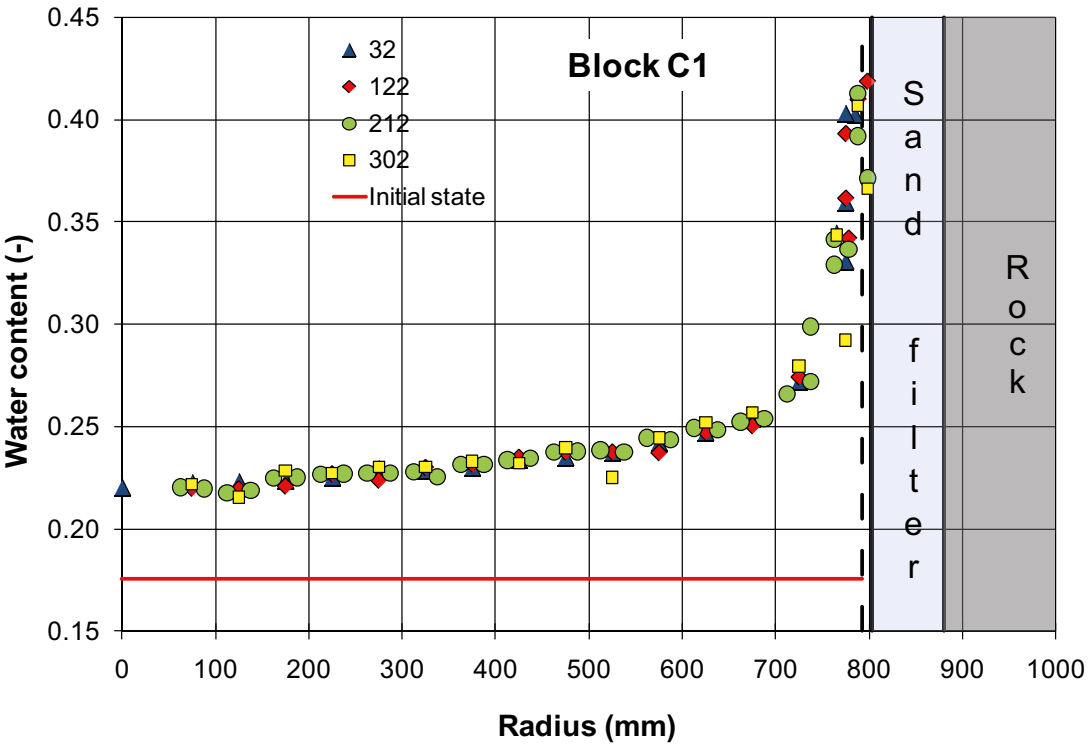
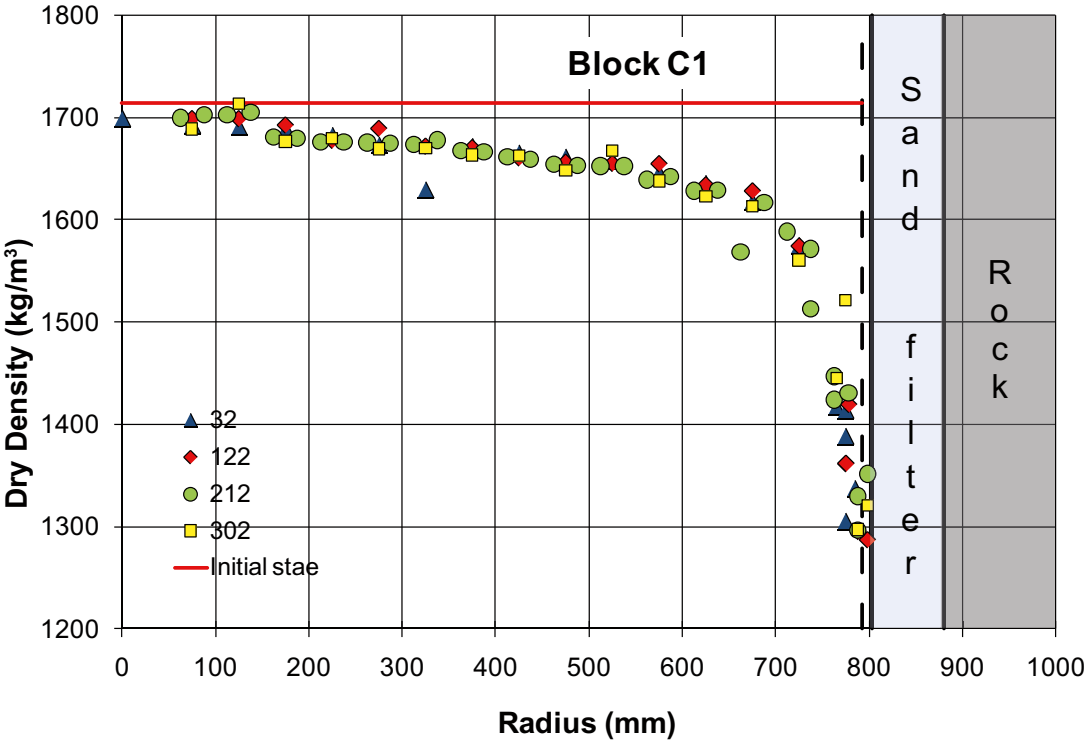
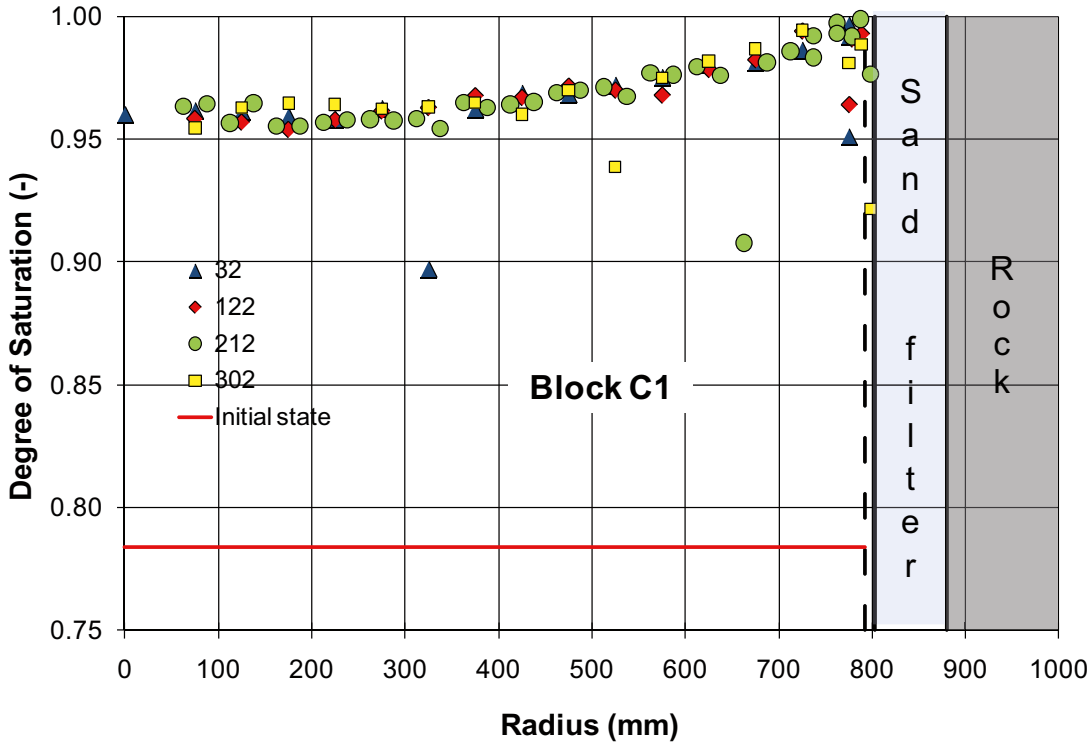
		TBT			Edetion	Sheet

Results from measurements made in block C1



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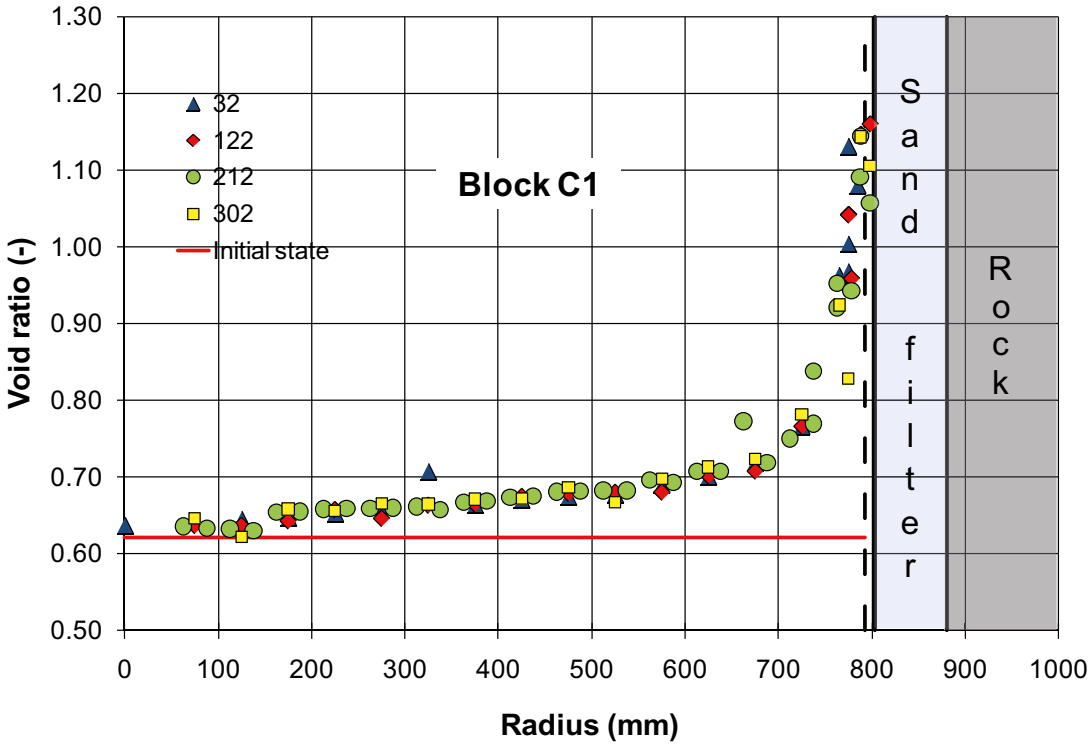
1.00
0.95
0.90
0.85
0.80
0.75
0
100
200
300
400
500
600
700
800
900
1000
Radius (mm)
32
122
212
302
Initial state
Block C1
Sand filter
Rock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0.90
0.80
0.70
0.60
0.50
0
100
200
300
400
500
600
700
800
900
1000
Radius (mm)
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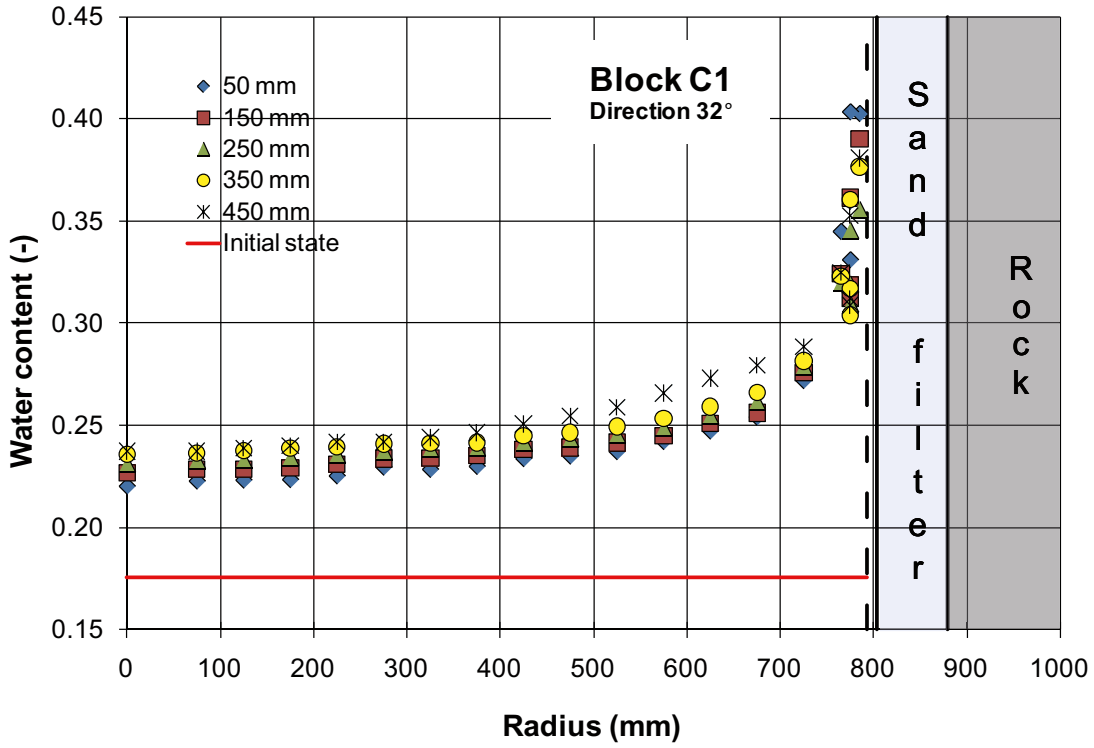
122
212
302
Initial state
Block C1
Sand filter
Rock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Direction 32°
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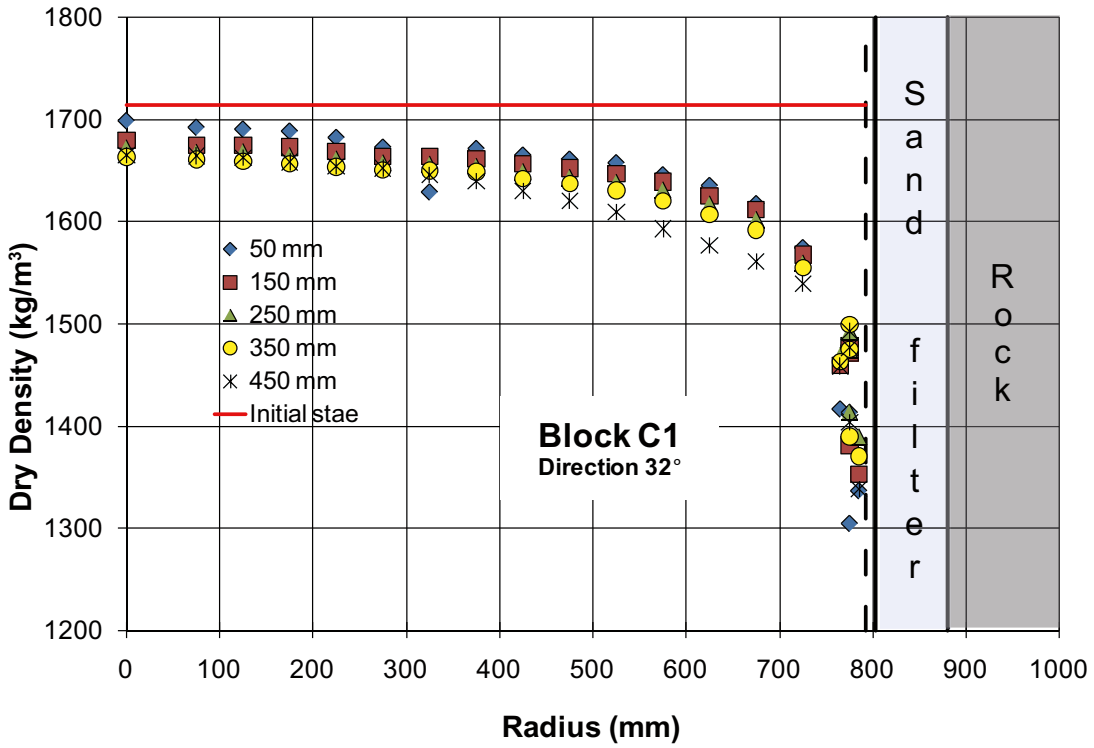
150 mm
250 mm
350 mm
450 mm
Initial state
Water content (-)
Radius (mm)
Sand filter
Rock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Direction 32°
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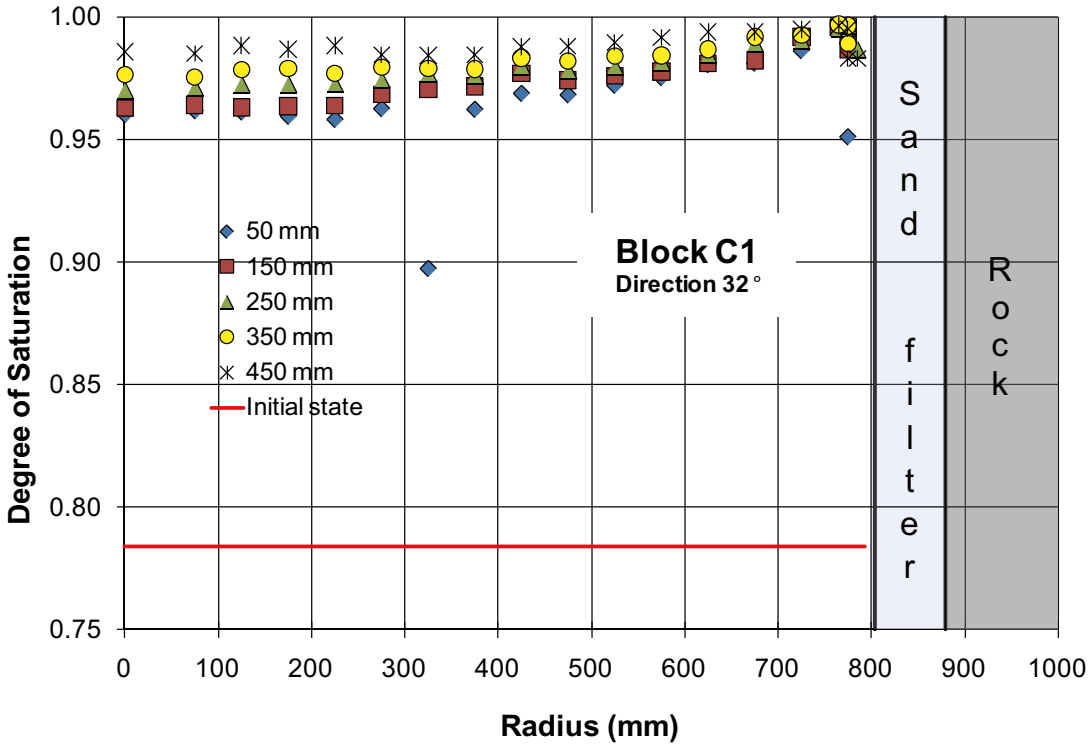
150 mm
250 mm
350 mm
450 mm
Initial stae
Dry Density (kg/m³)
Radius (mm)
Sand filter
Rock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0.85
0.80
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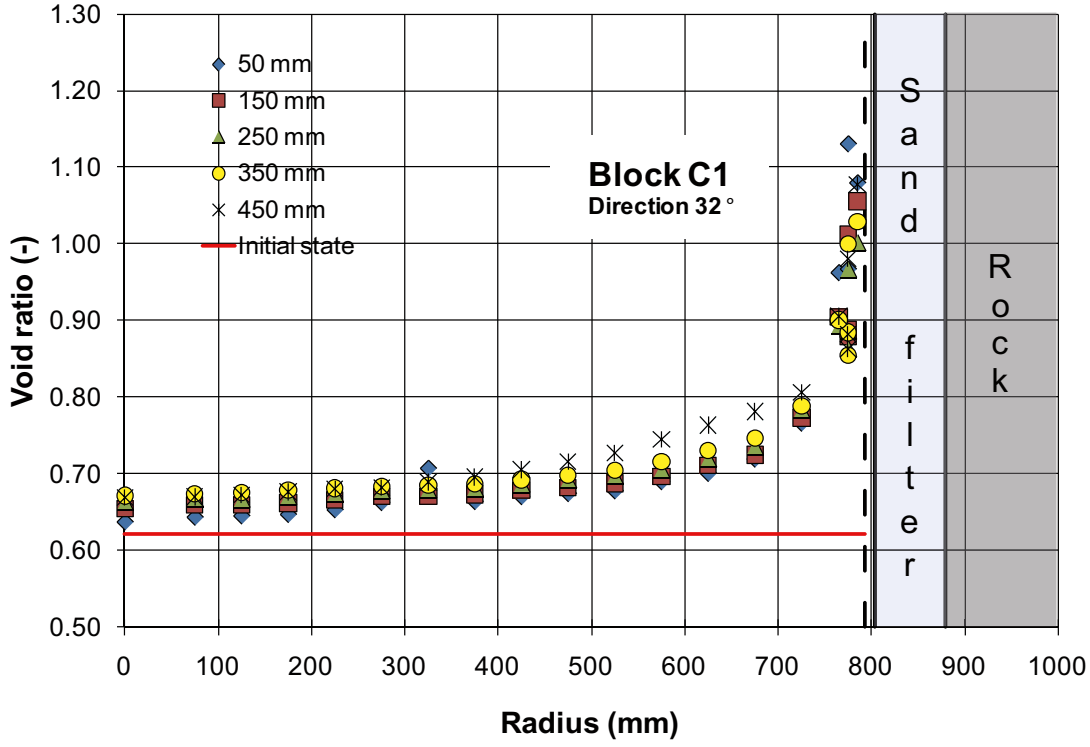
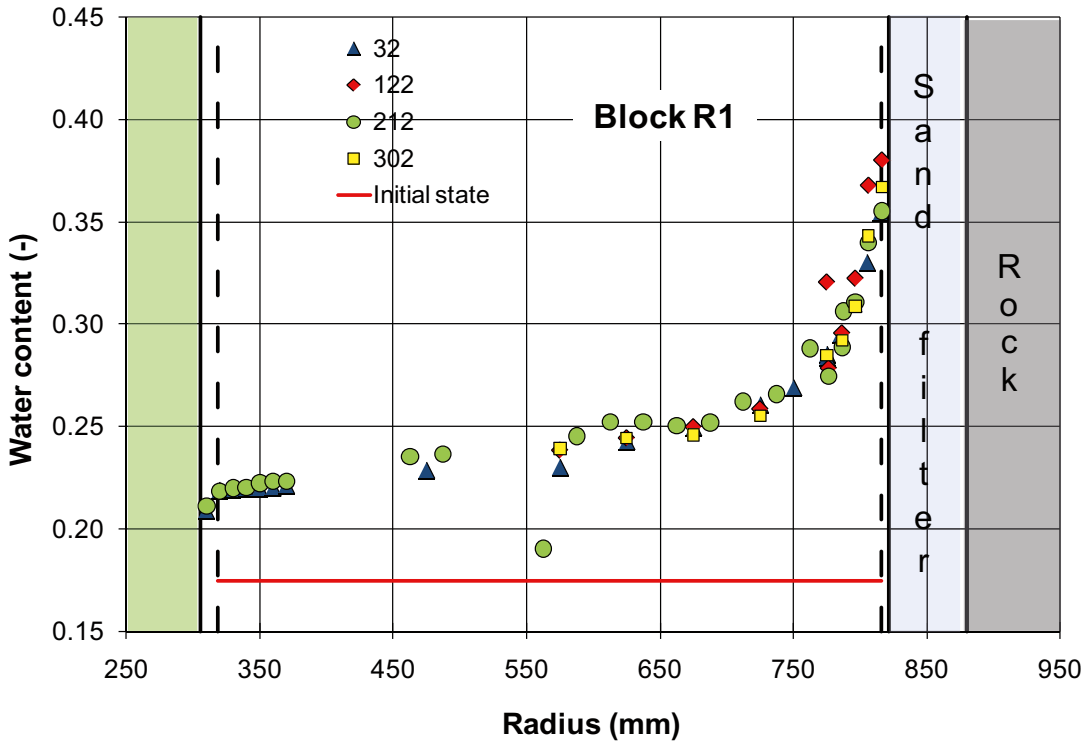
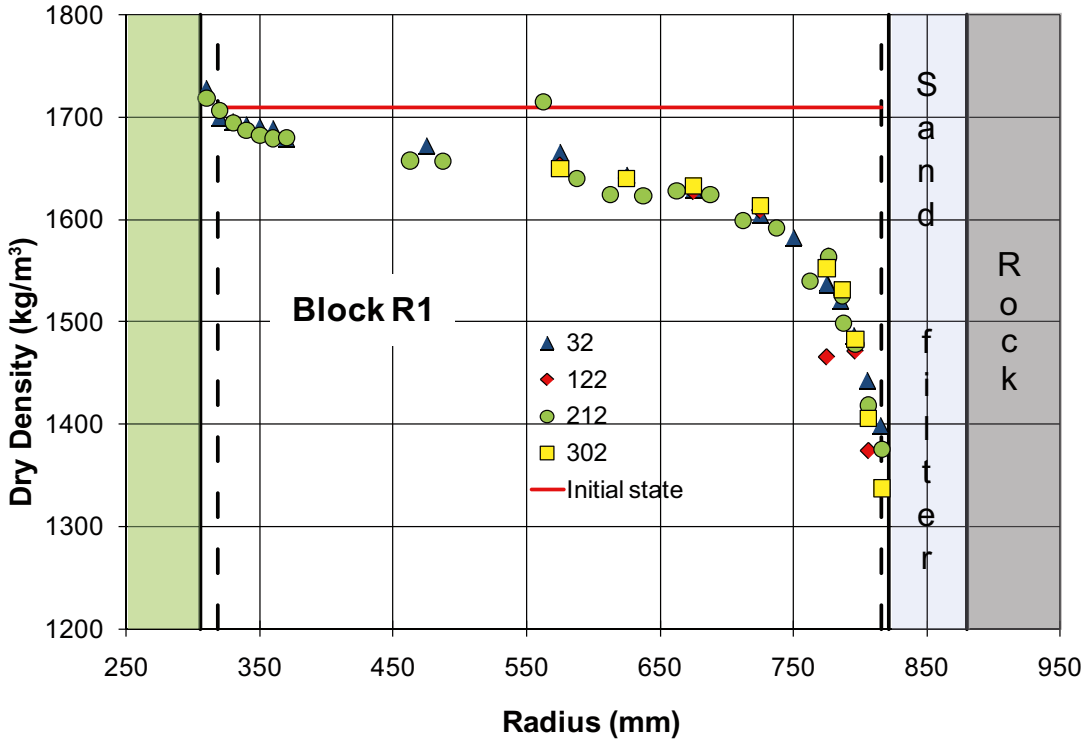
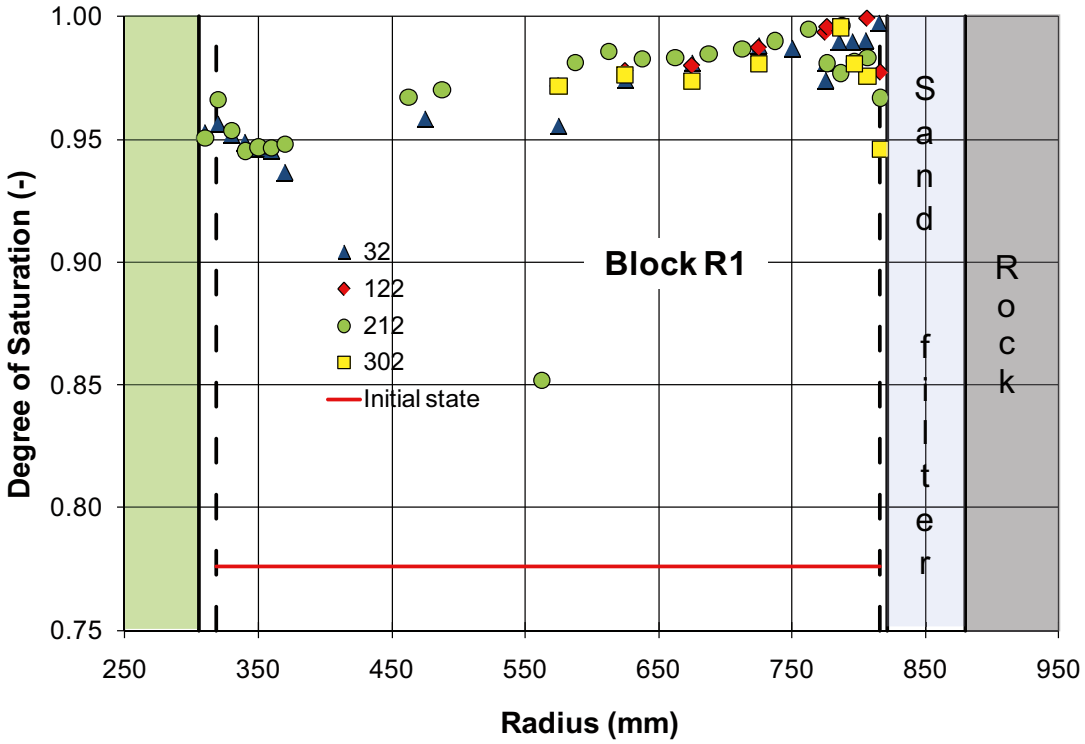
100
200
300
400
500
600
700
800
900
1000
Radius (mm)
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block C1
Direction 32°
Sand filter
Rock

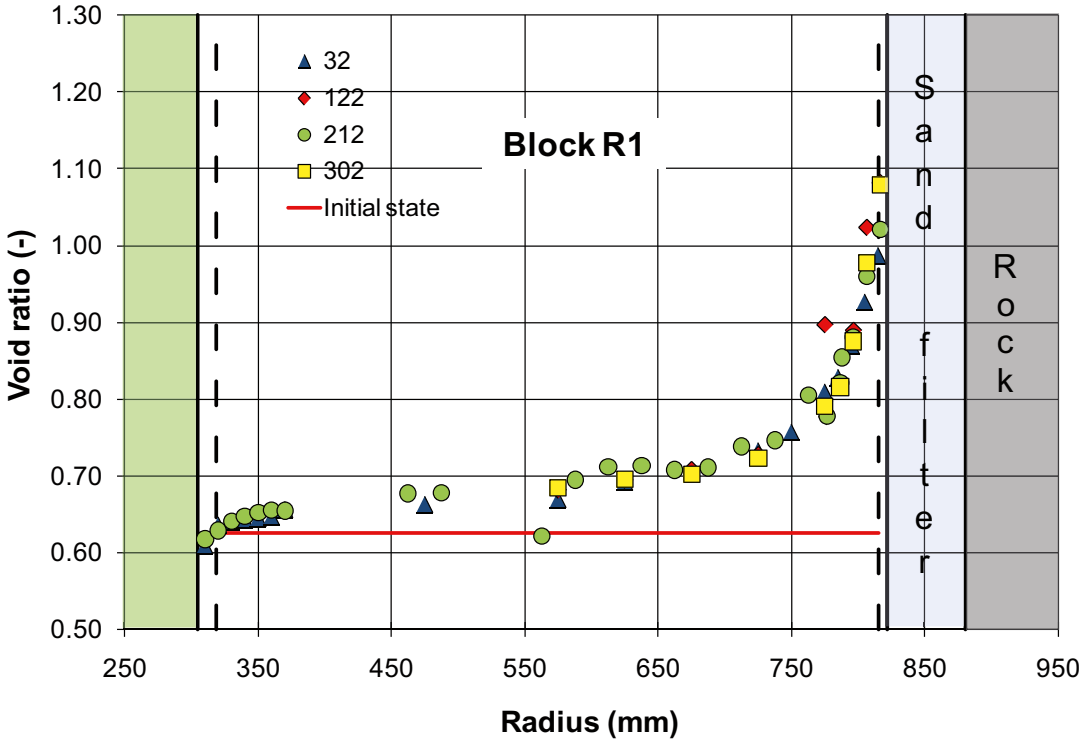

Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0
100
200
300
400
500
600
700
800
900
1000
Radius (mm)
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block C1
Direction 32°
Sand filter
Rock

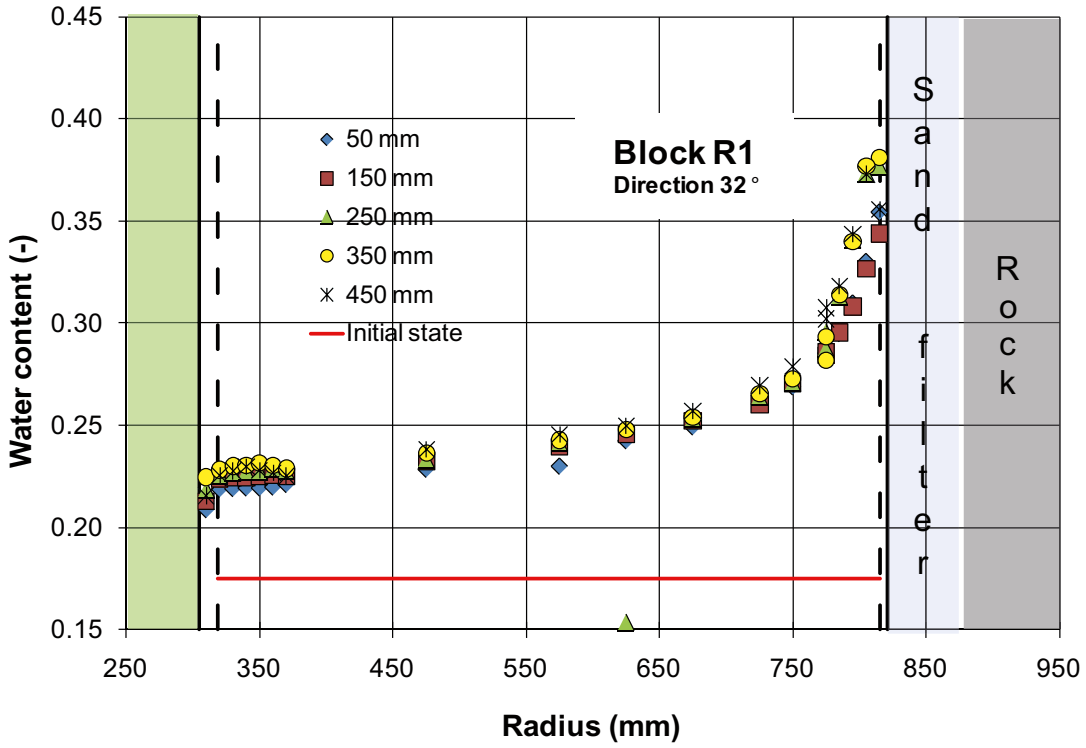
Results from measurements made in block R1

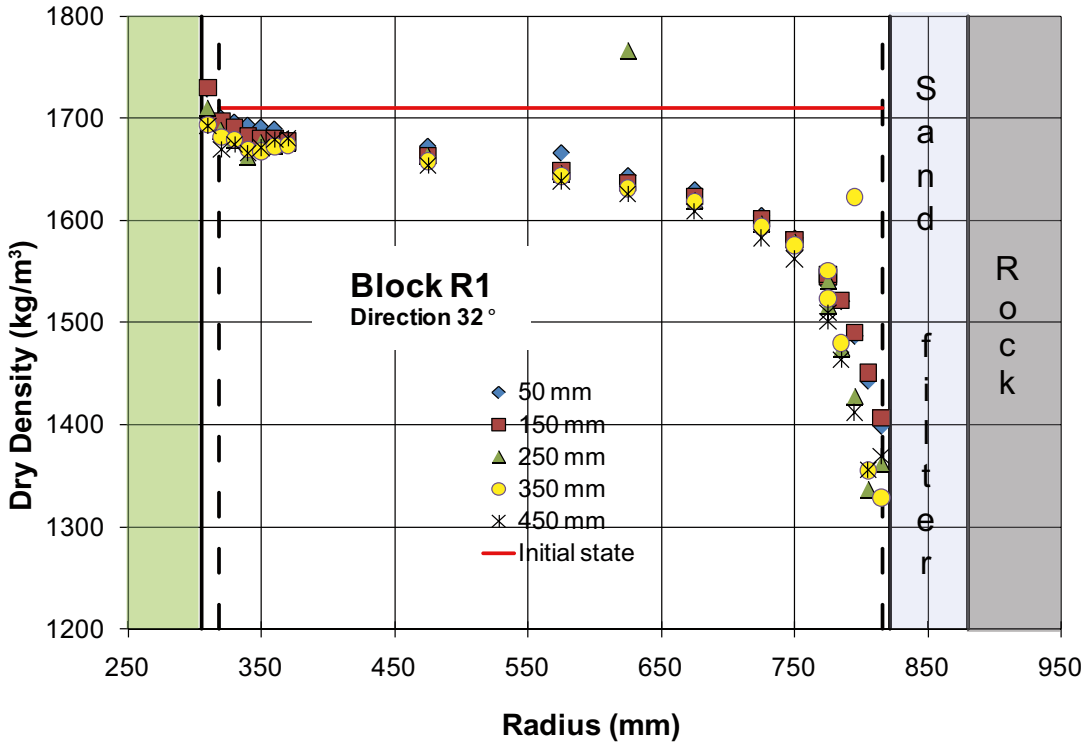


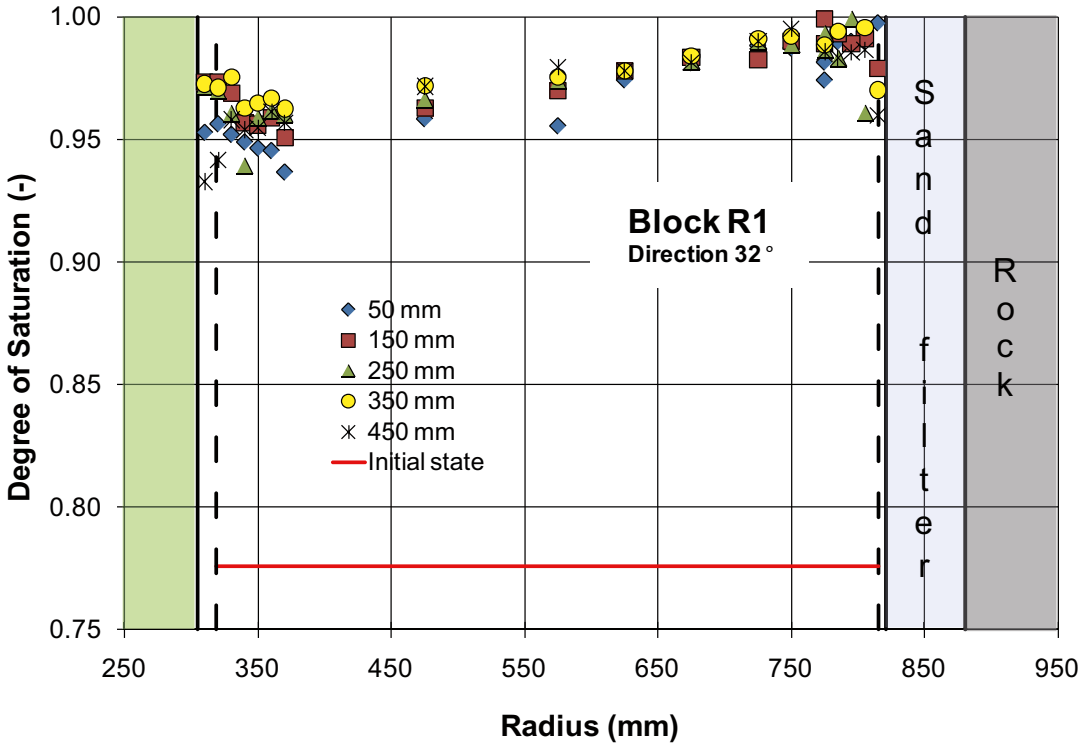


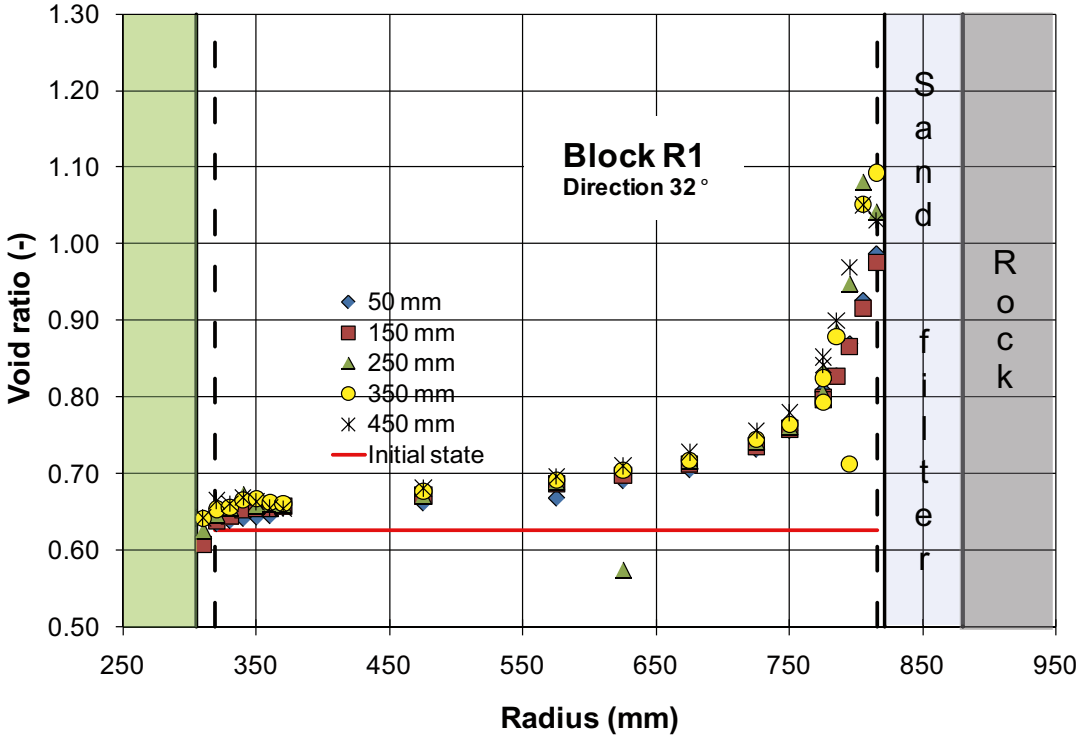

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
Block R1
32
122
212
302
Initial state
Sand filter
Rock


Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Block R1
32
122
212
302
Initial state
Sand filter
Rock

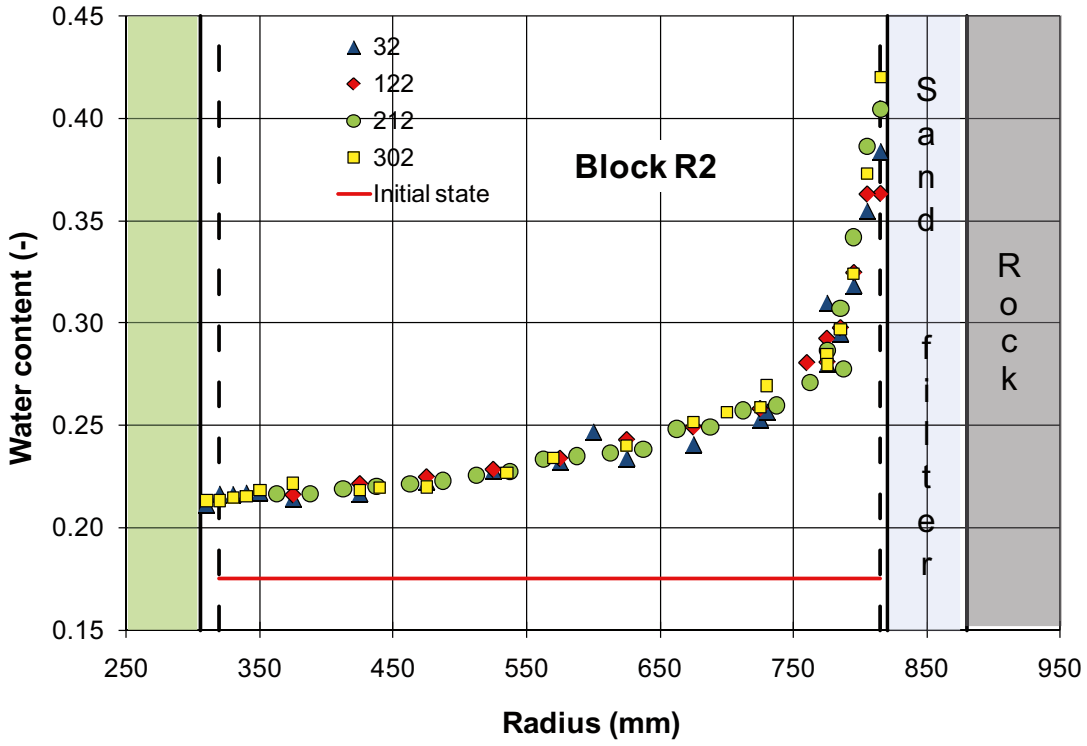

Water content (-)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
250
350
450
550
650
750
850
950
Radius (mm)
Block R1
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Sand filter
Rock

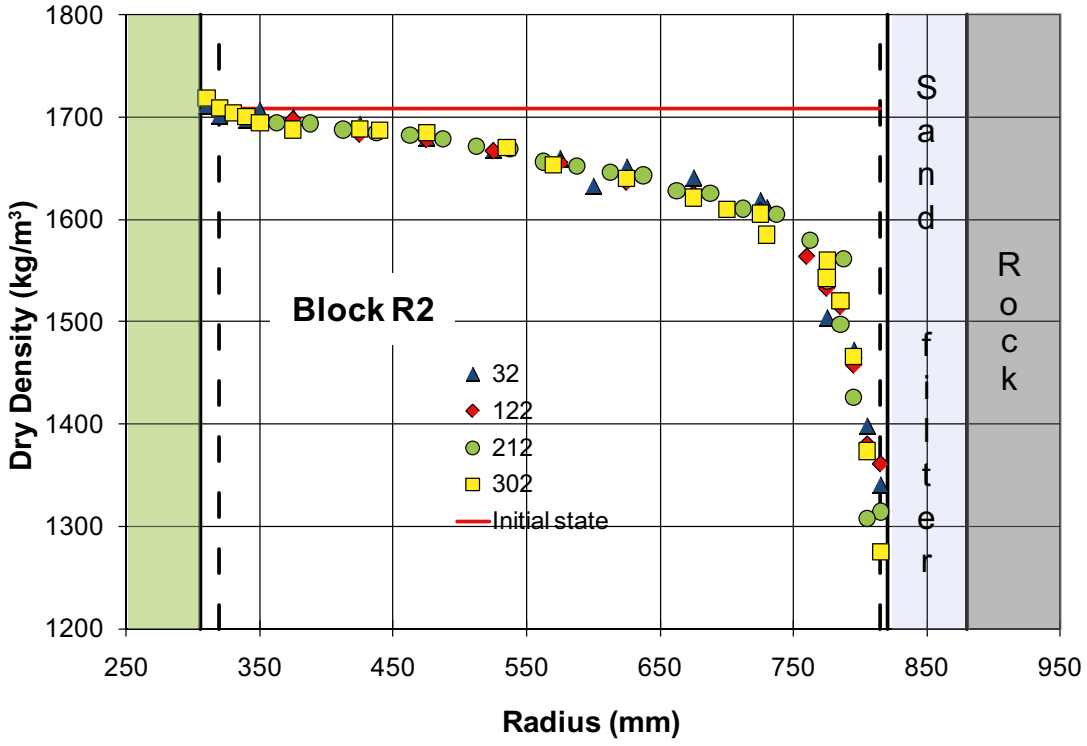

Dry Density (kg/m³)
1800
1700
1600
1500
1400
1300
1200
250
350
450
550
650
750
850
950
Radius (mm)
Block R1
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Sand filter
Rock

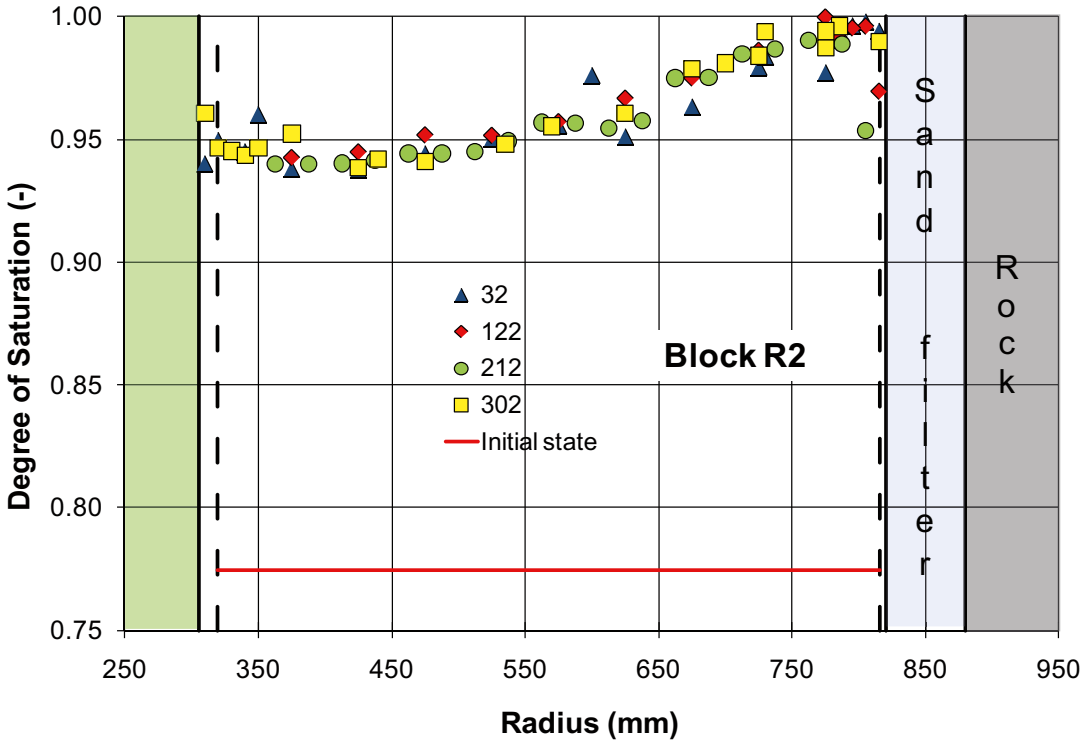

Block R1
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Degree of Saturation (-)
Radius (mm)
Sand filter
Rock
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950

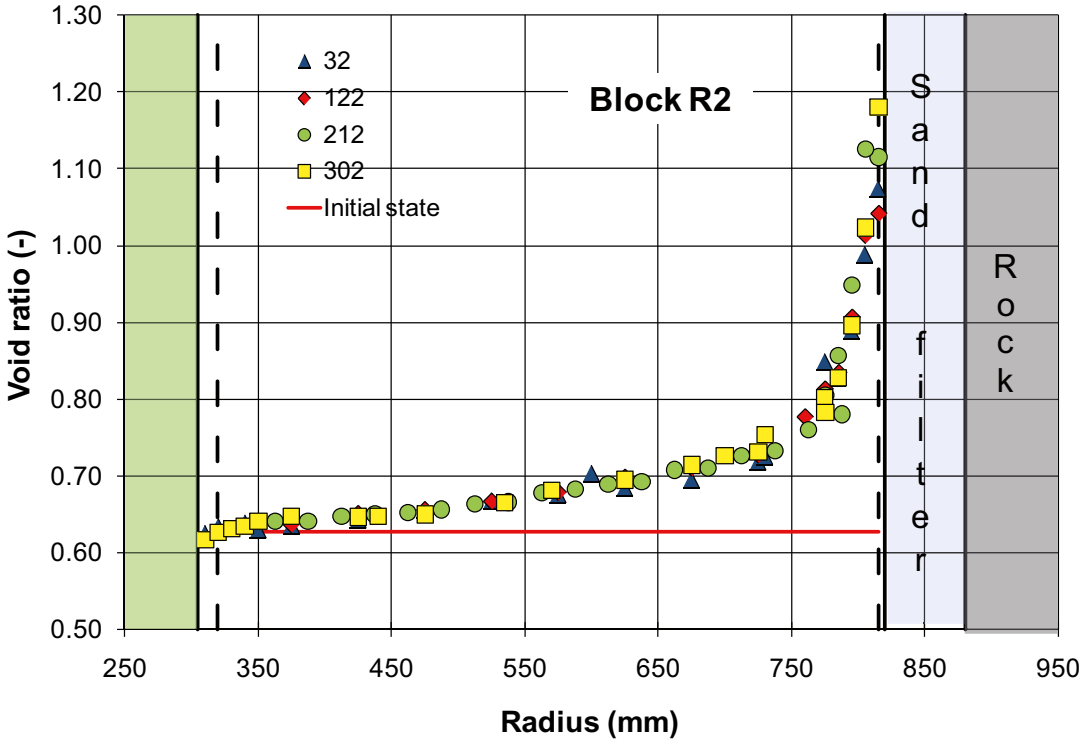

Block R1
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Void ratio (-)
Radius (mm)
Sand filter
Rock
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950

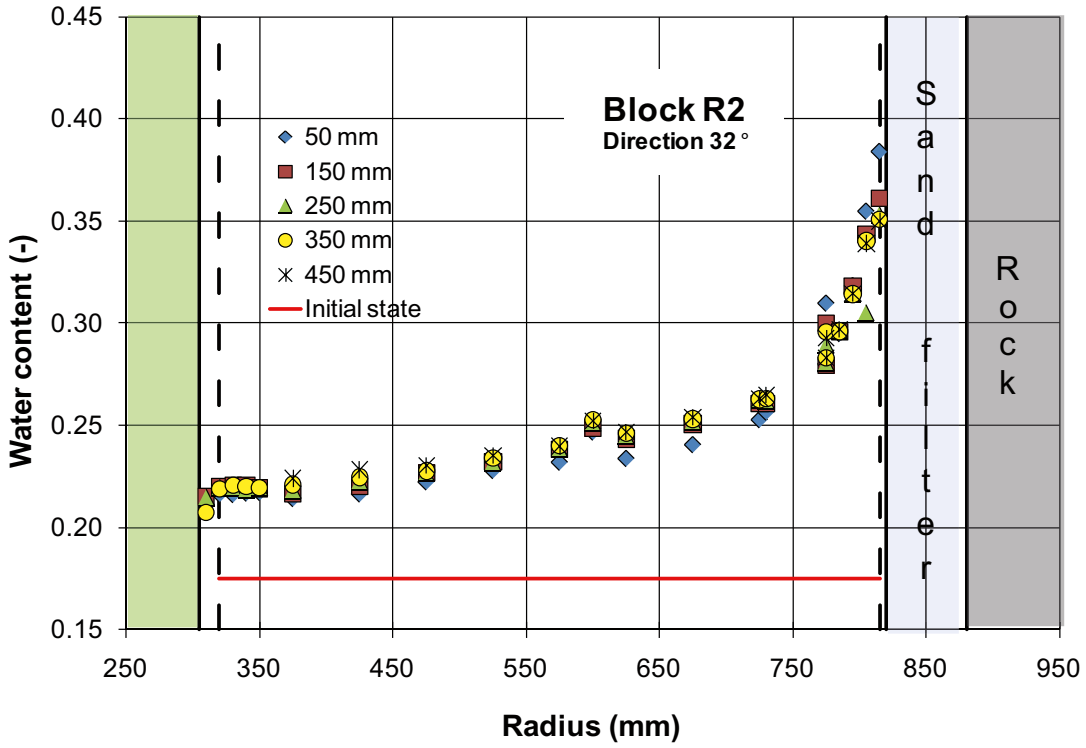
Results from measurements made in block R2

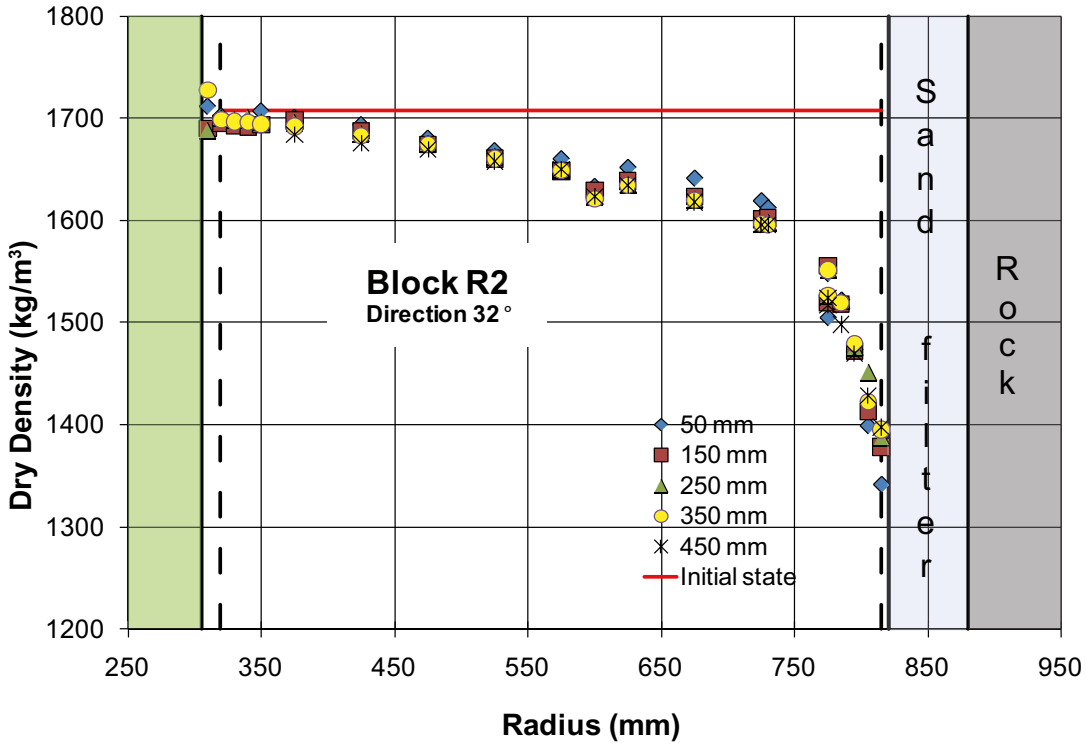


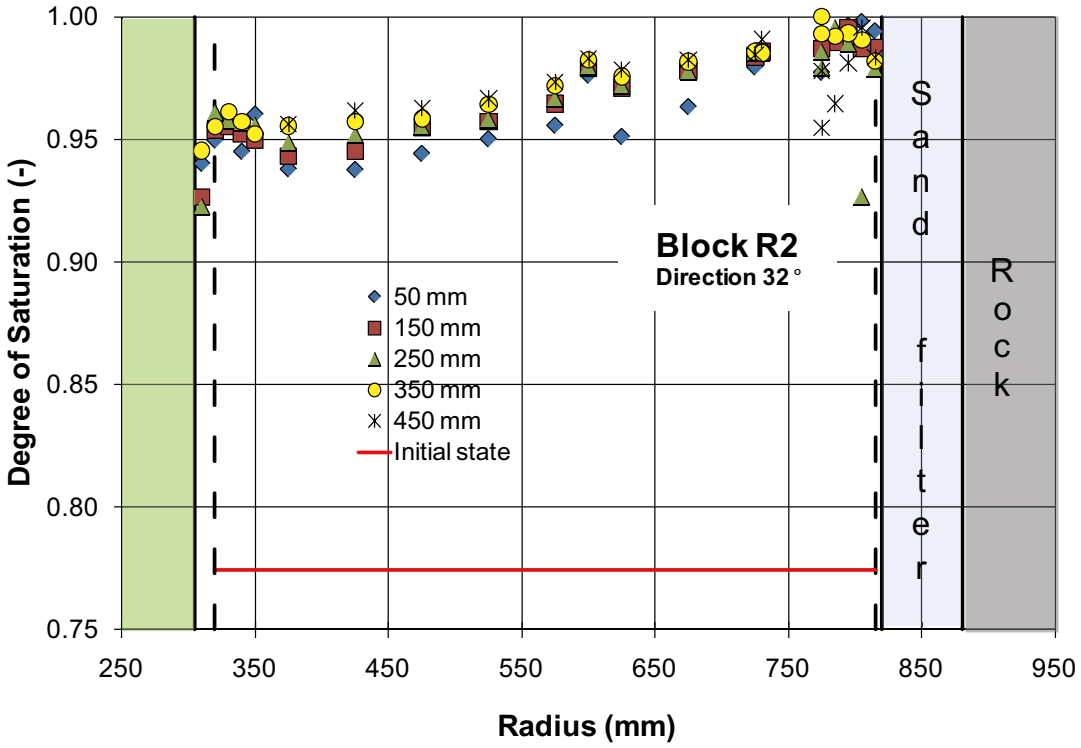


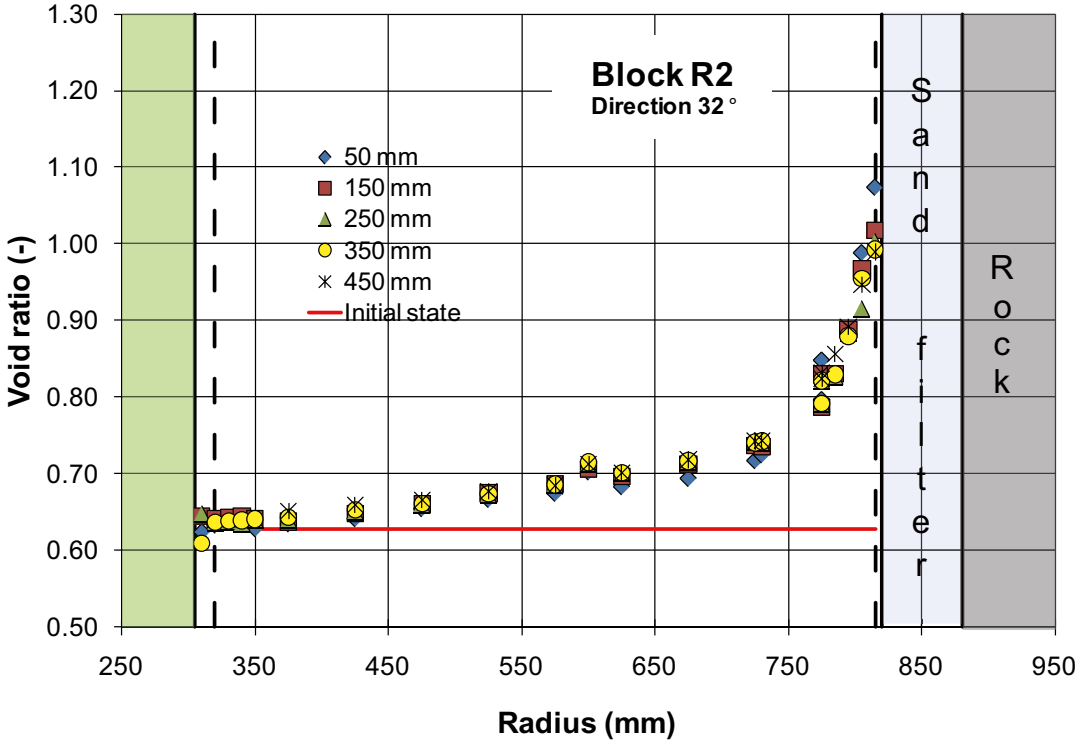

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
32
122
212
302
Initial state
Block R2
Sand filter
Rock


Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
32
122
212
302
Initial state
Block R2
Sand filter
Rock

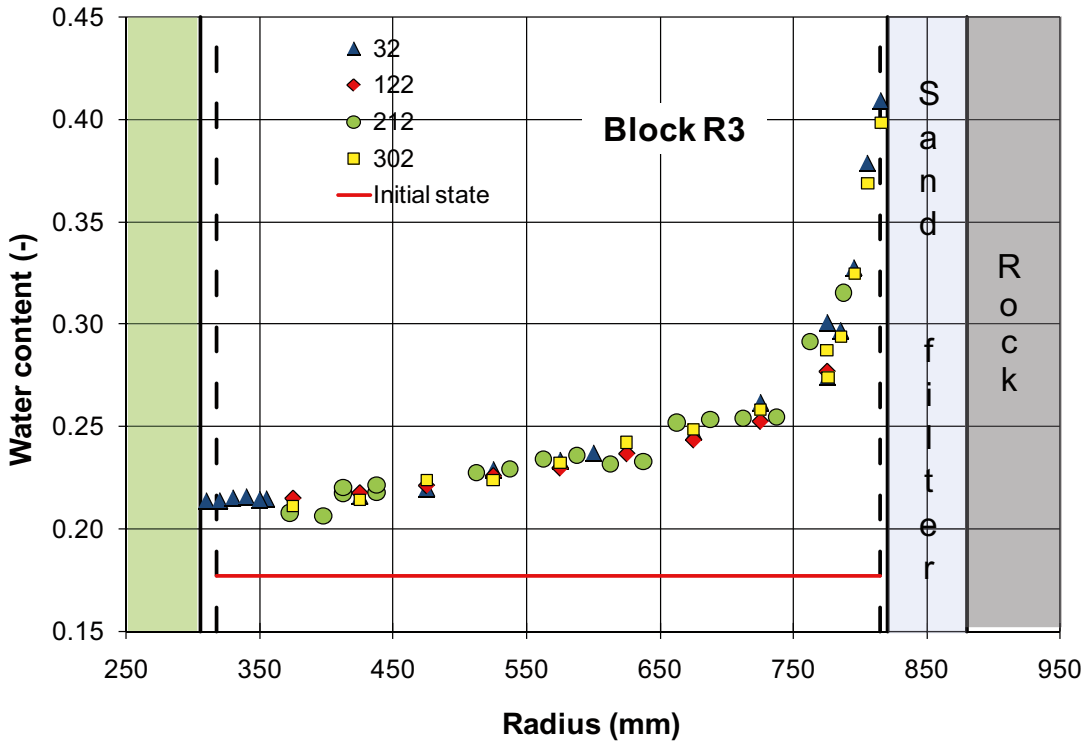

Block R2
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Water content (-)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
250
350
450
550
650
750
850
950
Radius (mm)
Sand filter
Rock

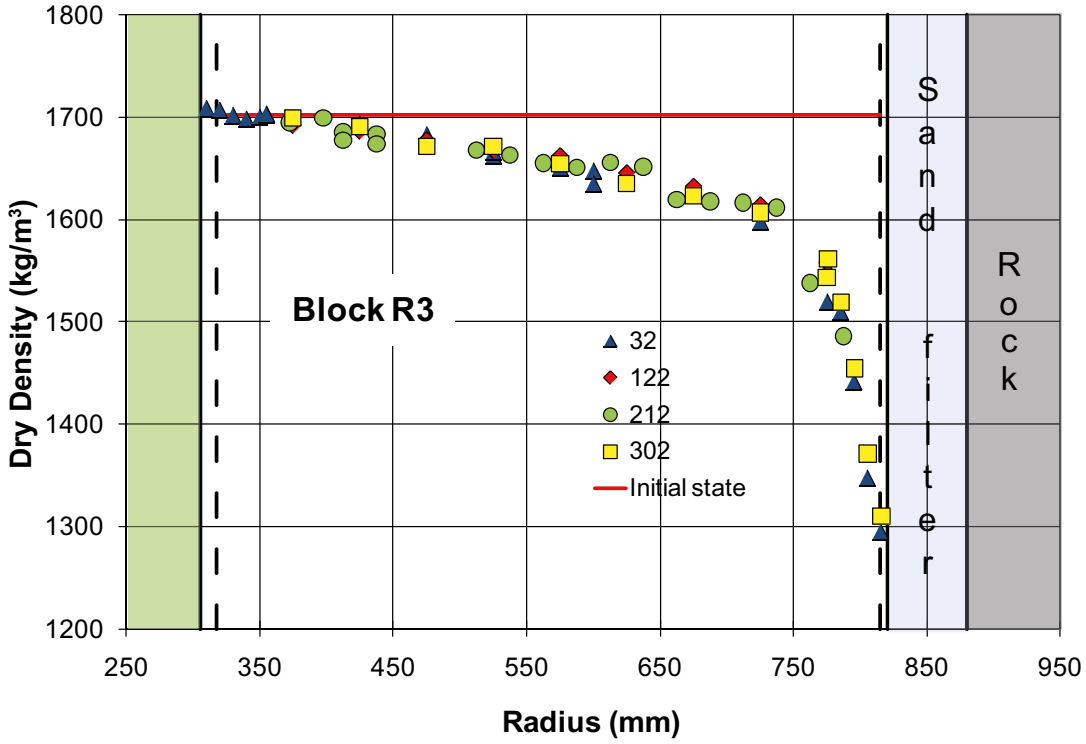

Block R2
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Dry Density (kg/m³)
1800
1700
1600
1500
1400
1300
1200
250
350
450
550
650
750
850
950
Radius (mm)
Sand filter
Rock

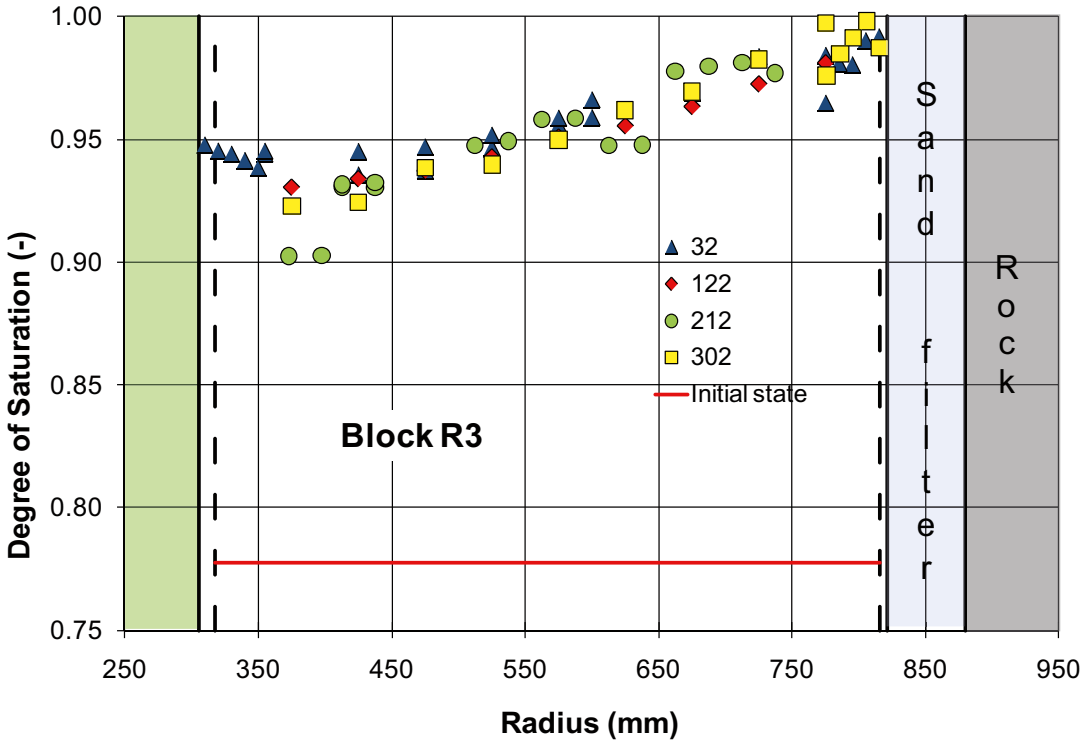

Block R2
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Degree of Saturation (-)
Radius (mm)
Sand filter
Rock

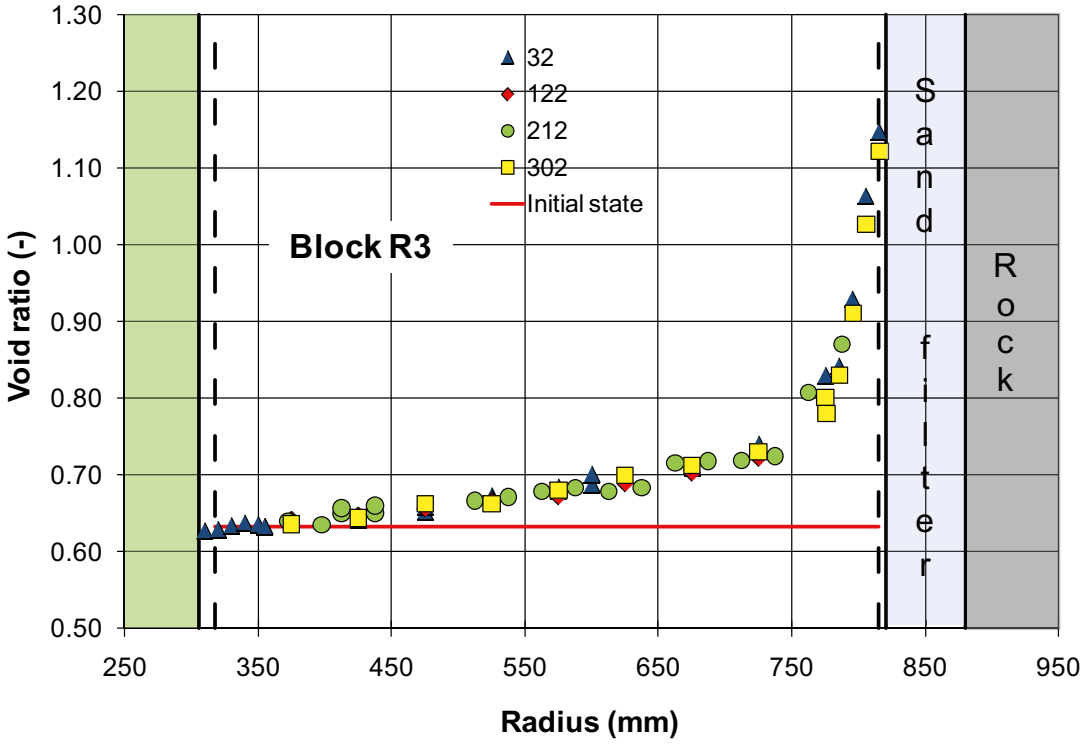

Block R2
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Void ratio (-)
Radius (mm)
Sand filter
Rock

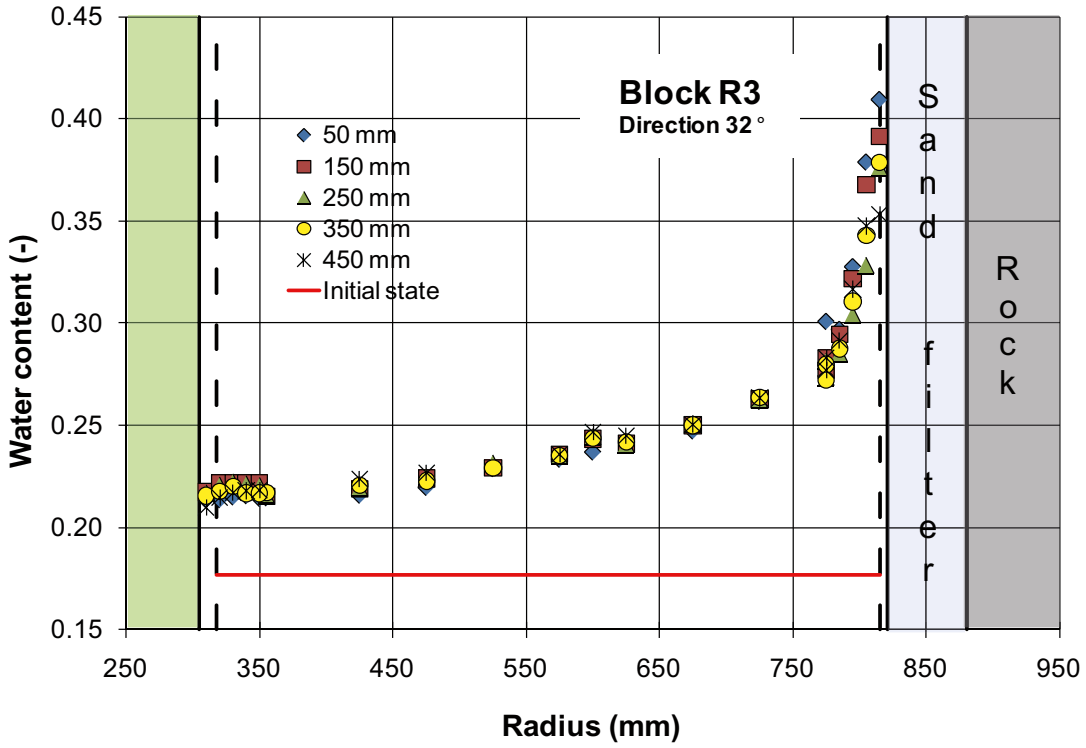
Results from measurements made in block R3

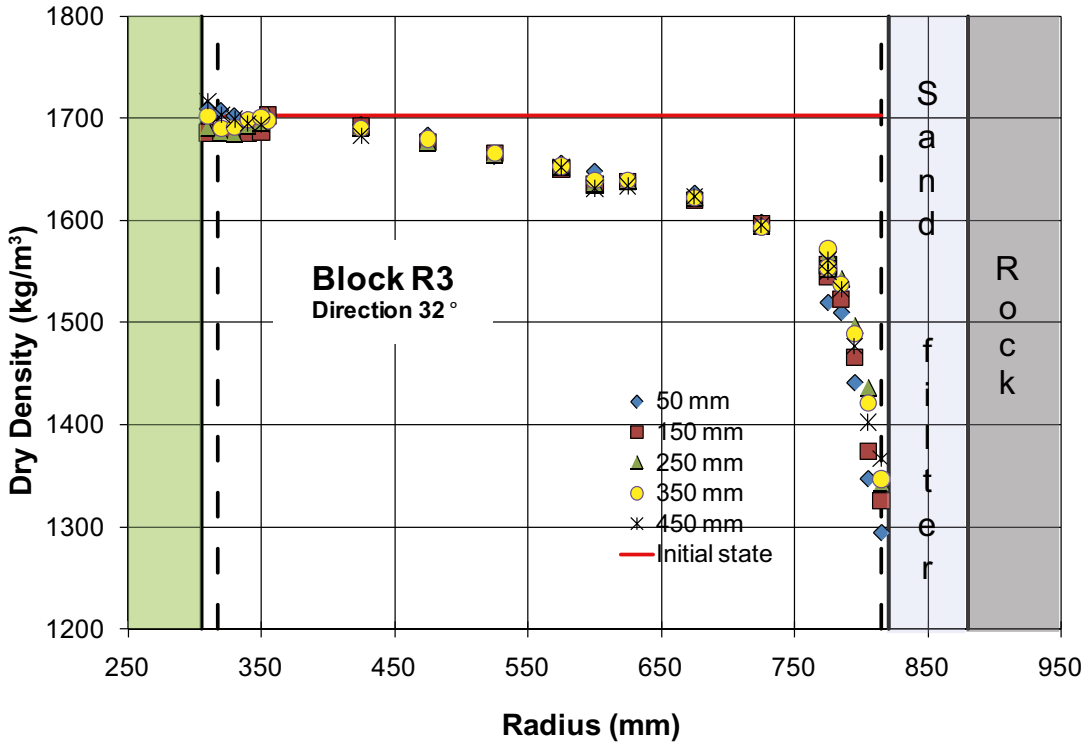


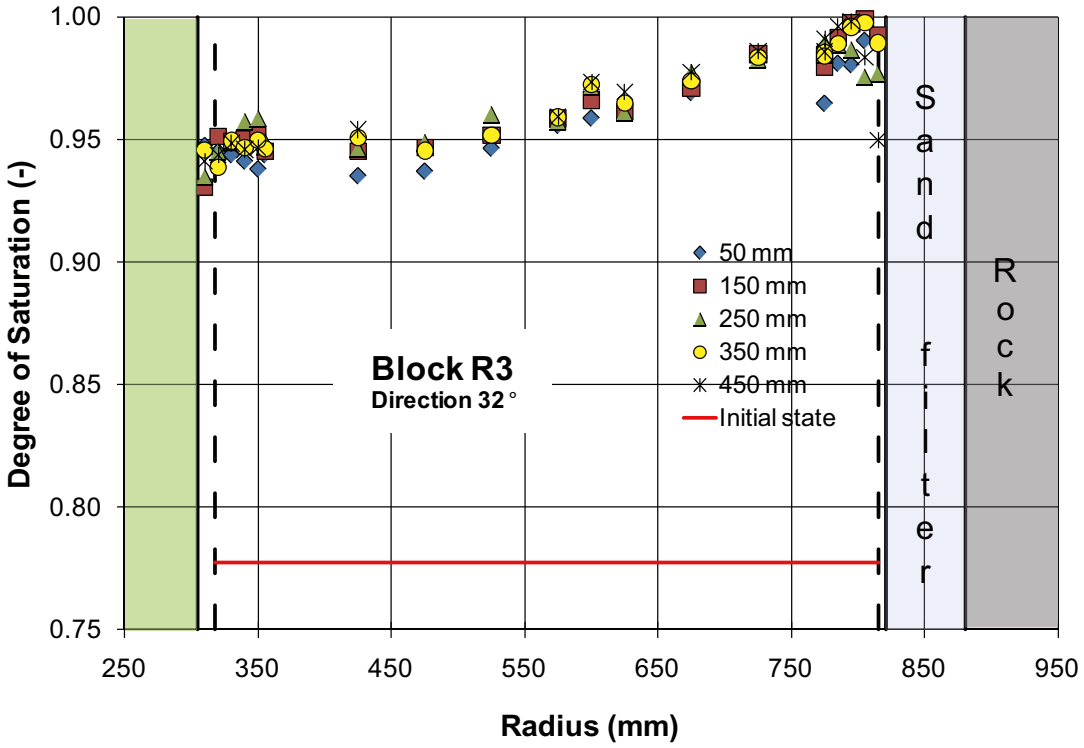


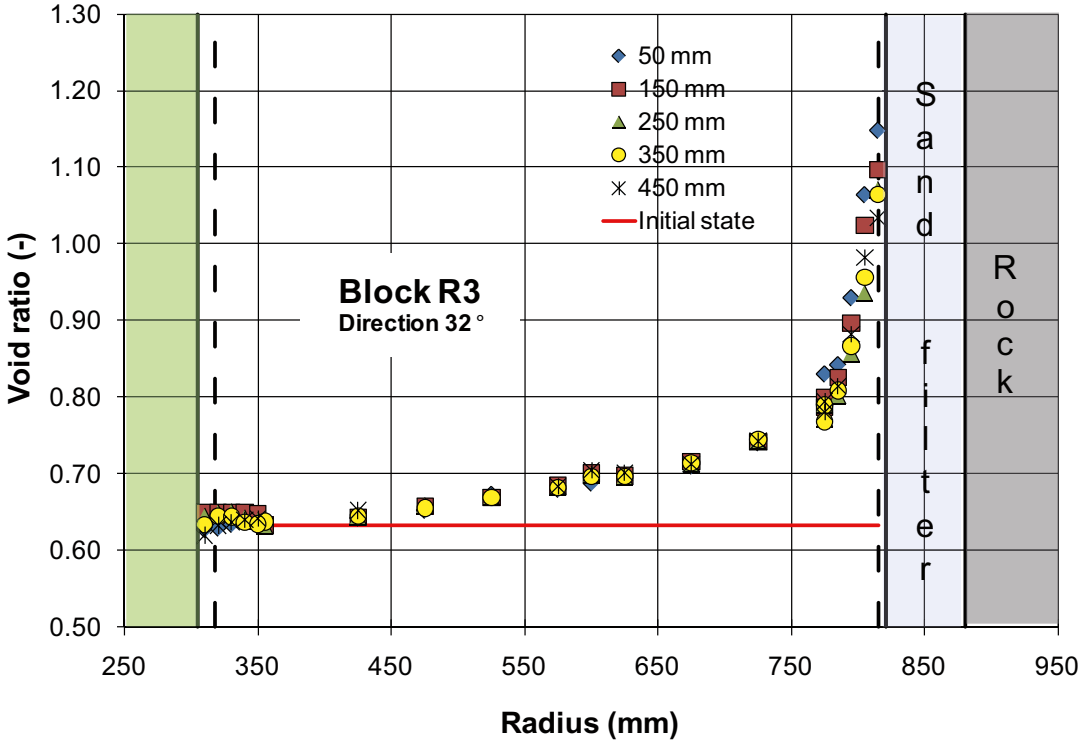

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
Block R3
32
122
212
302
Initial state
Sand filter
Rock


Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Block R3
32
122
212
302
Initial state
Sand filter
Rock

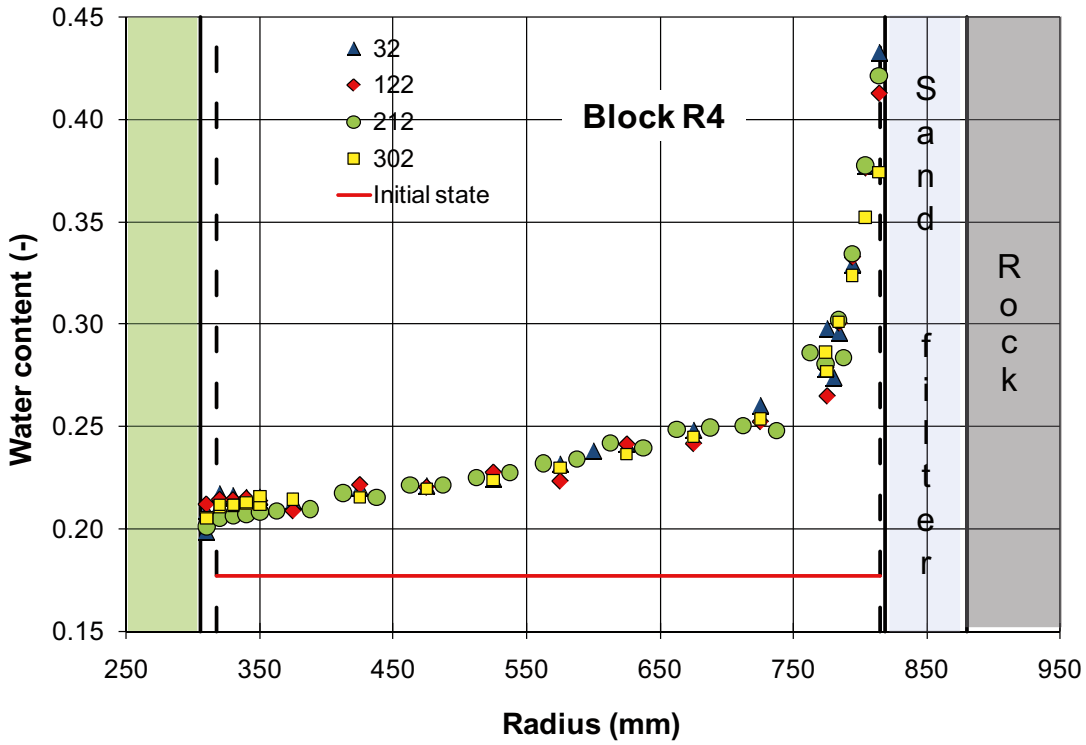

Block R3
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Water content (-)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
250
350
450
550
650
750
850
950
Radius (mm)
Sand filter
Rock

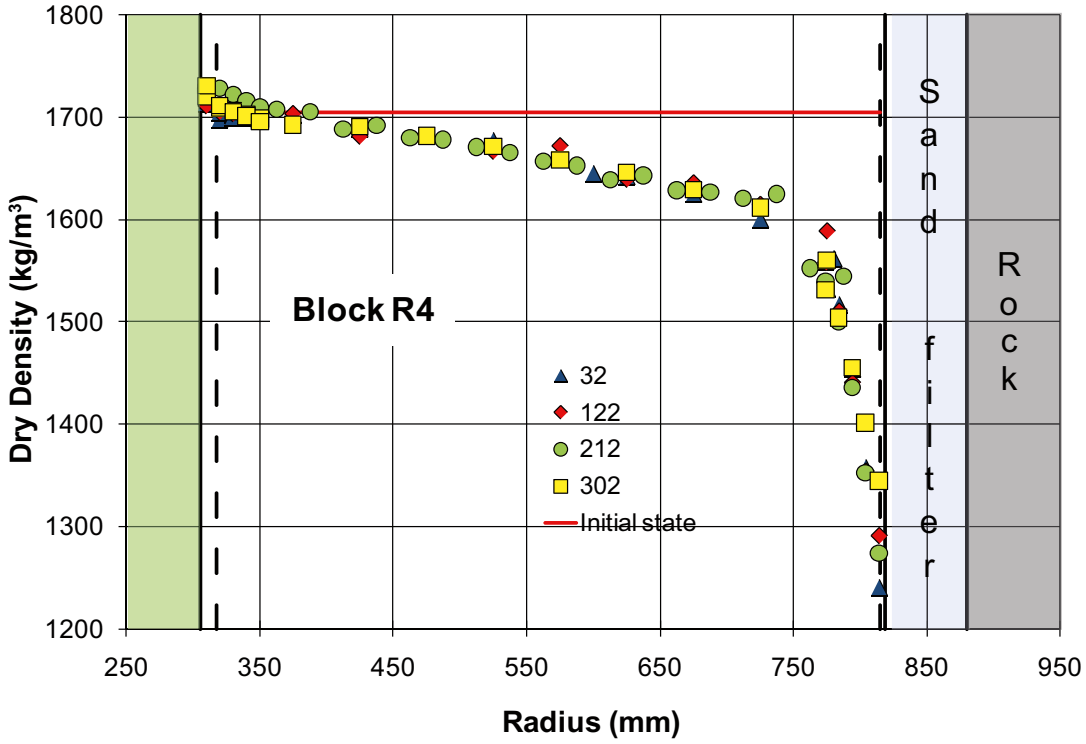

Block R3
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Dry Density (kg/m³)
1800
1700
1600
1500
1400
1300
1200
250
350
450
550
650
750
850
950
Radius (mm)
Sand filter
Rock

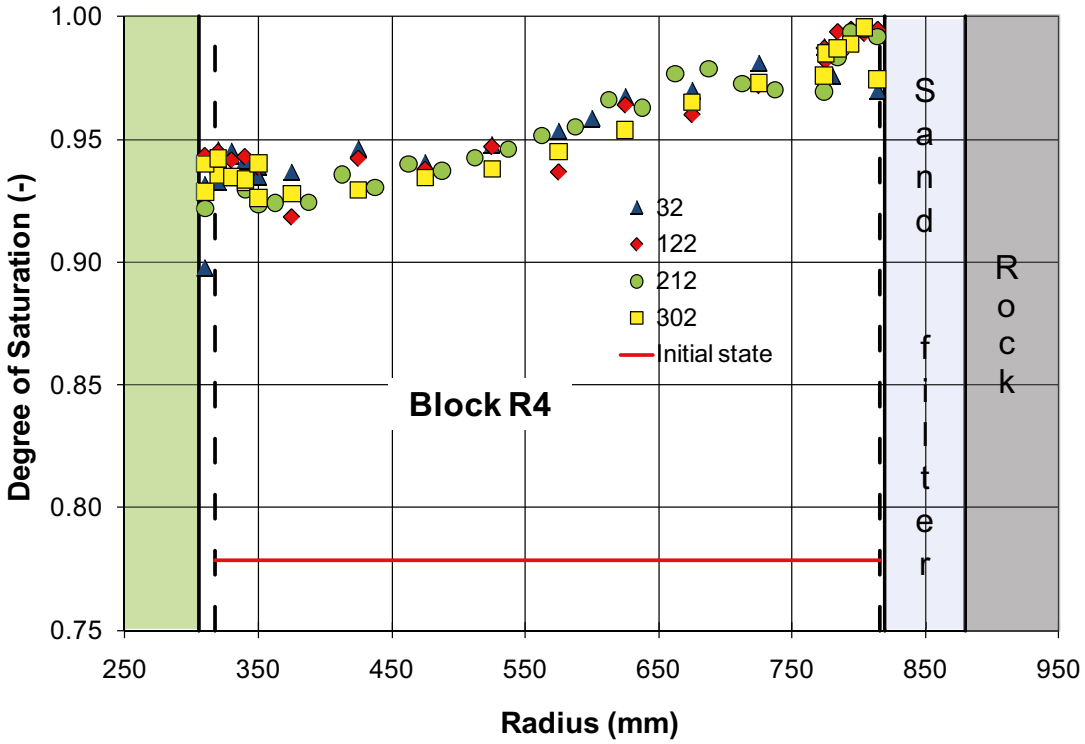

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
Block R3
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Sand filter
Rock

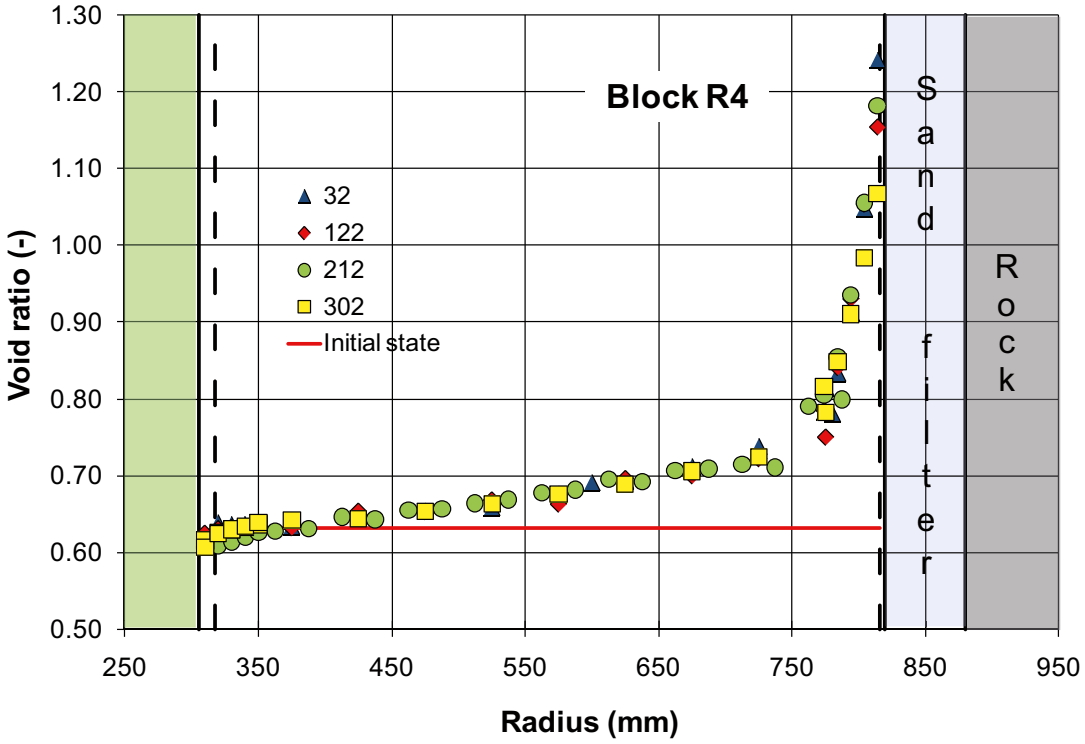

Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Block R3
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Sand filter
Rock

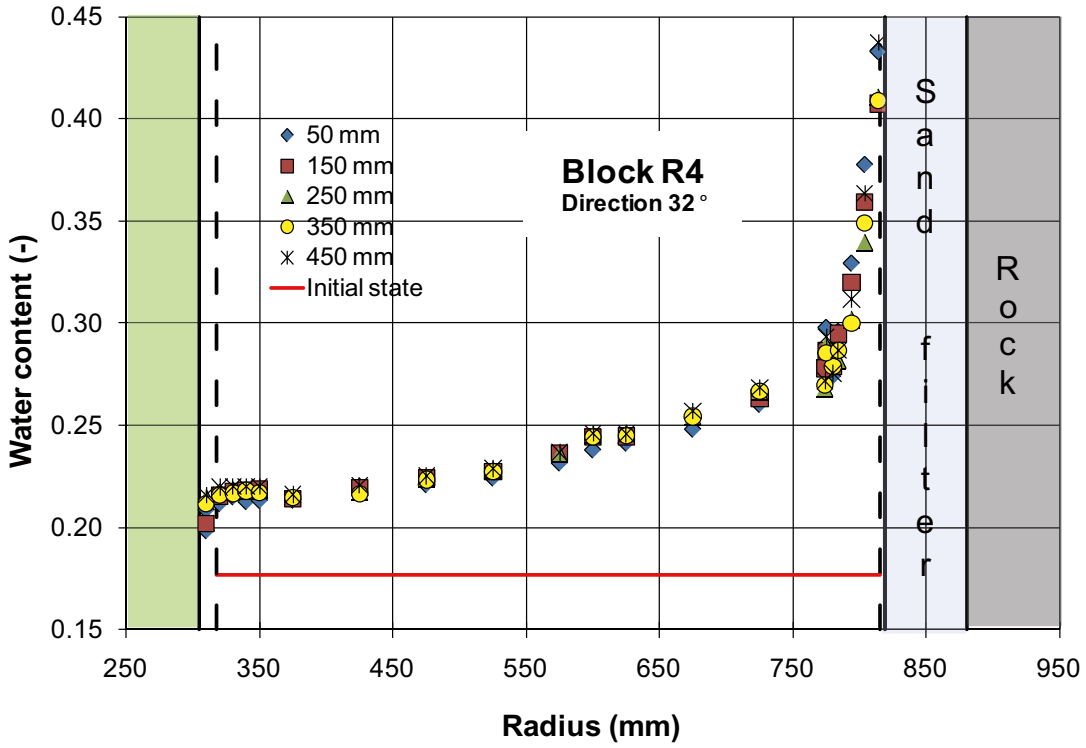
Results from measurements made in block R4

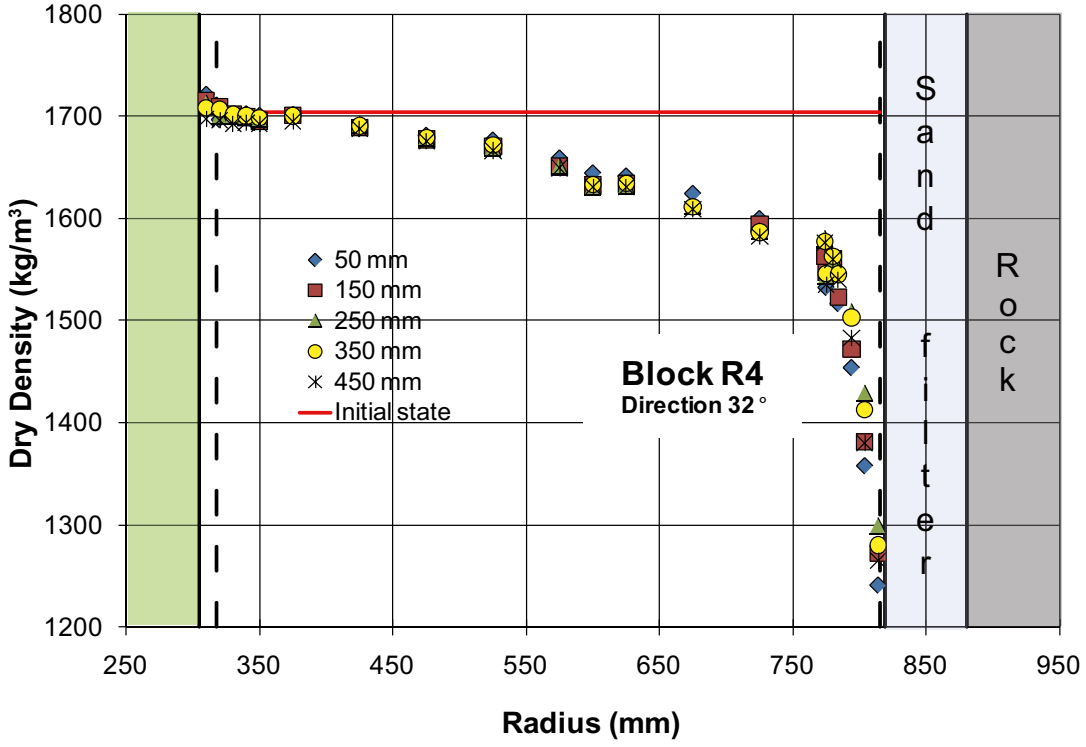


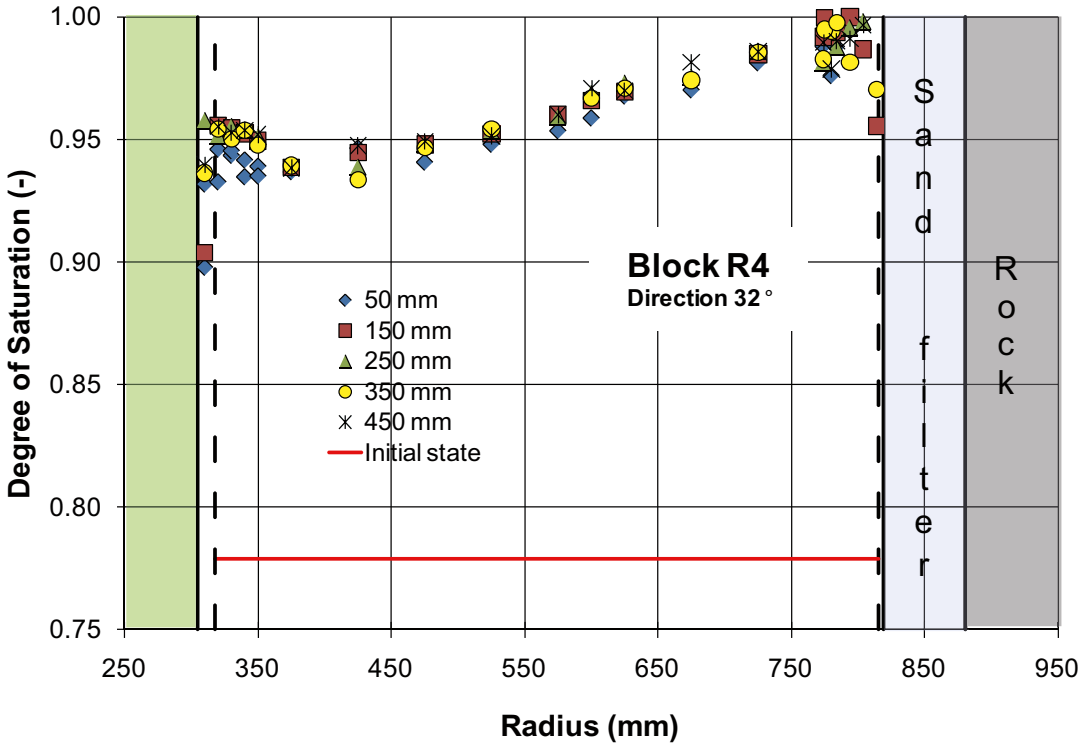


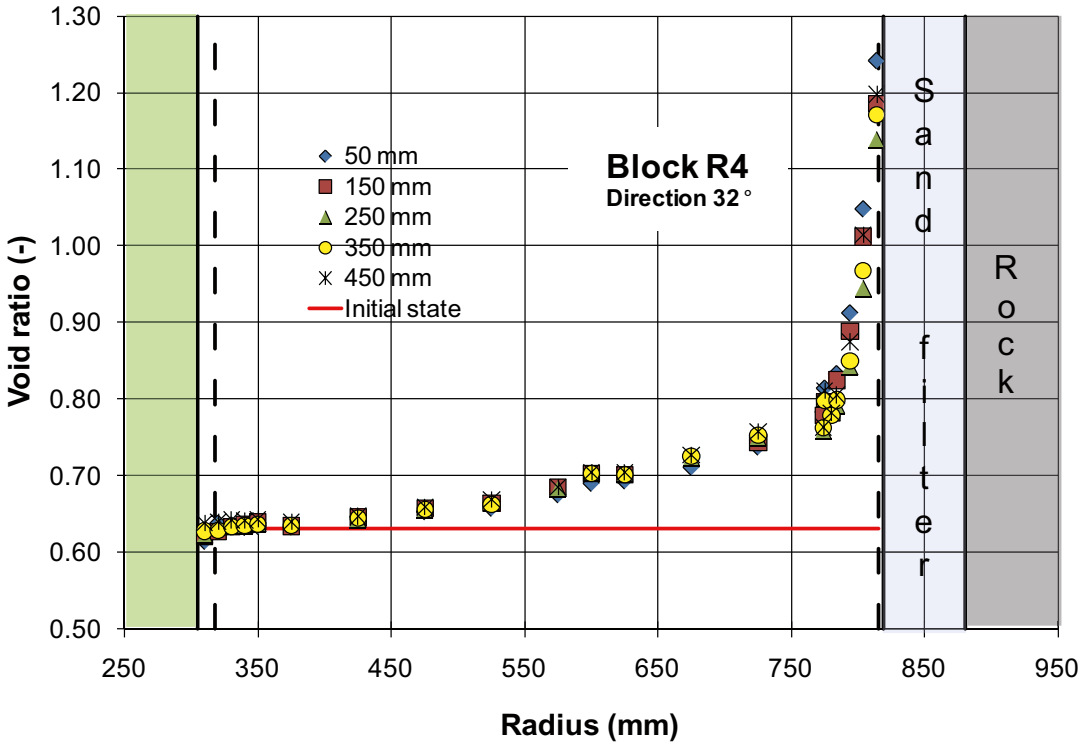

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
Block R4
32
122
212
302
Initial state
Sand filter
Rock


Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Block R4
32
122
212
302
Initial state
Sand filter
Rock

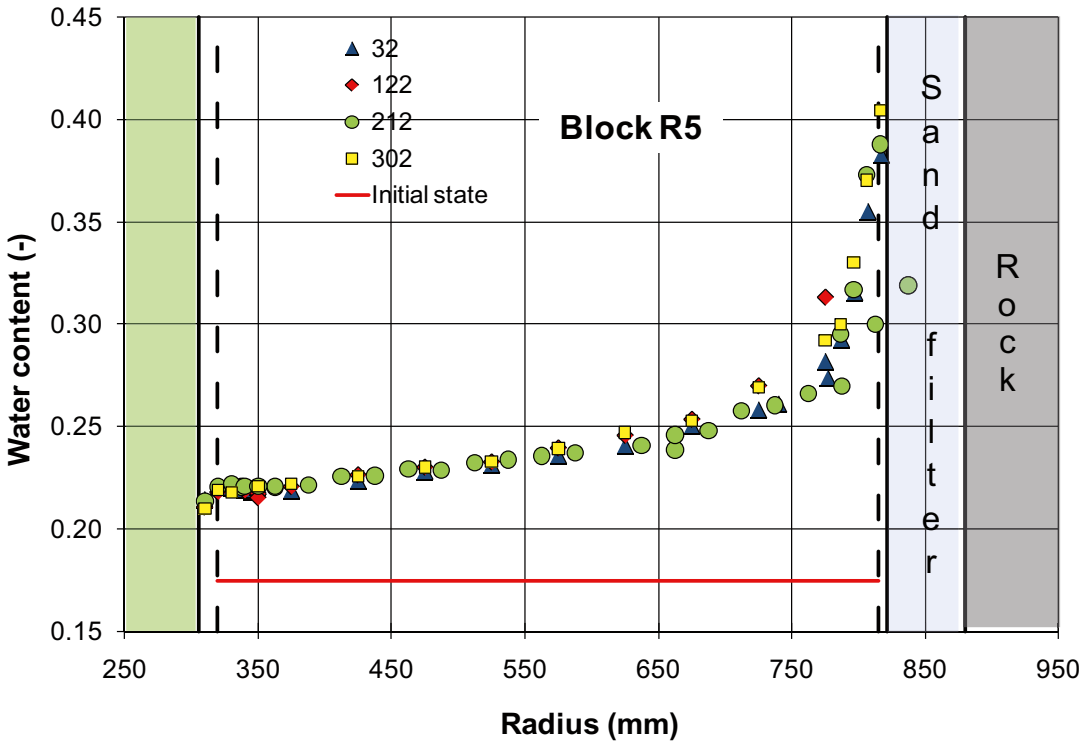

Water content (-)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
250
350
450
550
650
750
850
950
Radius (mm)
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R4
Direction 32°
Sand filter
Rock

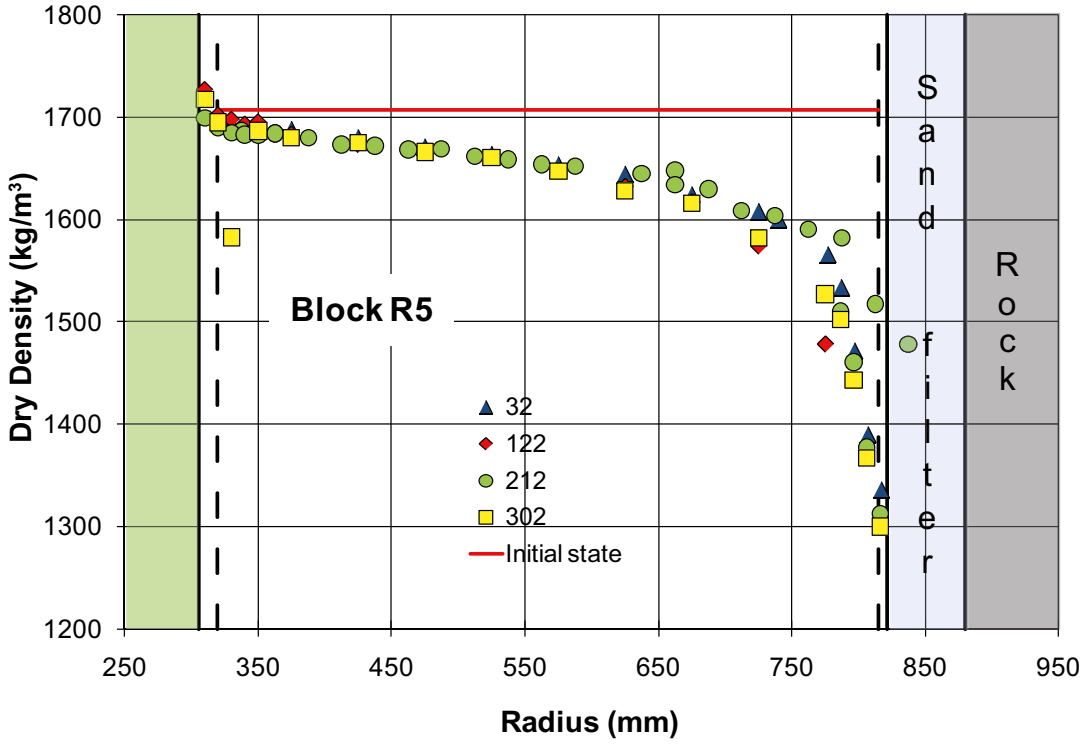

Dry Density (kg/m³)
1800
1700
1600
1500
1400
1300
1200
250
350
450
550
650
750
850
950
Radius (mm)
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R4
Direction 32°
Sand filter
Rock

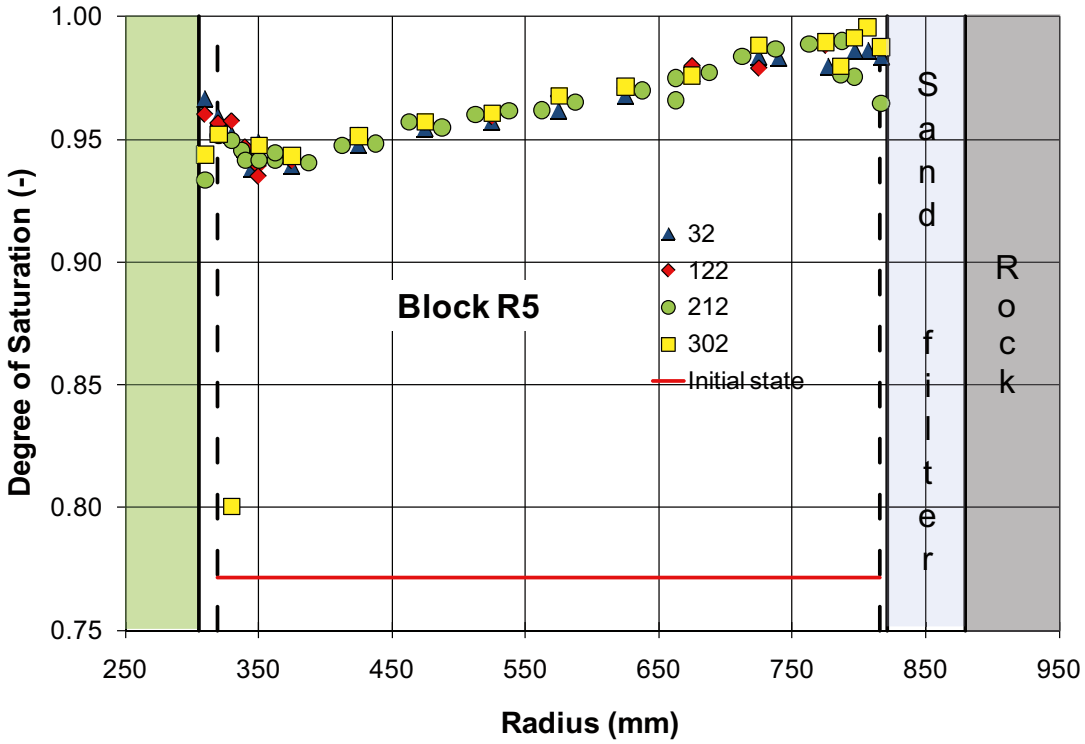

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
Block R4
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Sand filter
Rock

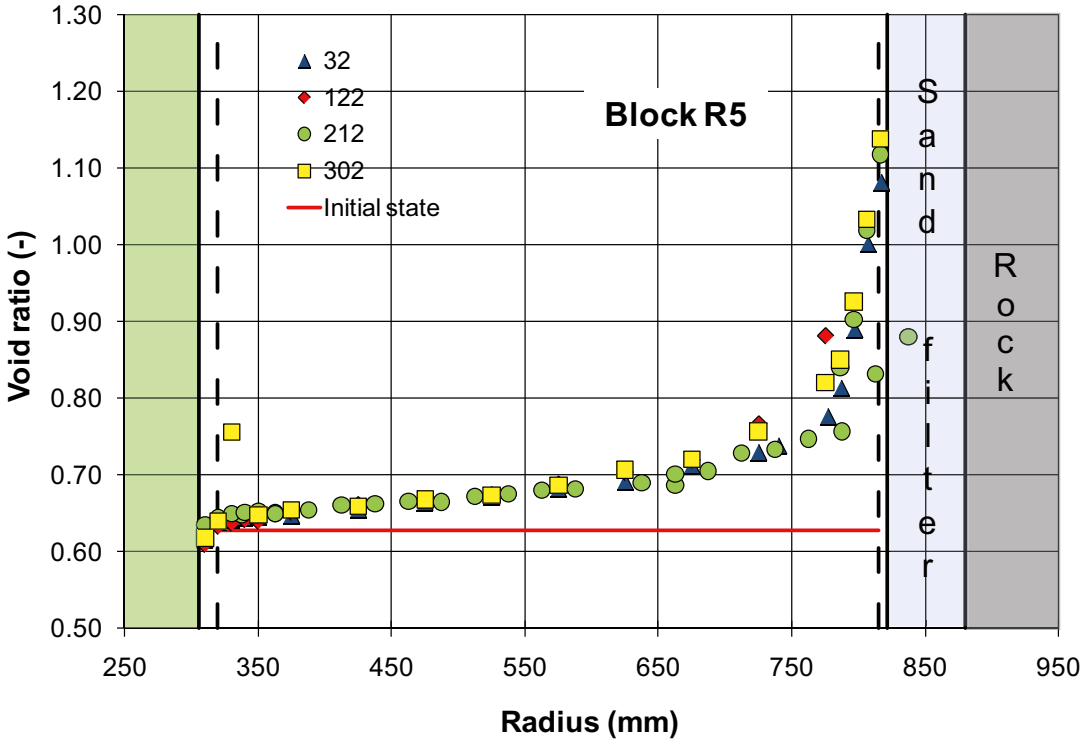

Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Block R4
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Sand filter
Rock

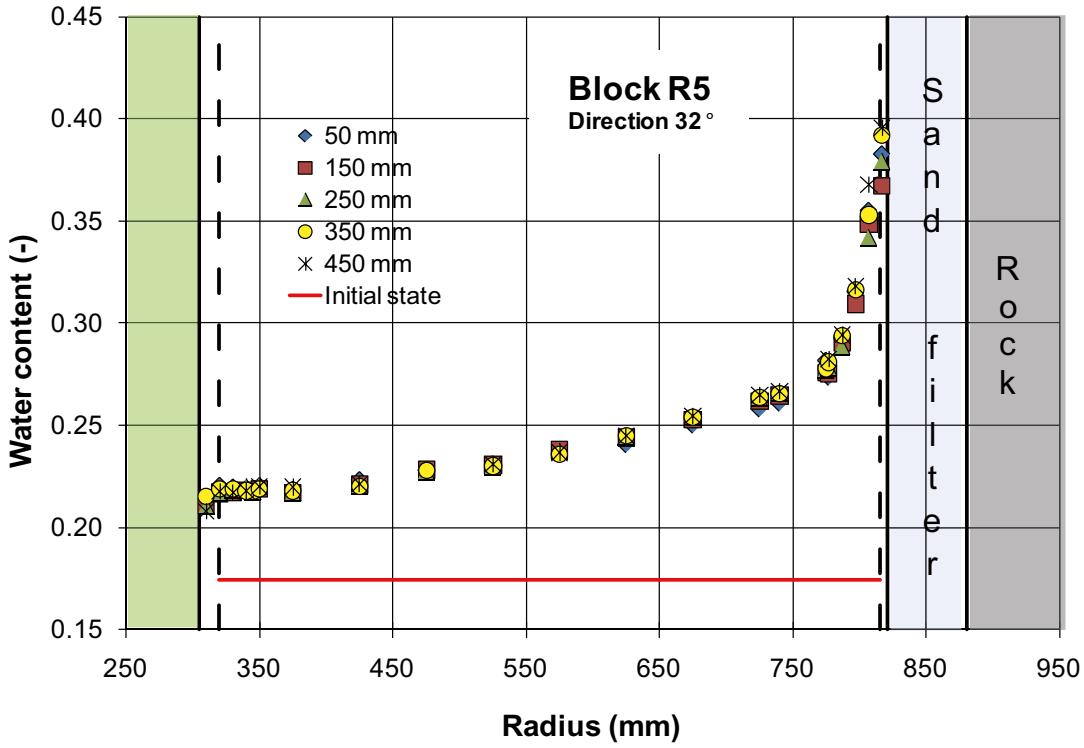
Results from measurements made in block R5

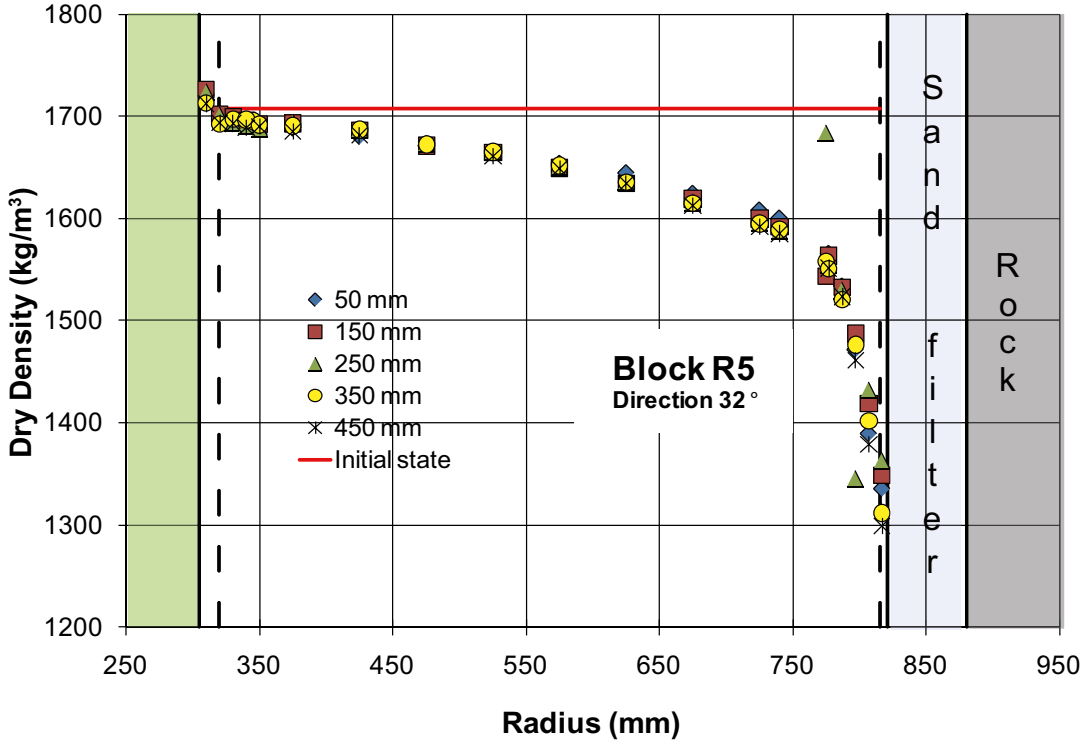


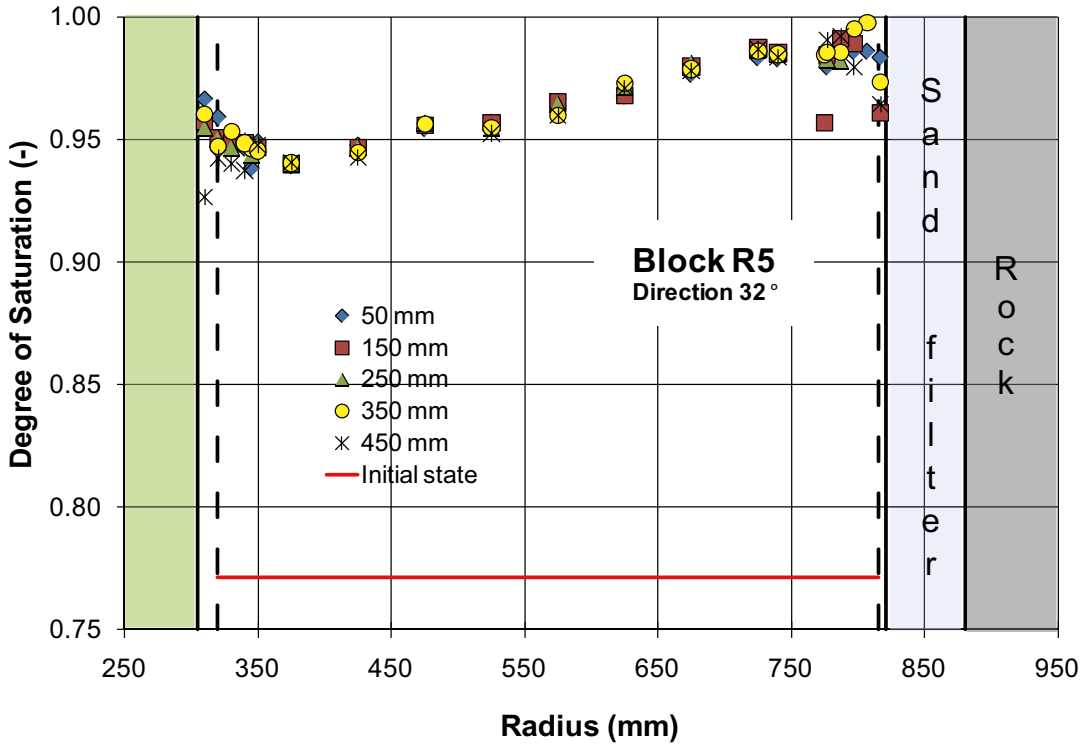


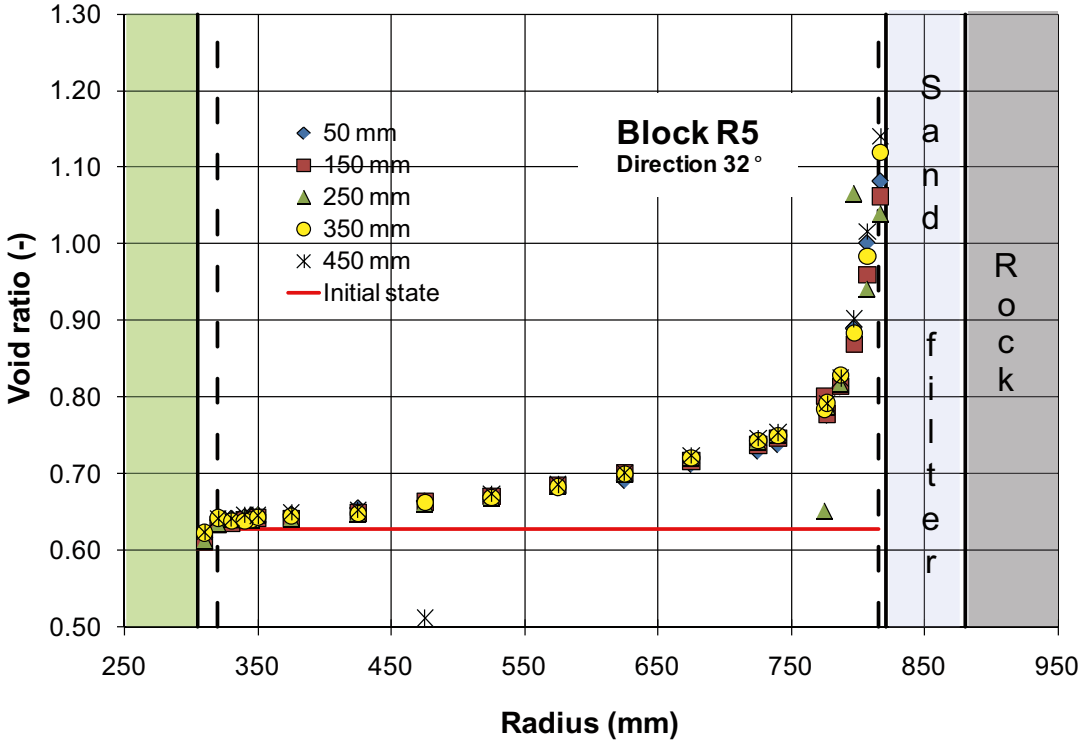

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
Block R5
32
122
212
302
Initial state
Sand filter
Rock


Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Block R5
32
122
212
302
Initial state
Sand filter
Rock

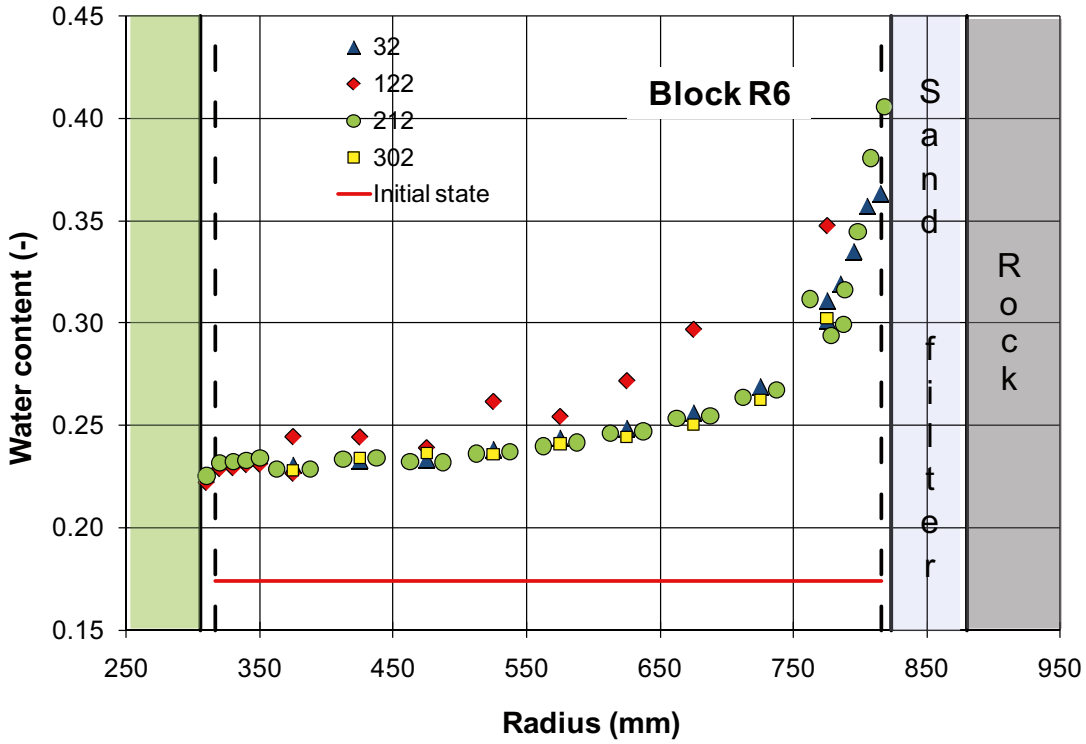

Block R5
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Water content (-)
Radius (mm)
Sand filter
Rock

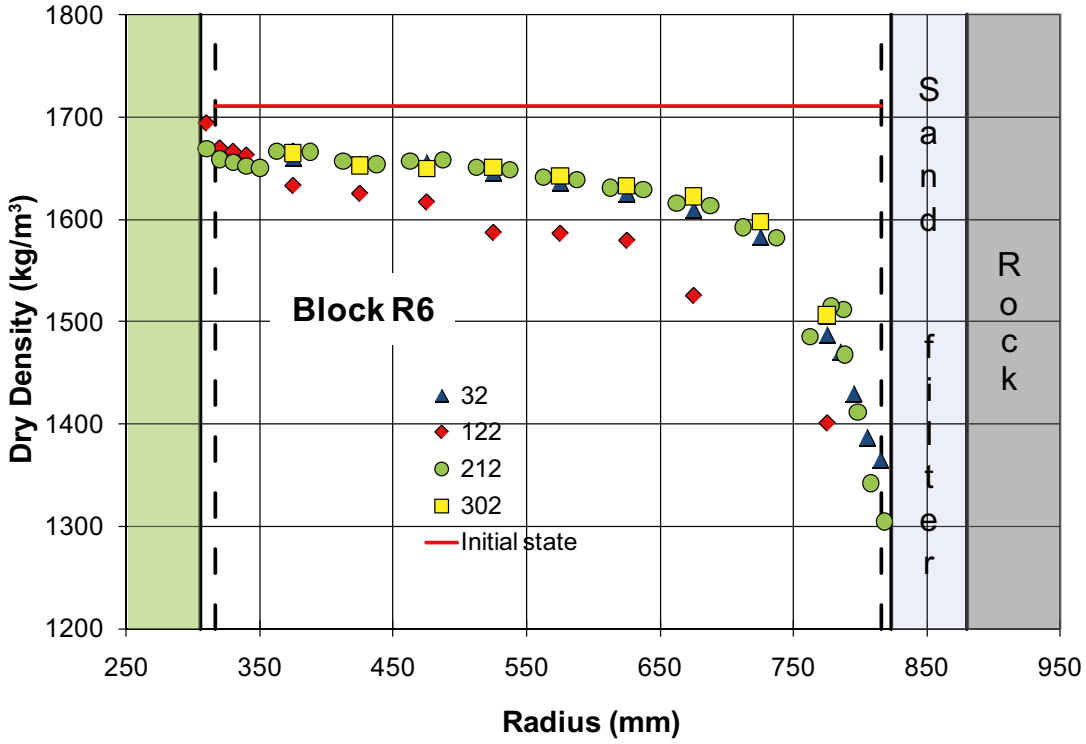

Block R5
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Dry Density (kg/m³)
Radius (mm)
Sand filter
Rock

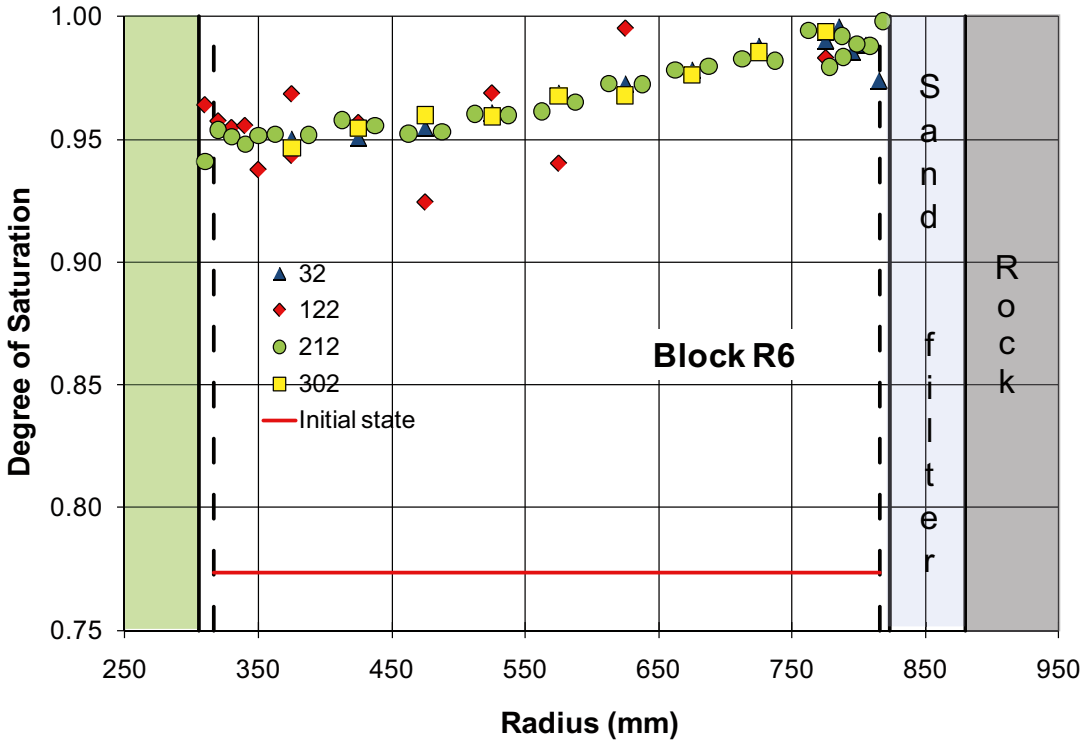

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
Block R5
Direction 32 °
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Sand filter
Rock

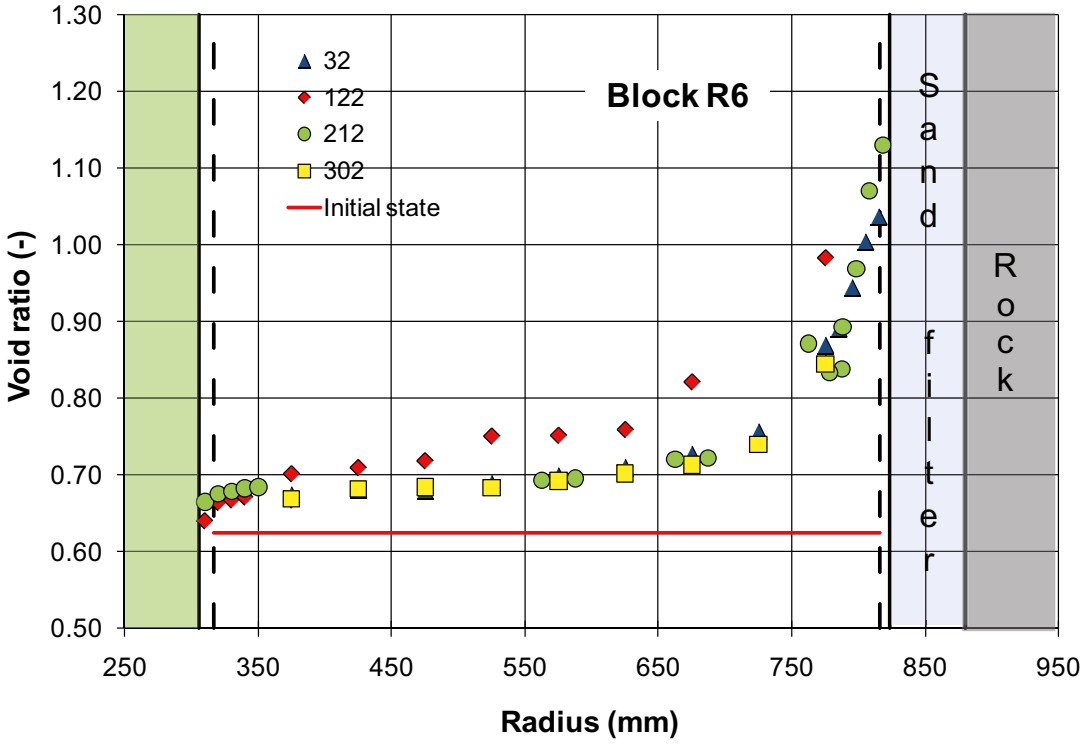

Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Block R5
Direction 32 °
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Sand filter
Rock

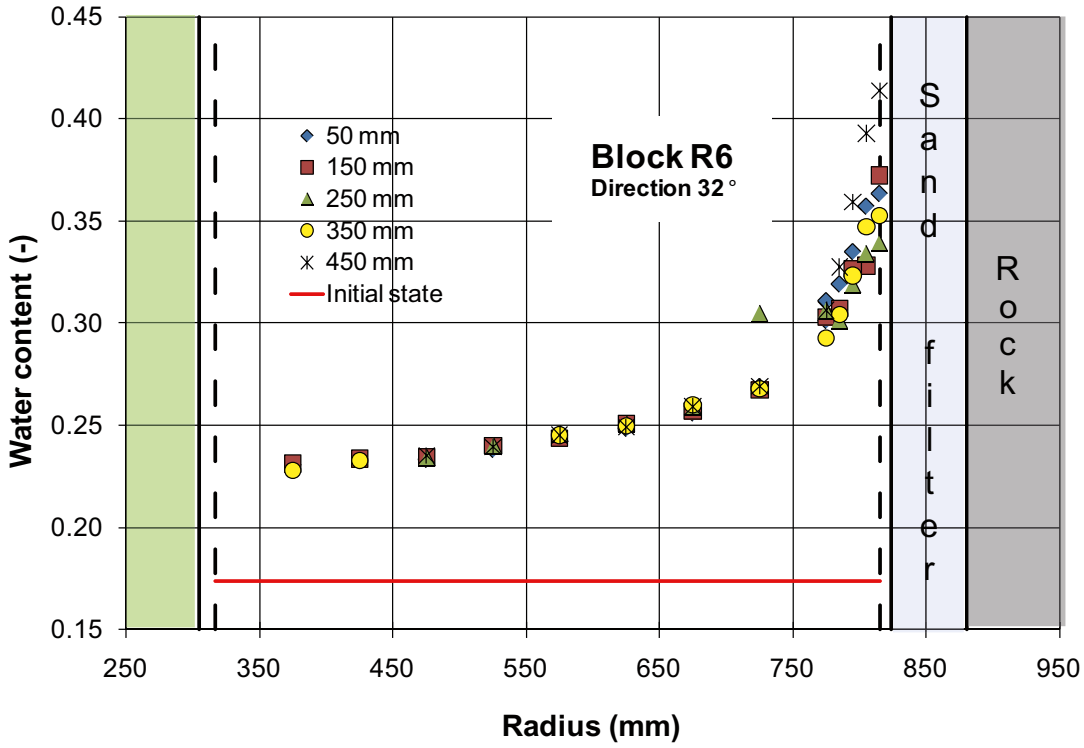
Results from measurements made in block R6

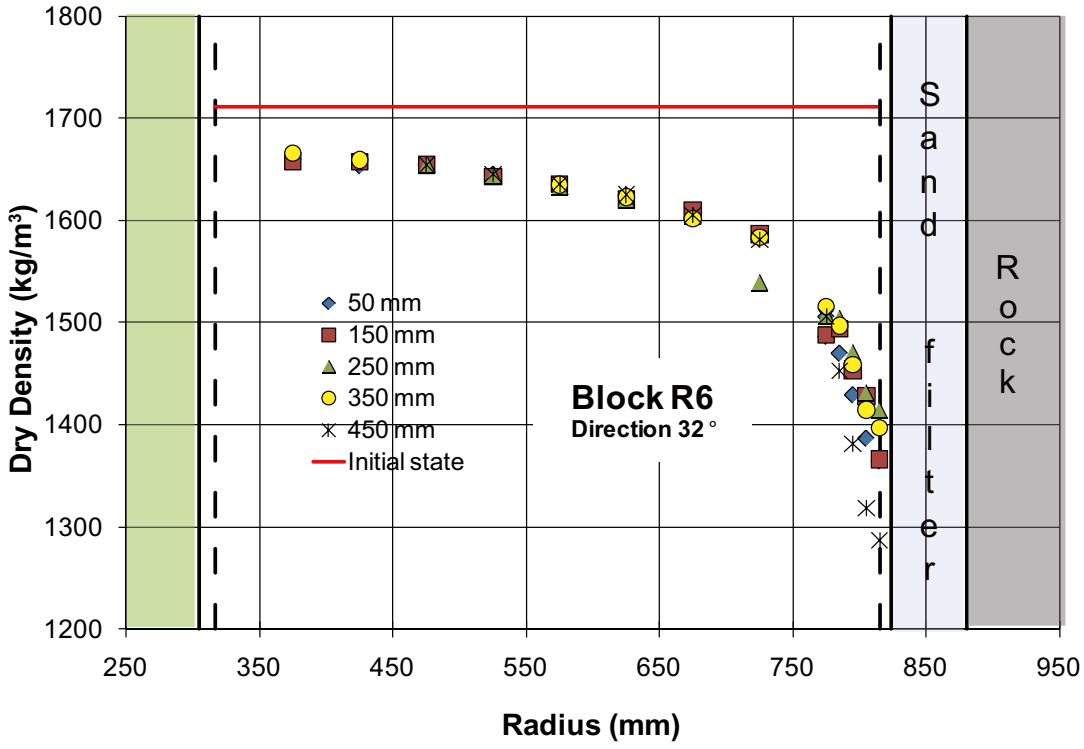


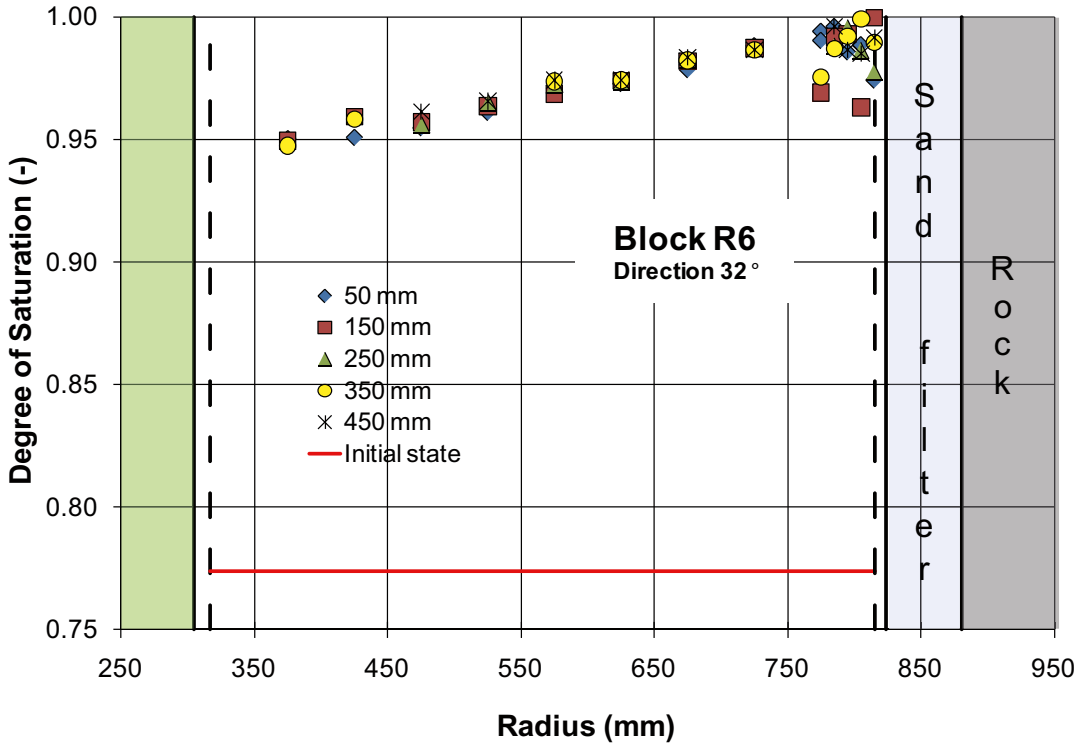


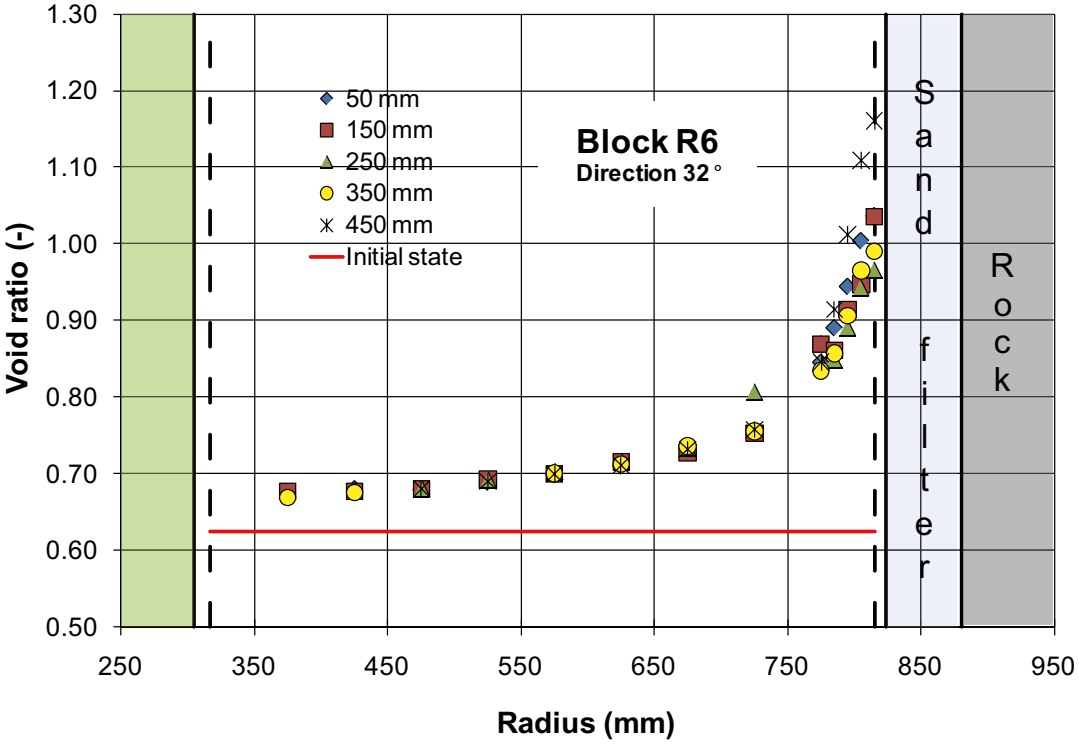

Degree of Saturation
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
32
122
212
302
Initial state
Block R6
Sand filter
Rock


Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
32
122
212
302
Initial state
Block R6
Sand filter
Rock

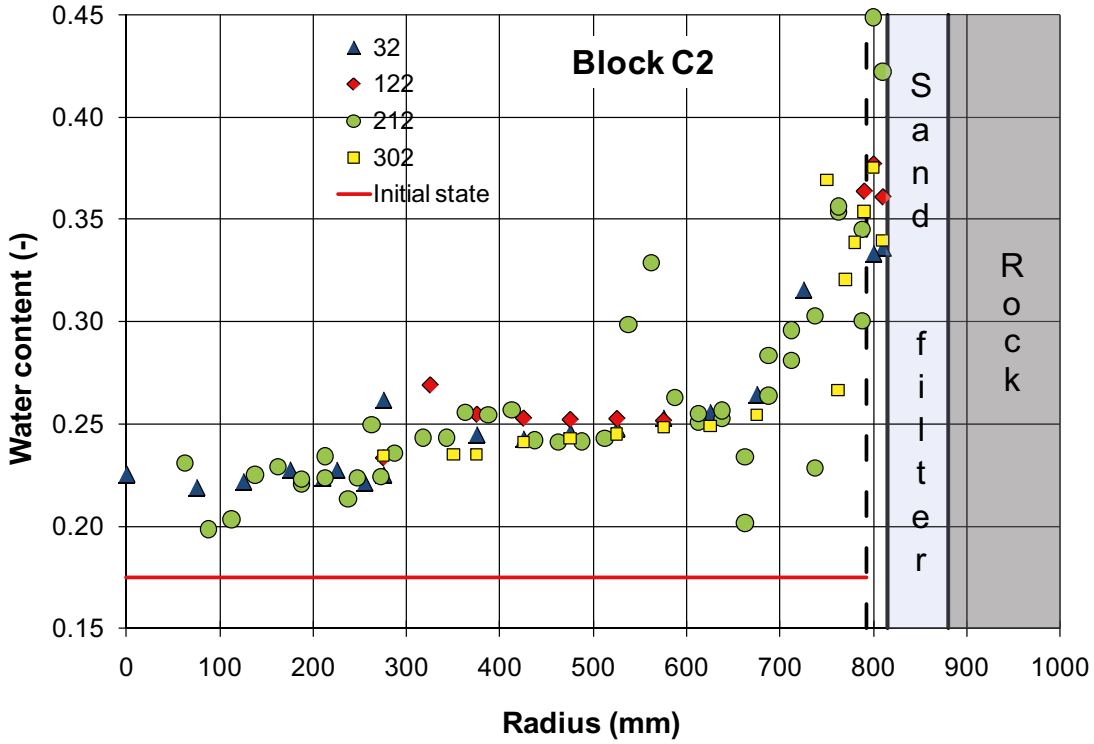

Water content (-)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
250
350
450
550
650
750
850
950
Radius (mm)
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R6
Direction 32°
Sand filter
Rock

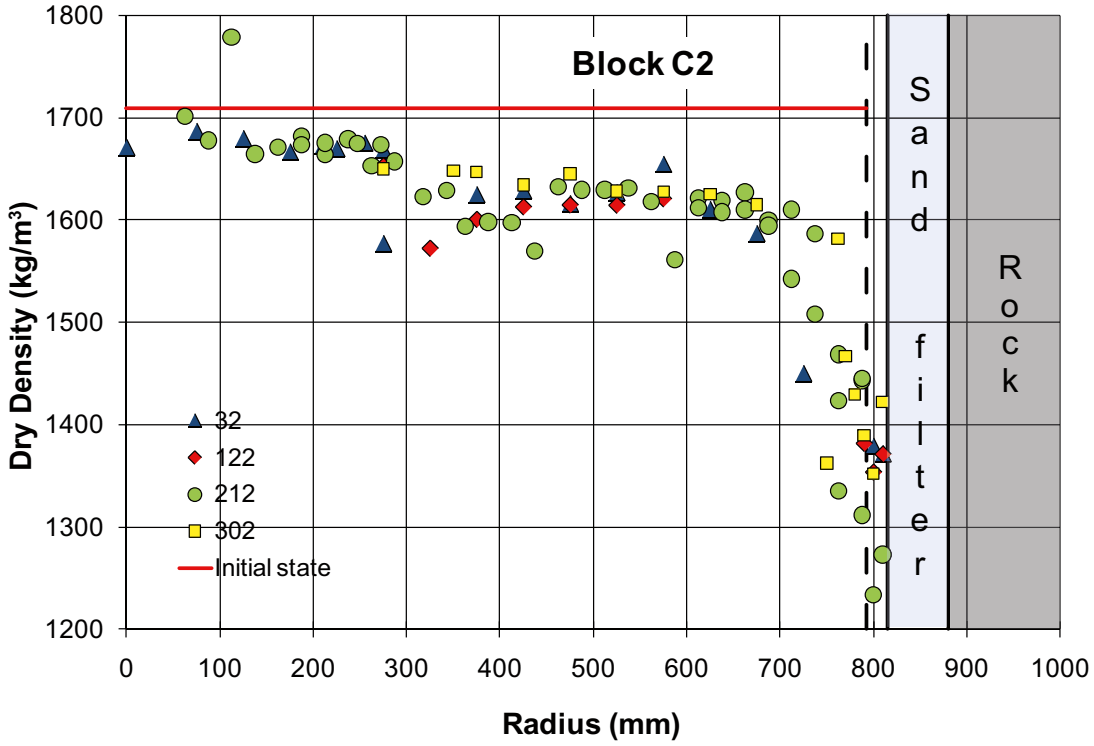

Dry Density (kg/m³)
1800
1700
1600
1500
1400
1300
1200
250
350
450
550
650
750
850
950
Radius (mm)
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R6
Direction 32°
Sand filter
Rock

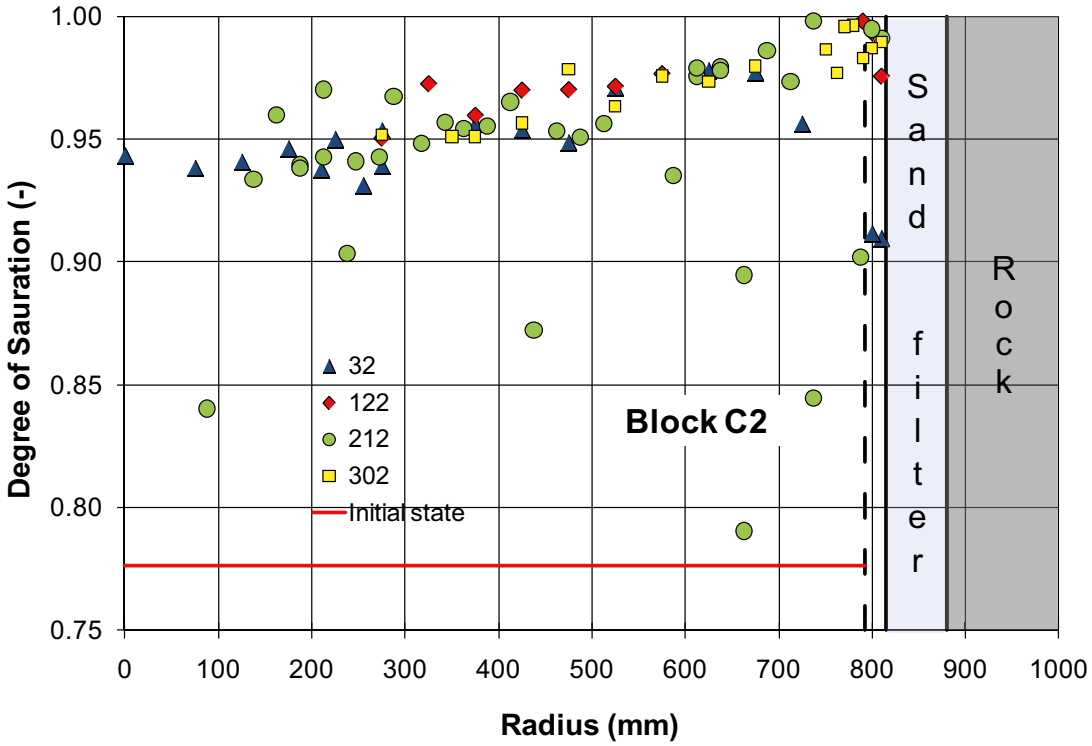

Block R6
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Degree of Saturation (-)
Radius (mm)
Sand filter
Rock
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950

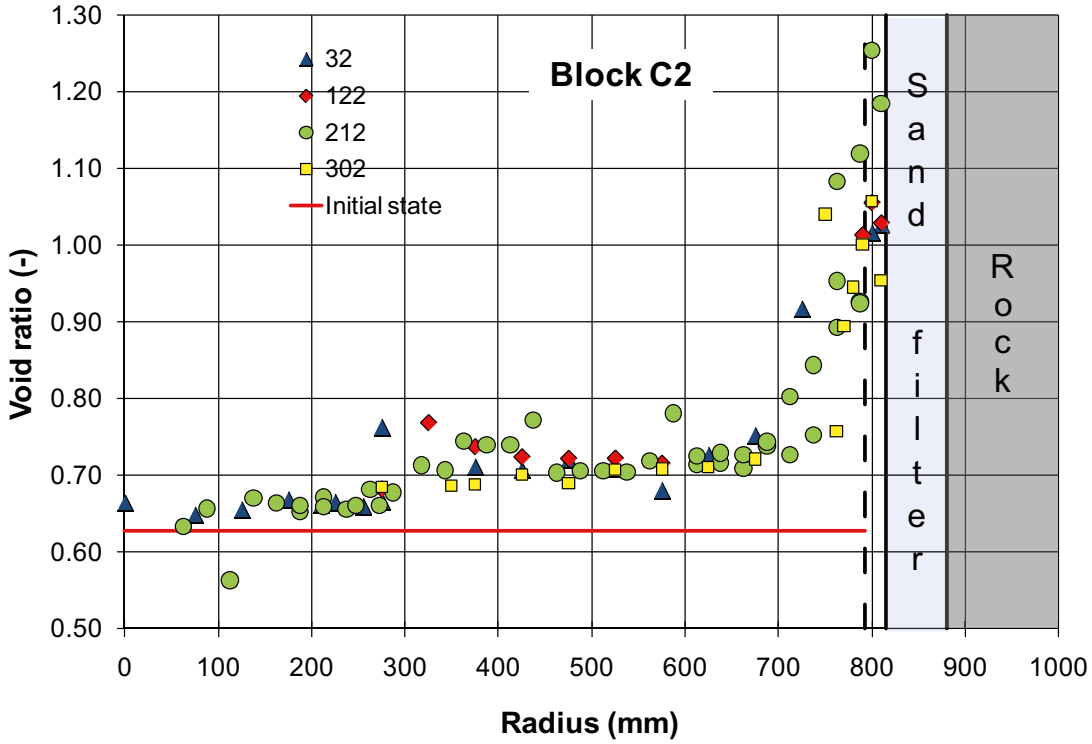

Block R6
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Void ratio (-)
Radius (mm)
Sand filter
Rock
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950

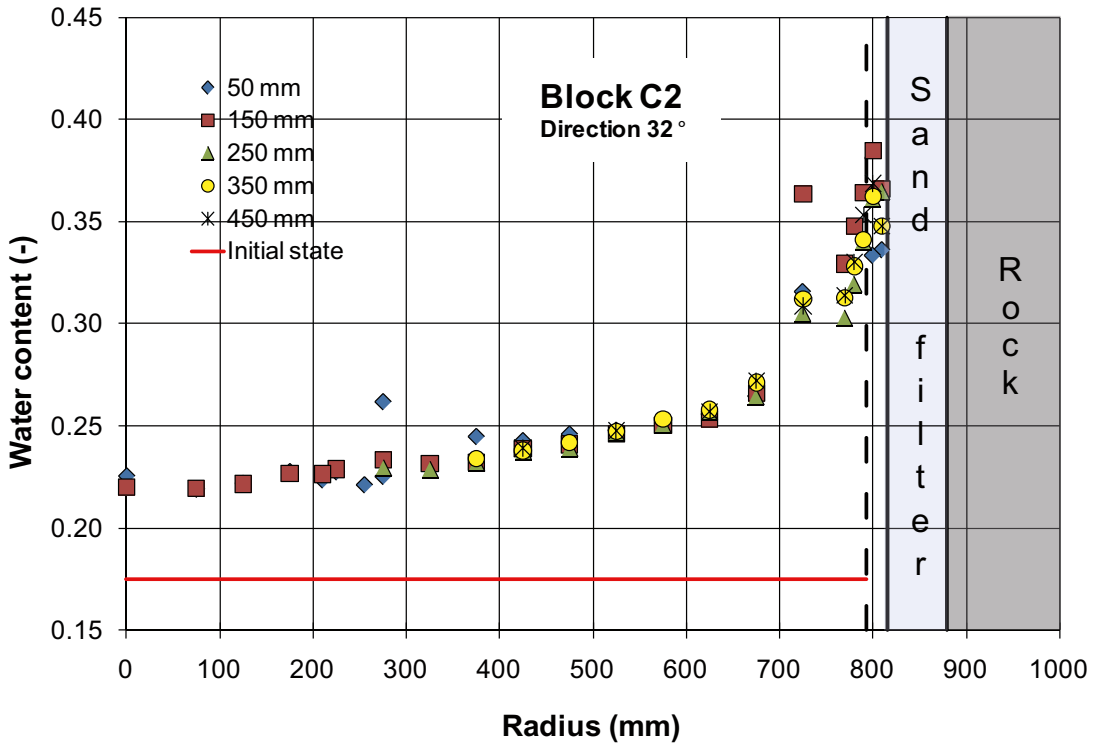
Results from measurements made in block C2

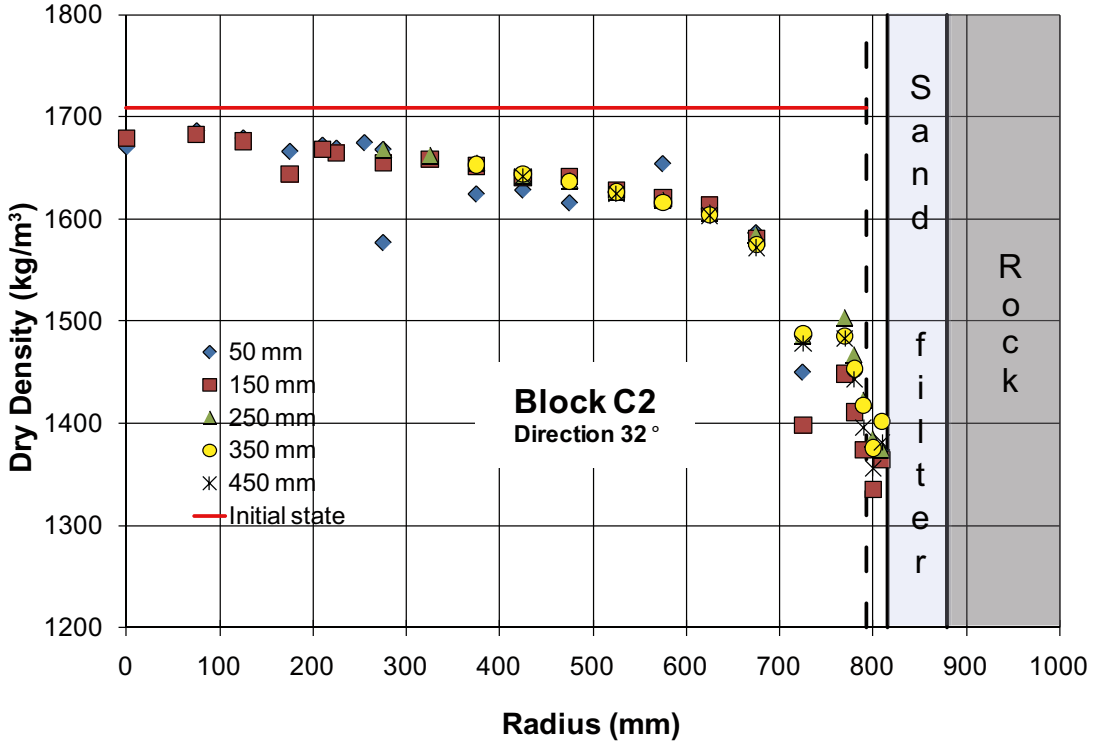


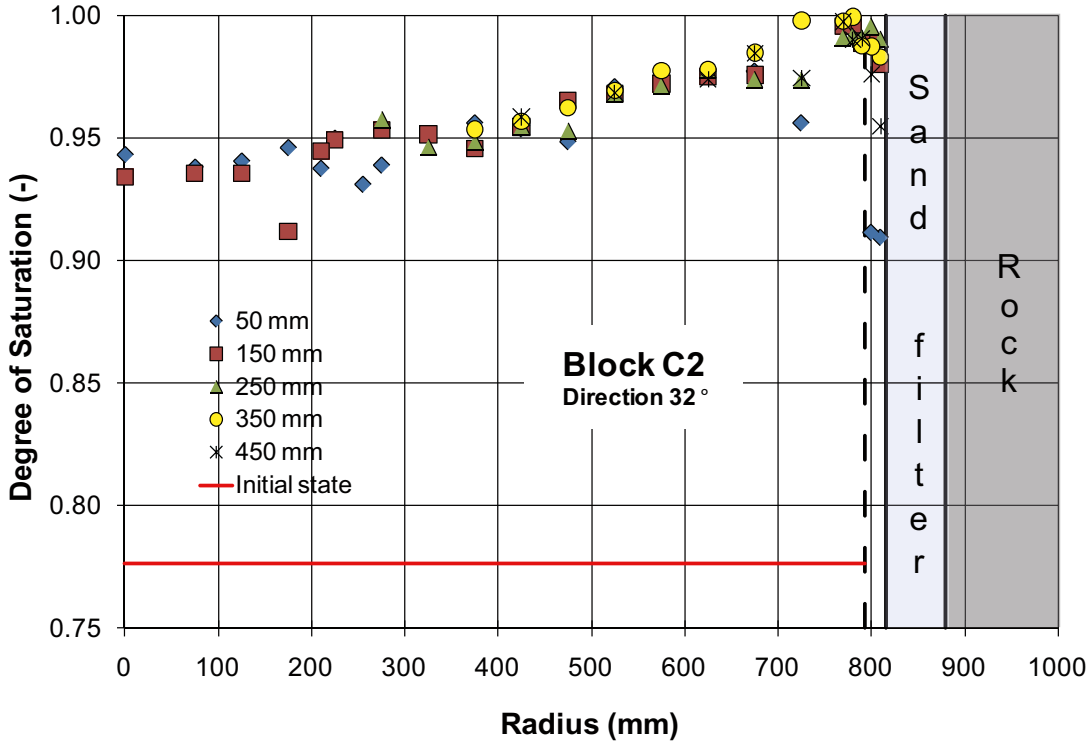


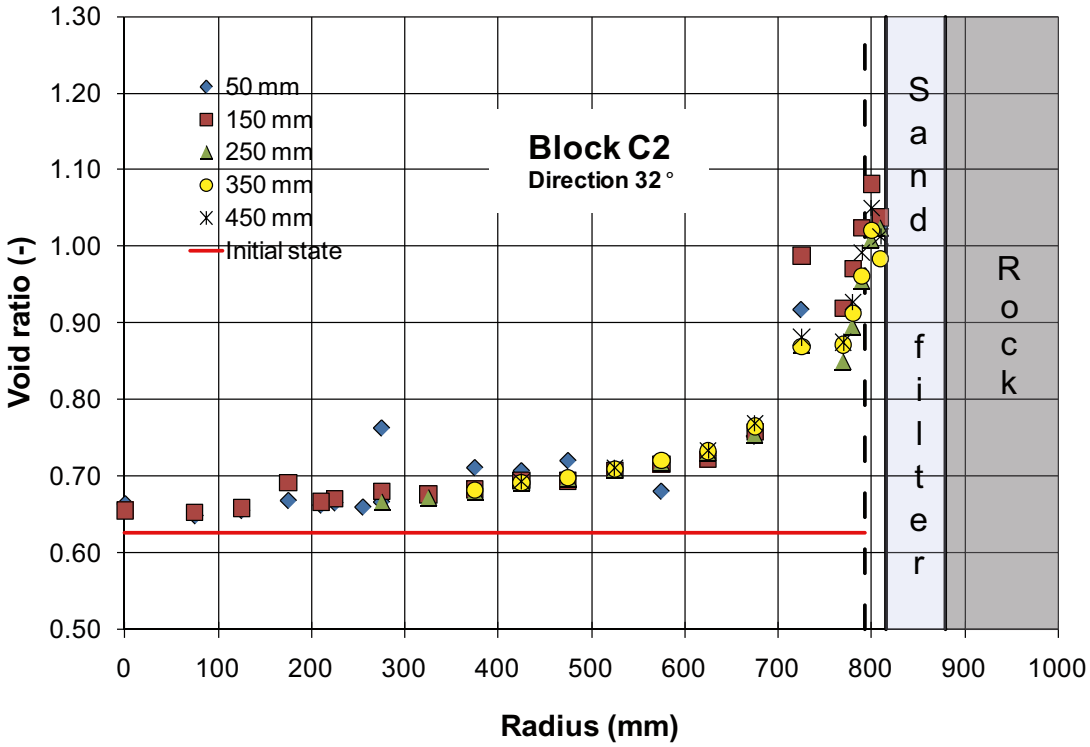

Degree of Sauration (-)
1.00
0.95
0.90
0.85
0.80
0.75
0
100
200
300
400
500
600
700
800
900
1000
Radius (mm)
32
122
212
302
Initial state
Block C2
Sand filter
Rock


Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0
100
200
300
400
500
600
700
800
900
1000
Radius (mm)
32
122
212
302
Initial state
Block C2
Sand filter
Rock

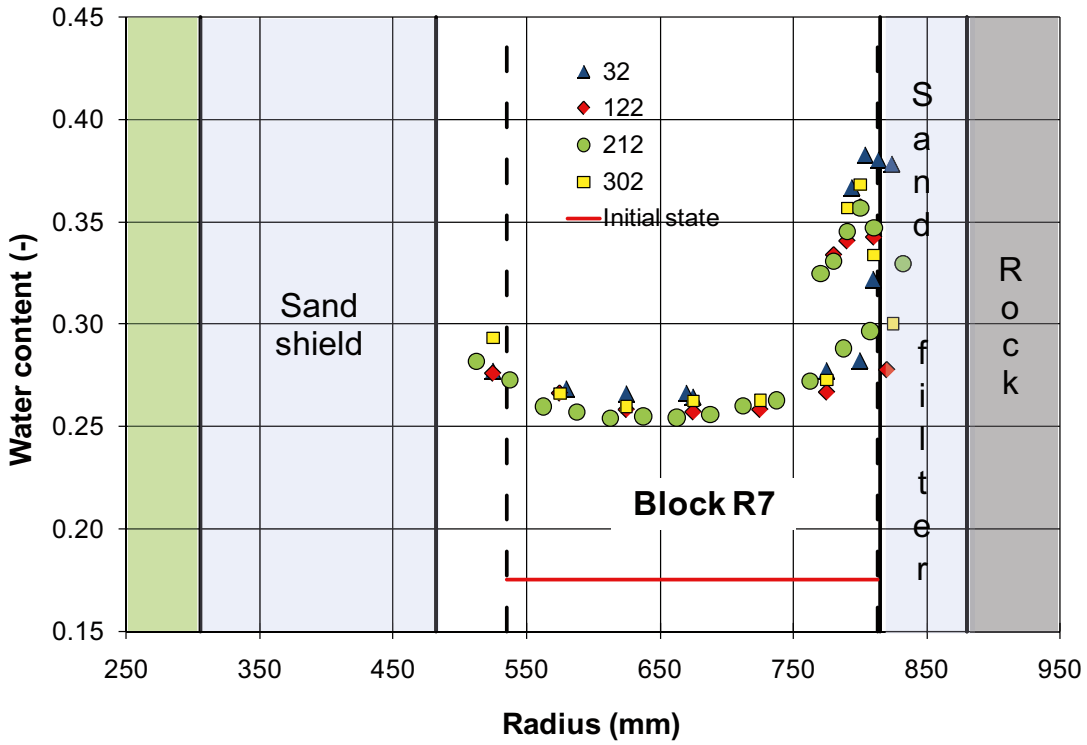

Block C2
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Water content (-)
Radius (mm)
Sand filter
Rock

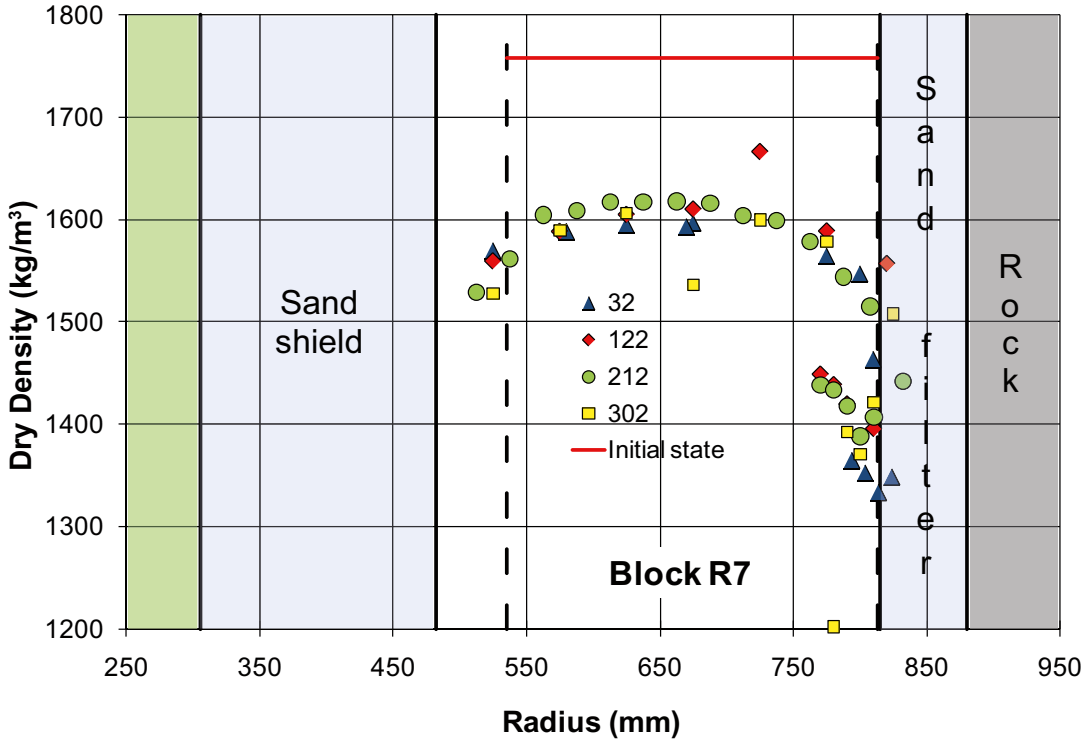

Block C2
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Dry Density (kg/m³)
Radius (mm)
Sand filter
Rock

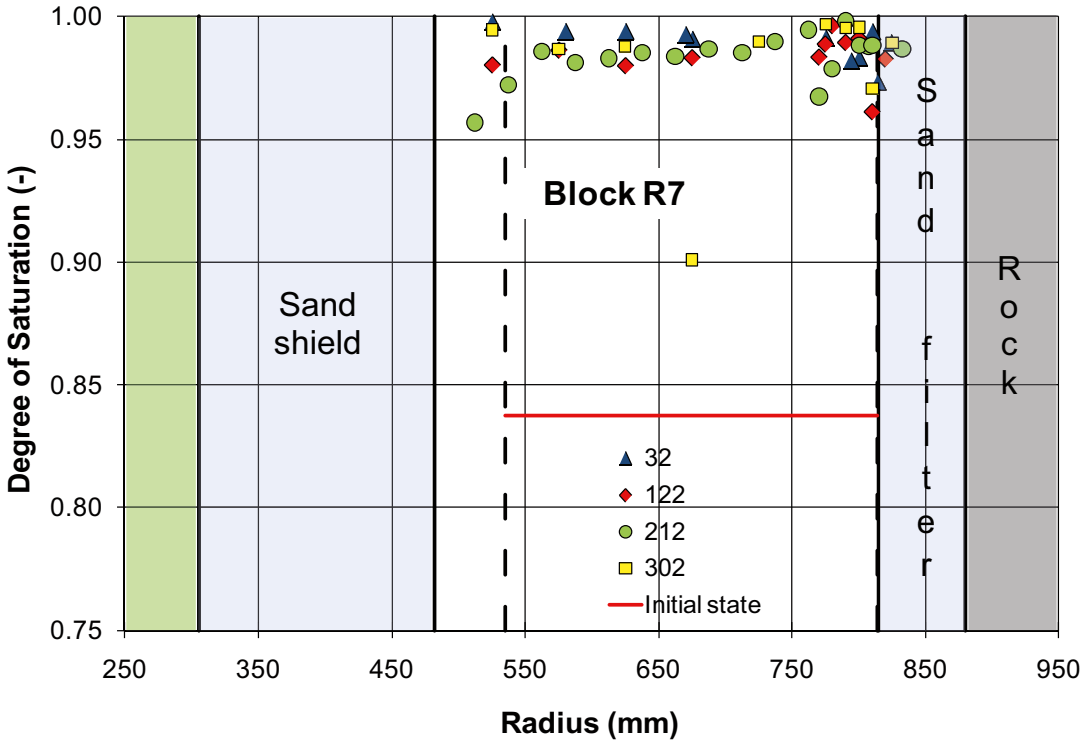

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
0
100
200
300
400
500
600
700
800
900
1000
Radius (mm)
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block C2
Direction 32 °
Sand filter
Rock

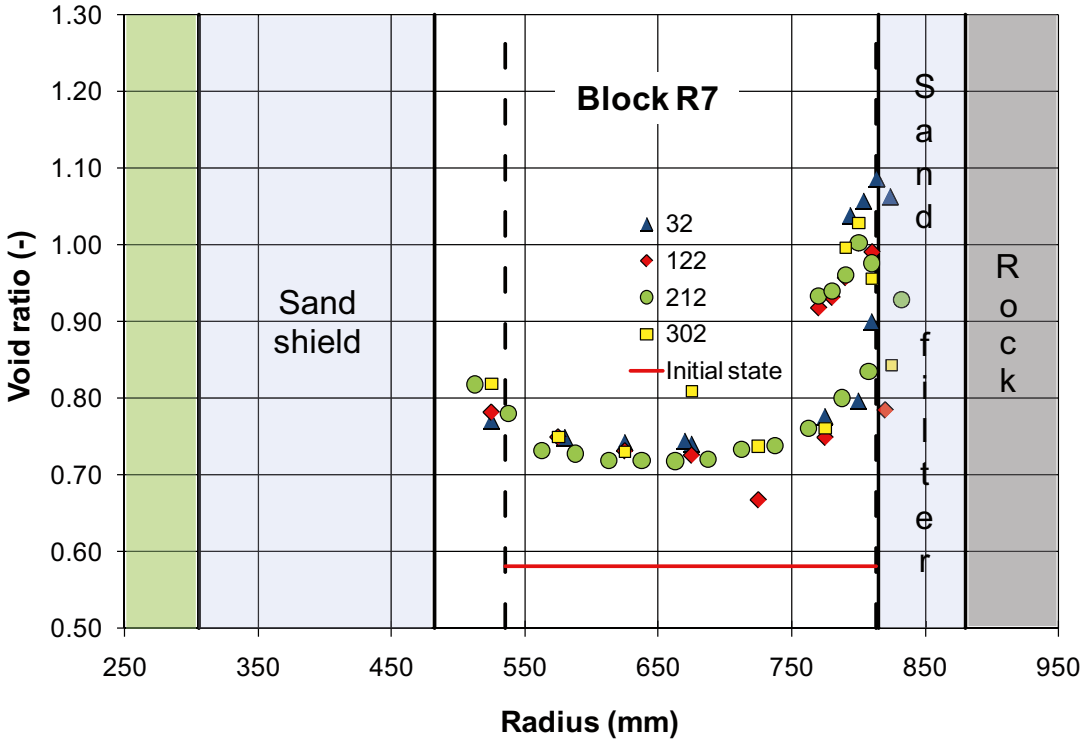

Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0
100
200
300
400
500
600
700
800
900
1000
Radius (mm)
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block C2
Direction 32 °
Sand filter
Rock

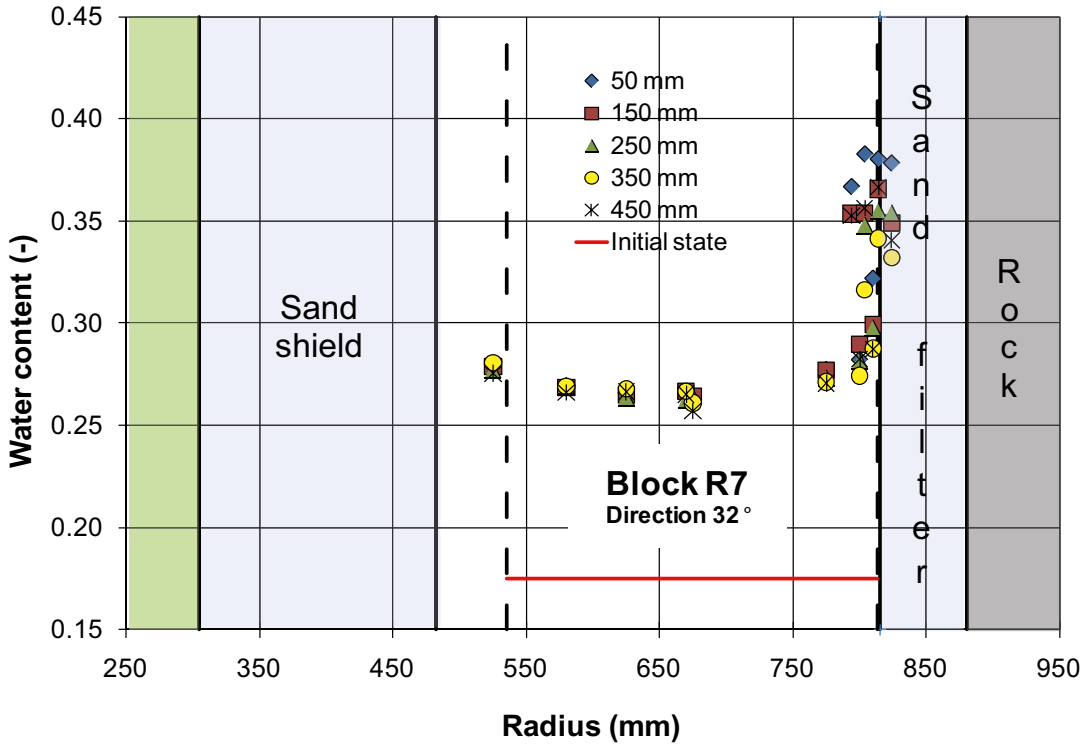
Results from measurements made in block R7

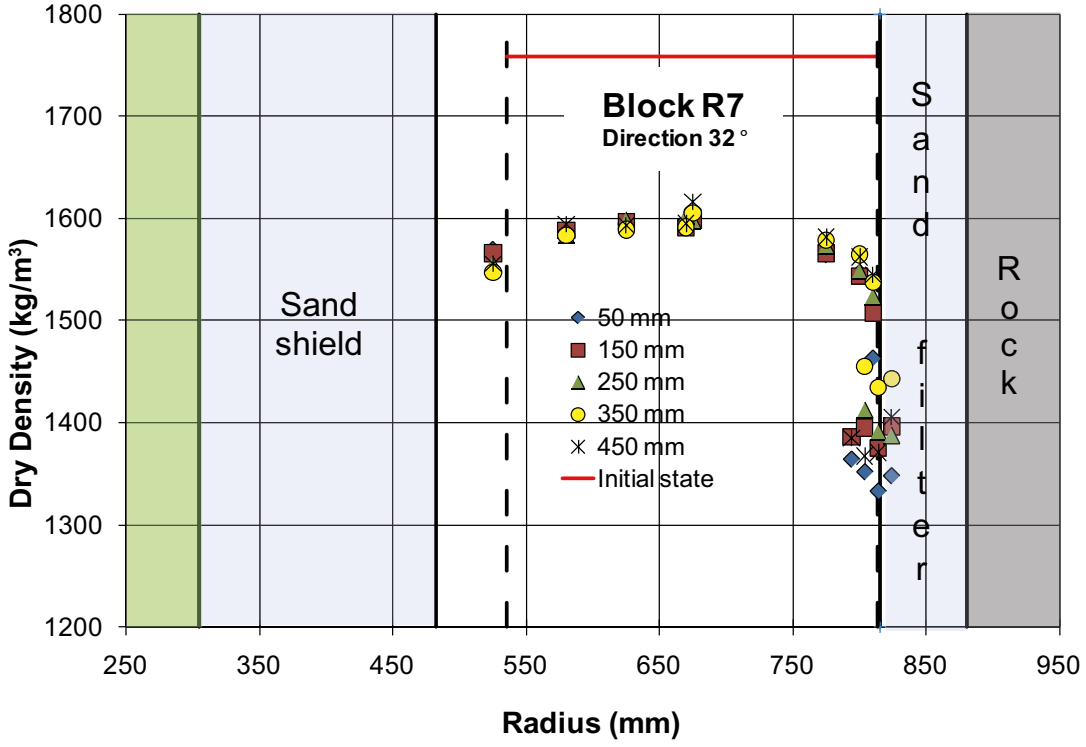


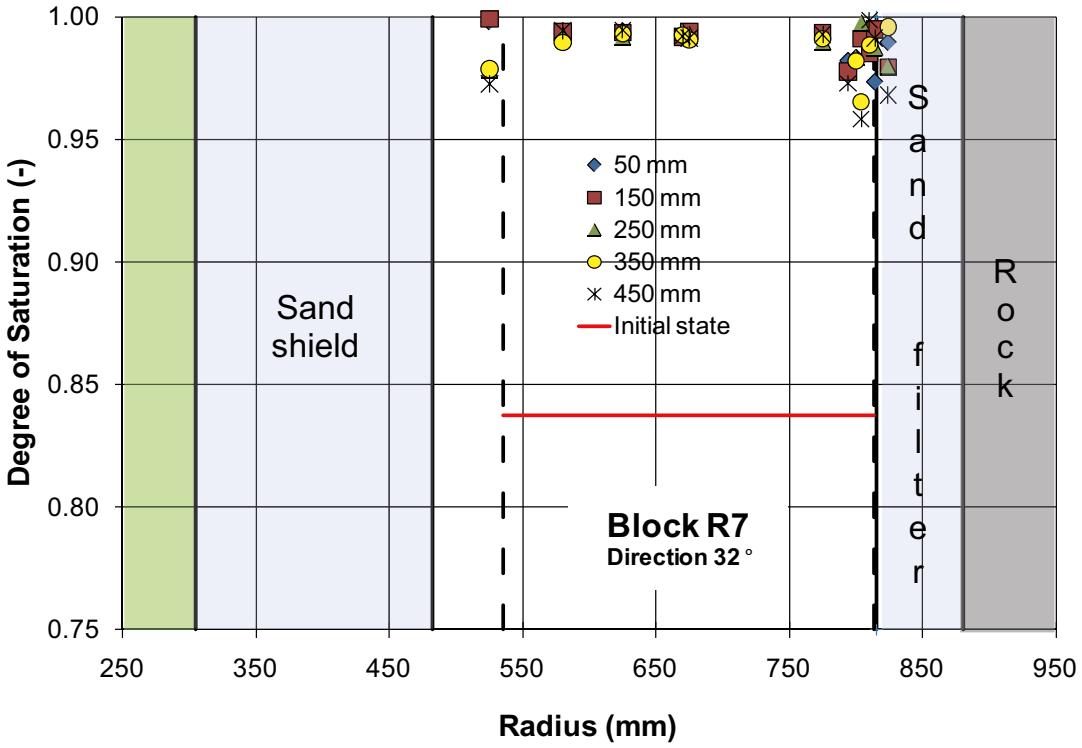


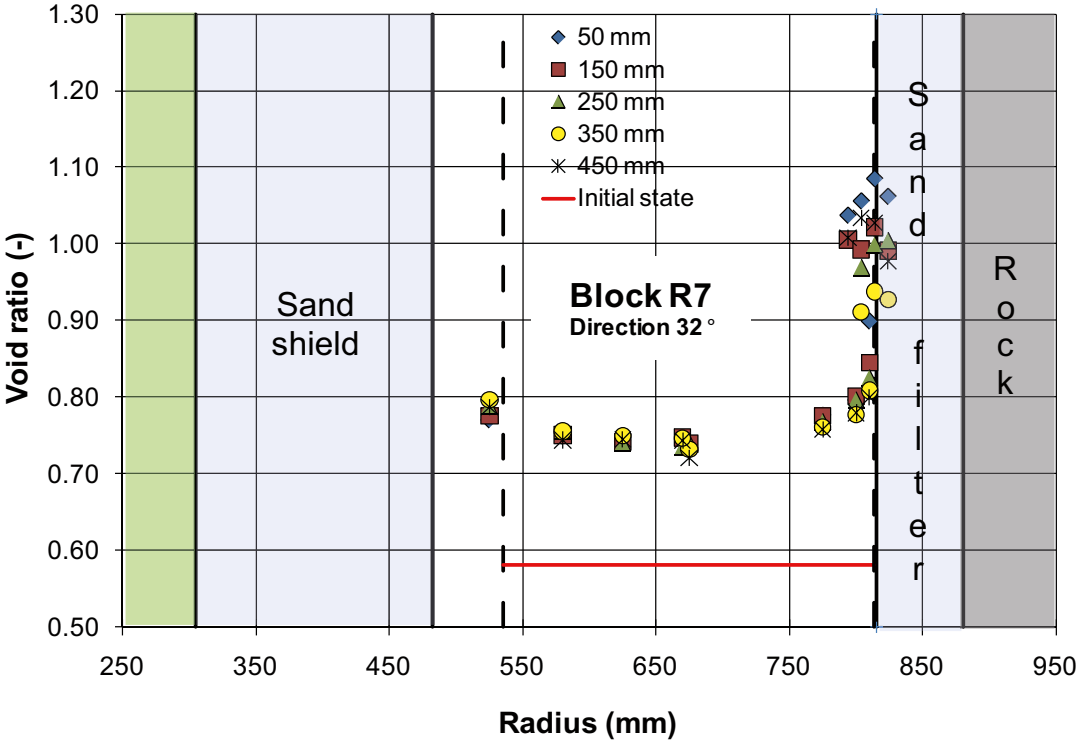

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
Block R7
Sand shield
Sand filter
Rock
32
122
212
302
Initial state


Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Block R7
Sand shield
Sand filter
Rock
32
122
212
302
Initial state

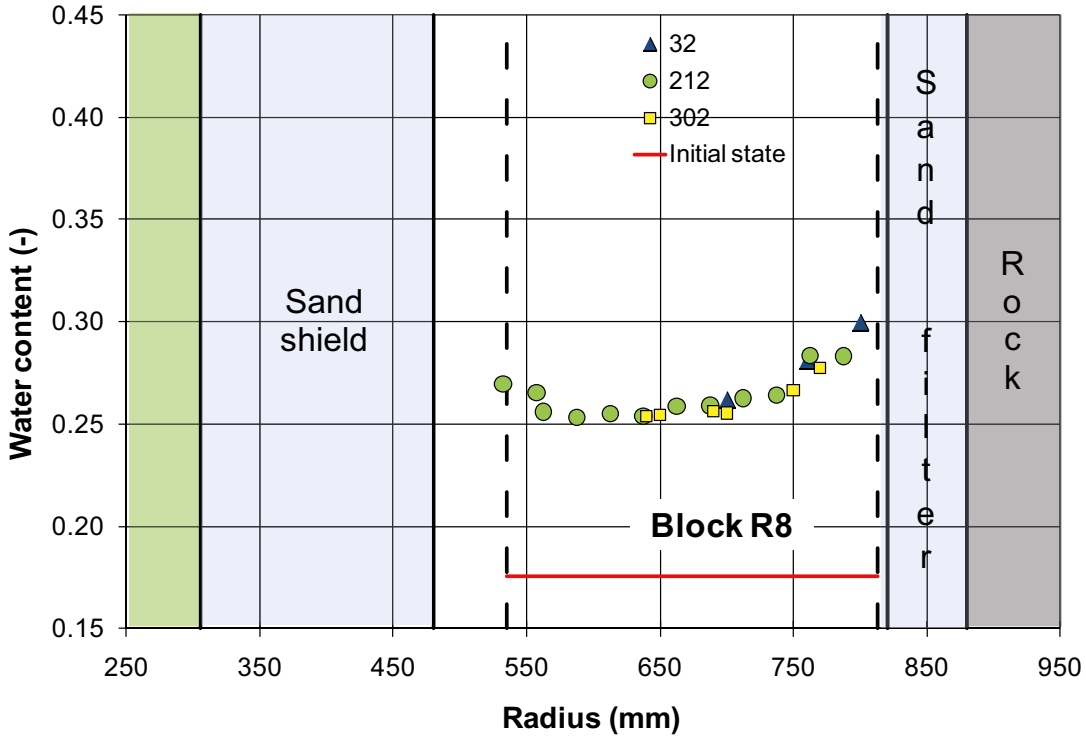

Water content (-)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
250
350
450
550
650
750
850
950
Radius (mm)
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Sand shield
Block R7
Direction 32 °
Sand filter
Rock

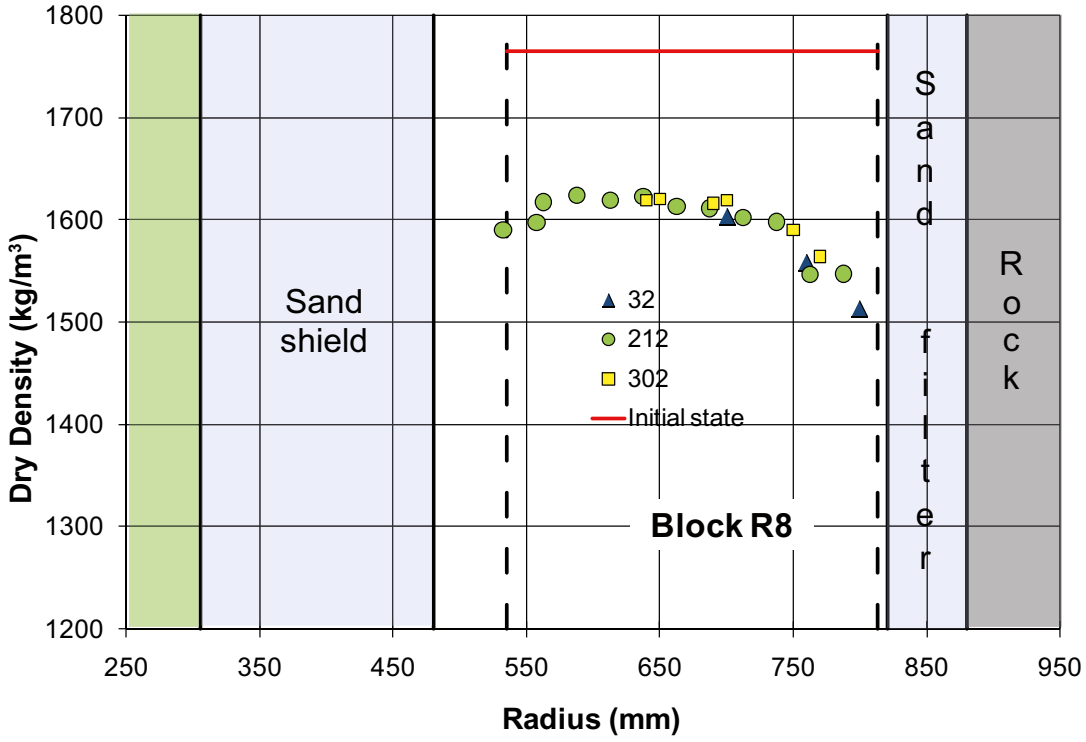

Dry Density (kg/m³)
1800
1700
1600
1500
1400
1300
1200
250
350
450
550
650
750
850
950
Radius (mm)
Block R7
Direction 32 °
Sand shield
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Sand filter
Rock

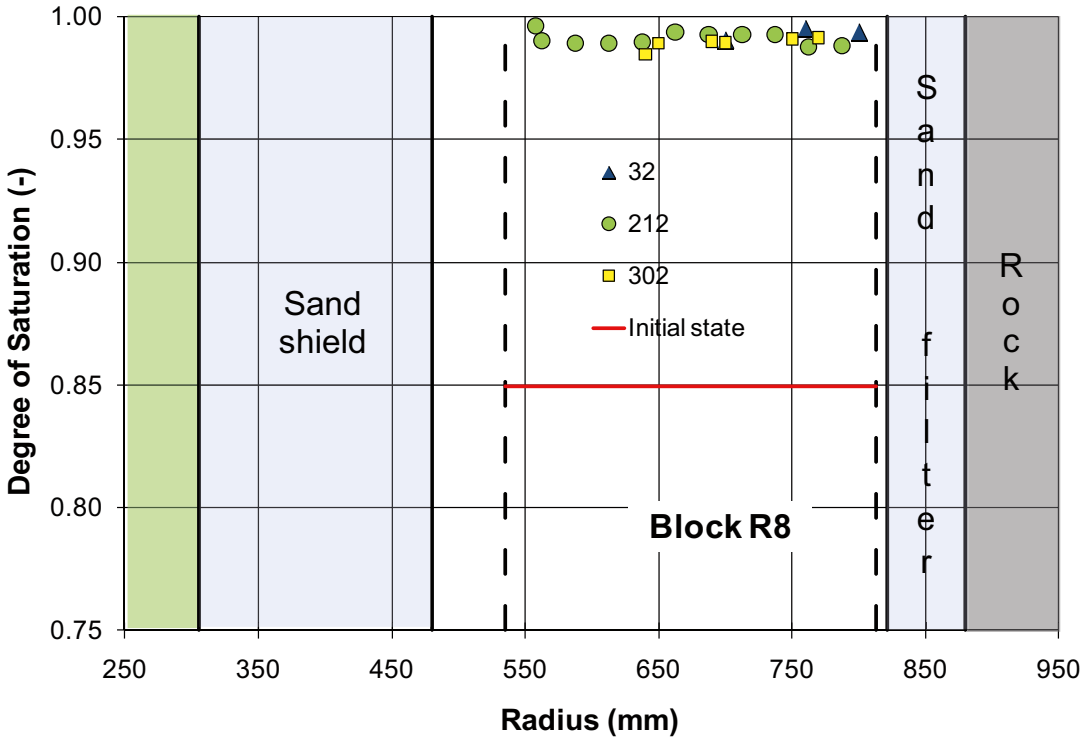

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R7
Direction 32 °
Sand filter
Rock

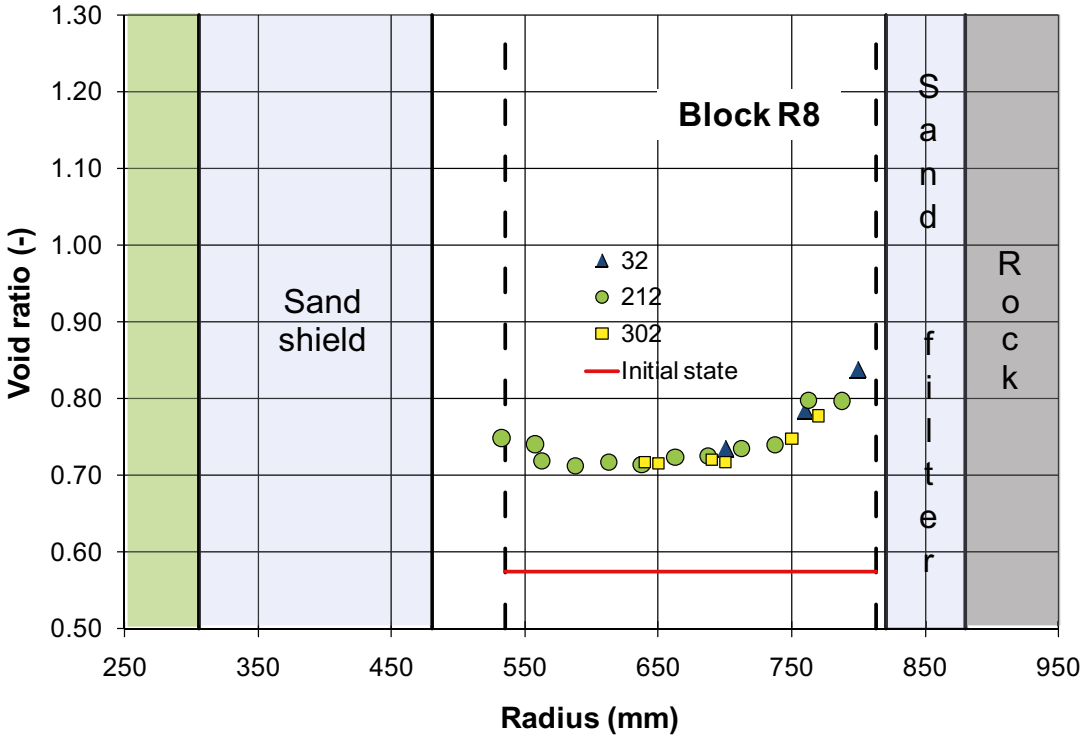

Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R7
Direction 32 °
Sand filter
Rock

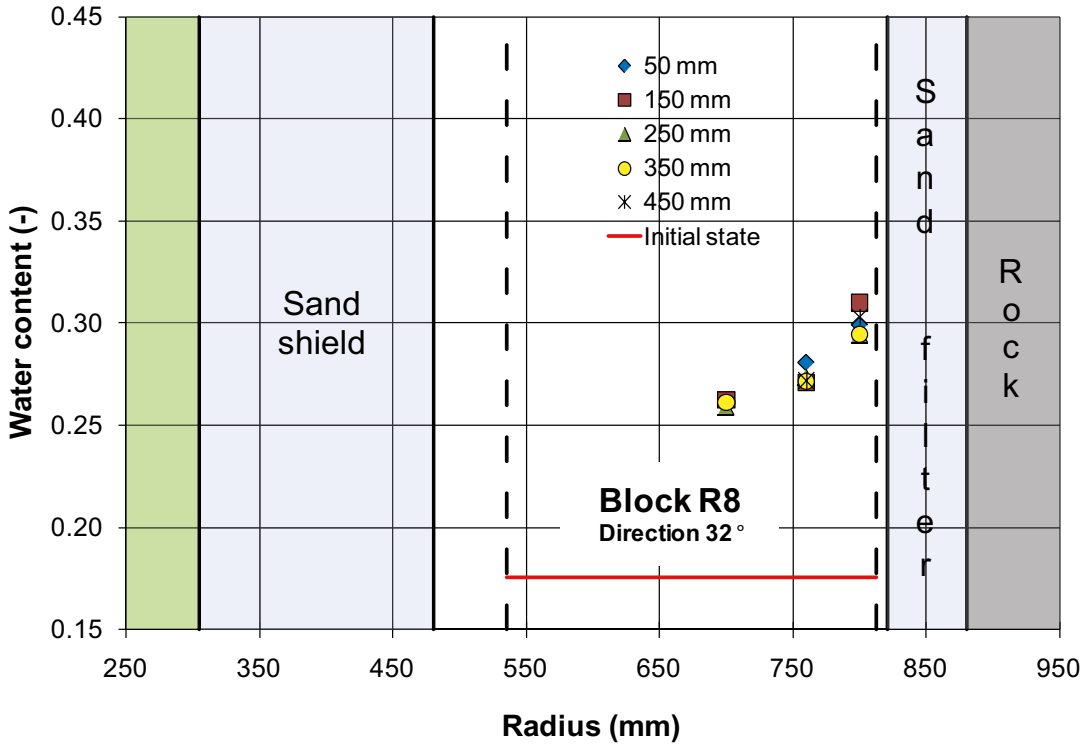
Results from measurements made in block R8

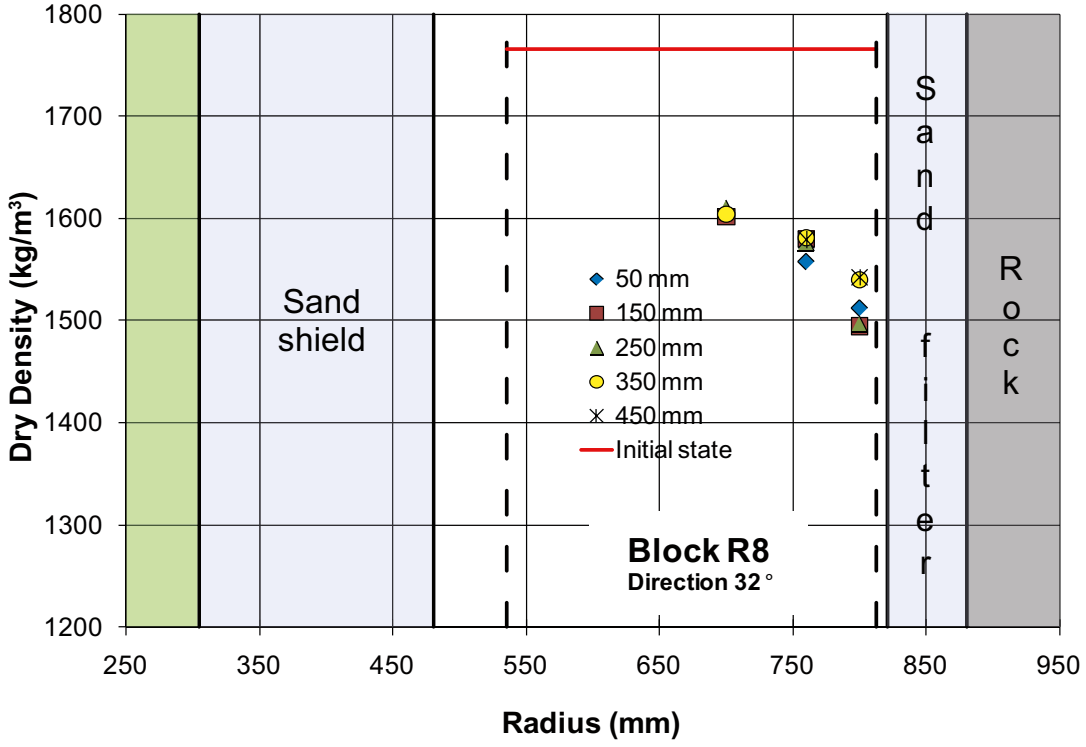


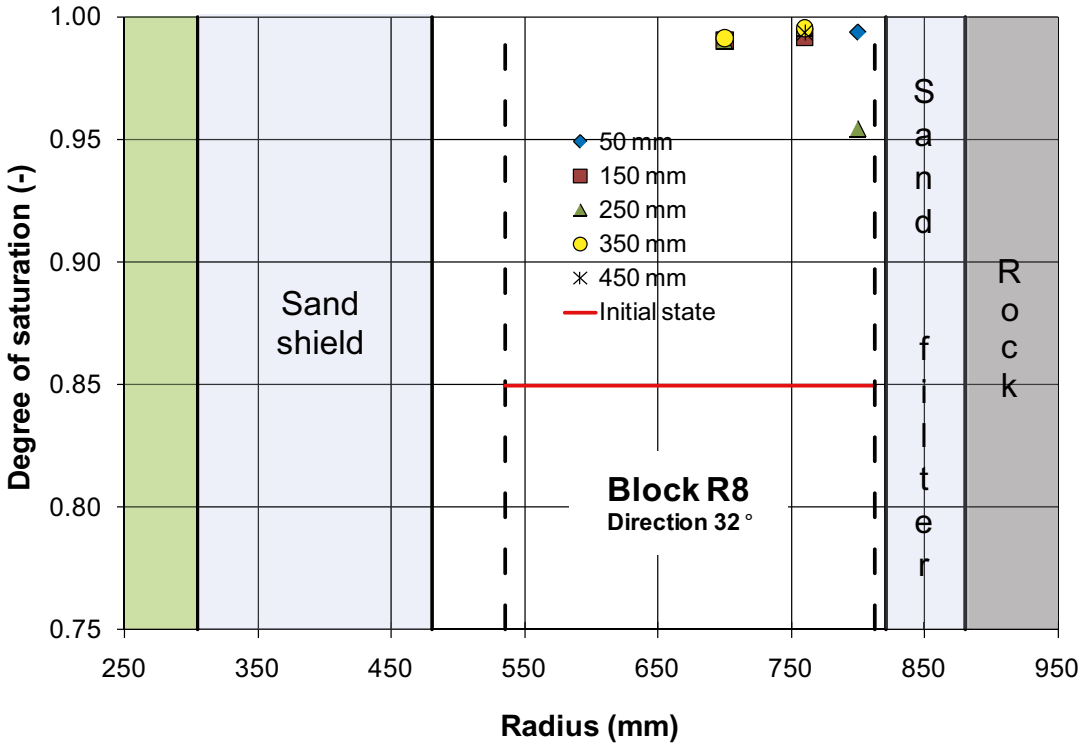


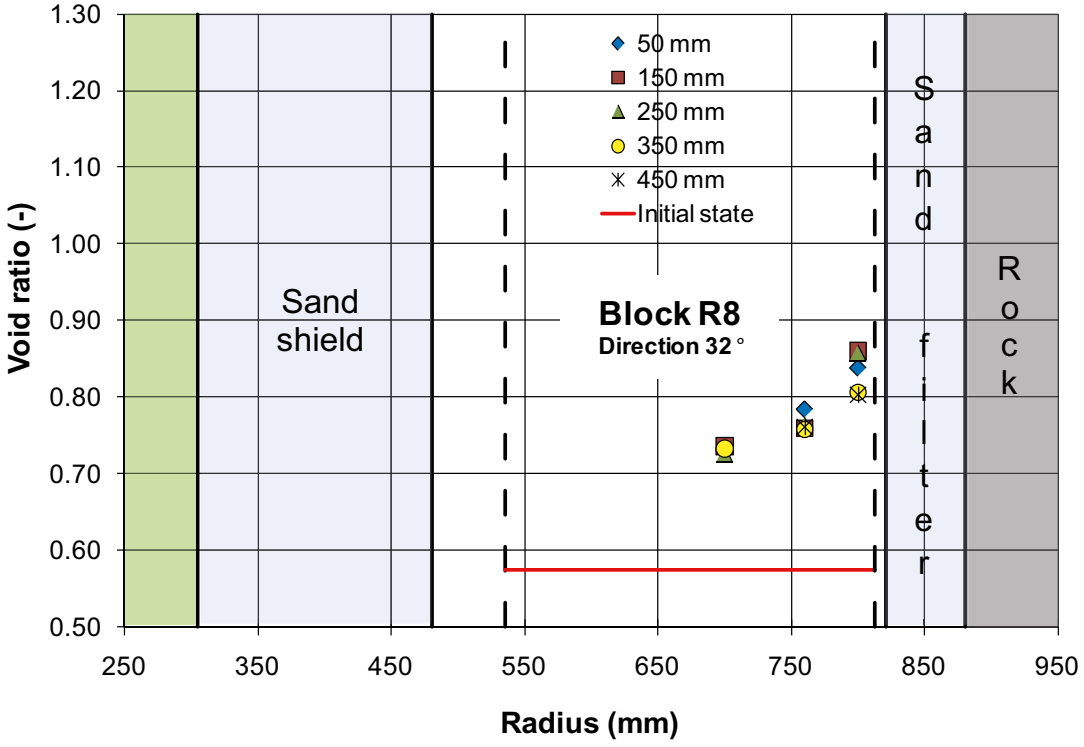

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Block R8
Sand filter
Rock
32
212
302
Initial state


Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Block R8
Sand filter
Rock
32
212
302
Initial state

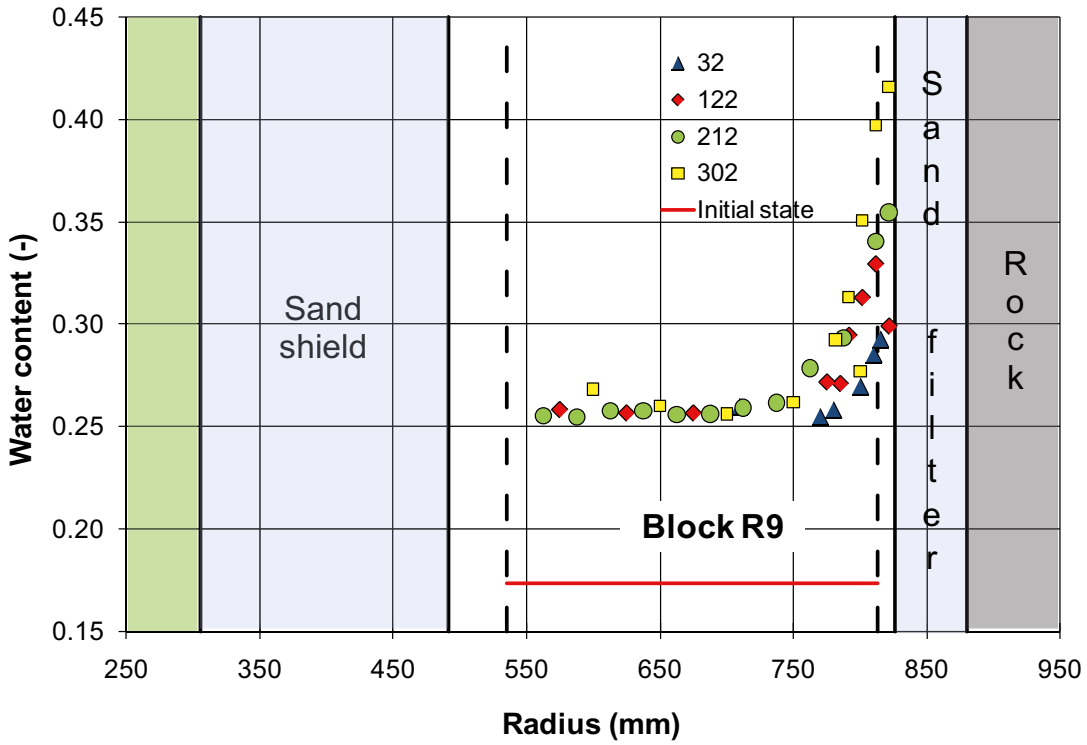

Water content (-)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Sand filter
Rock
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R8
Direction 32 °

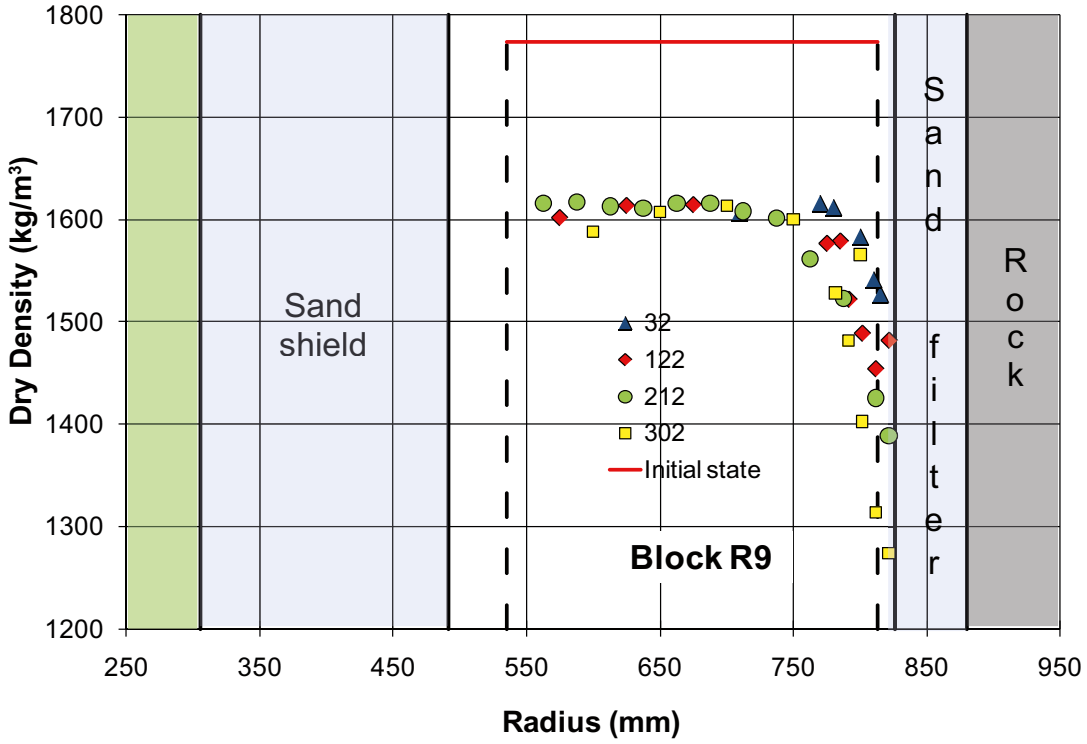

Dry Density (kg/m³)
1800
1700
1600
1500
1400
1300
1200
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Sand filter
Rock
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R8
Direction 32 °

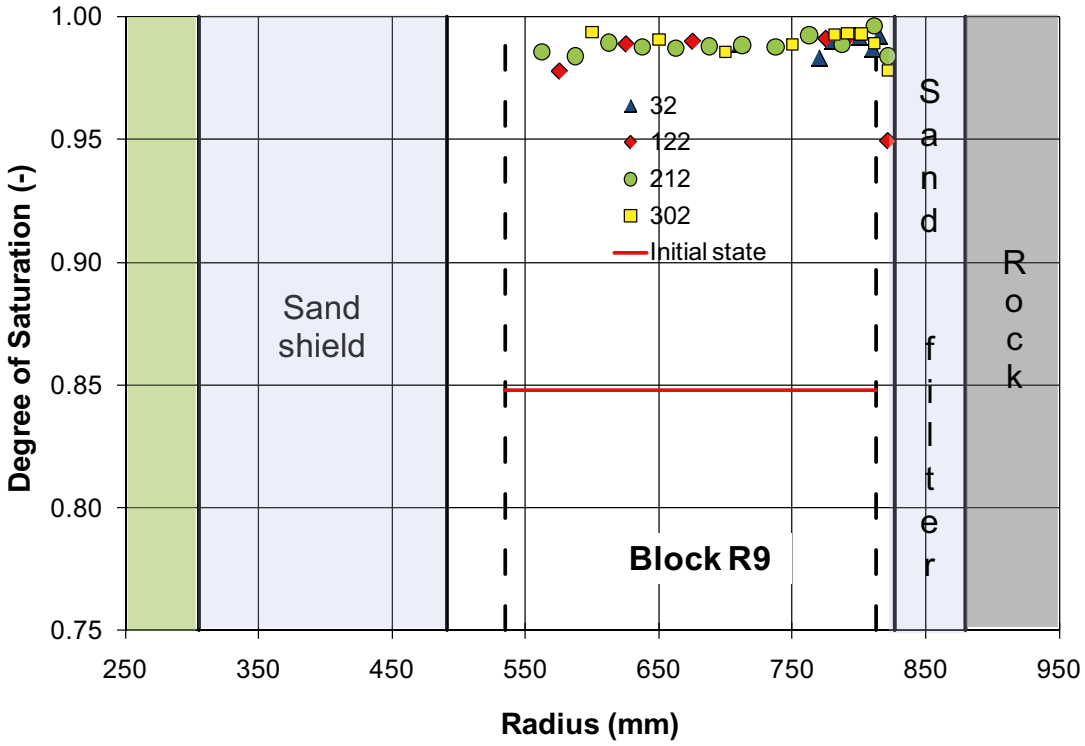

Degree of saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Sand filter
Rock
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R8
Direction 32 °

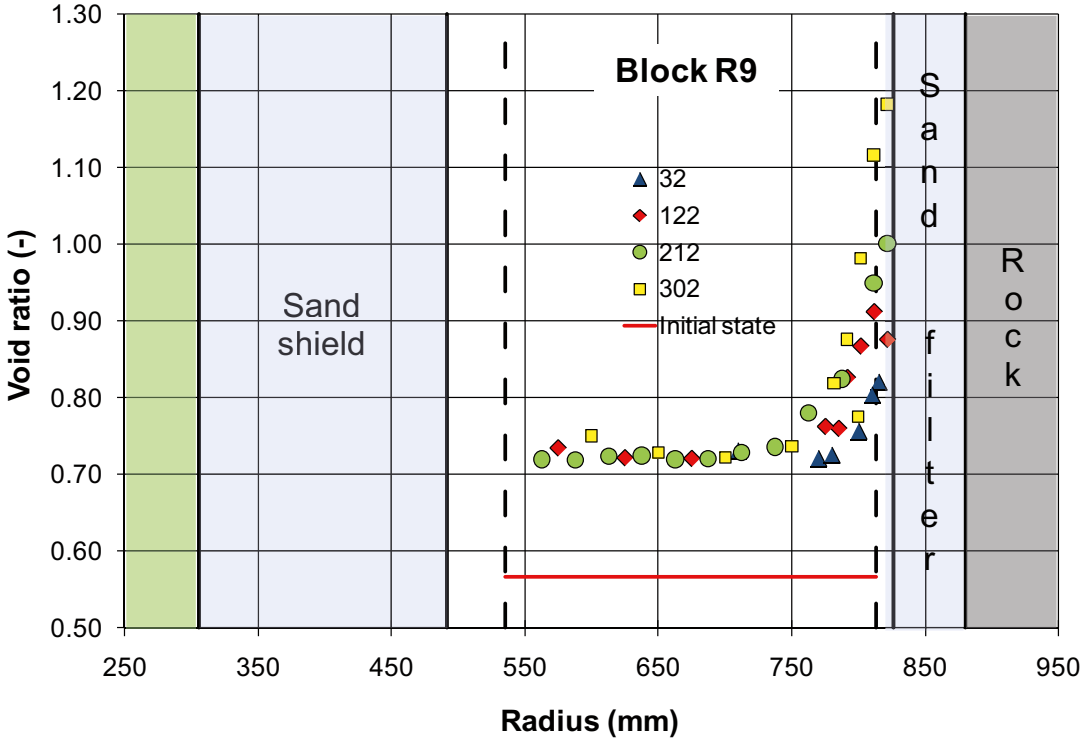

Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Sand filter
Rock
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R8
Direction 32 °

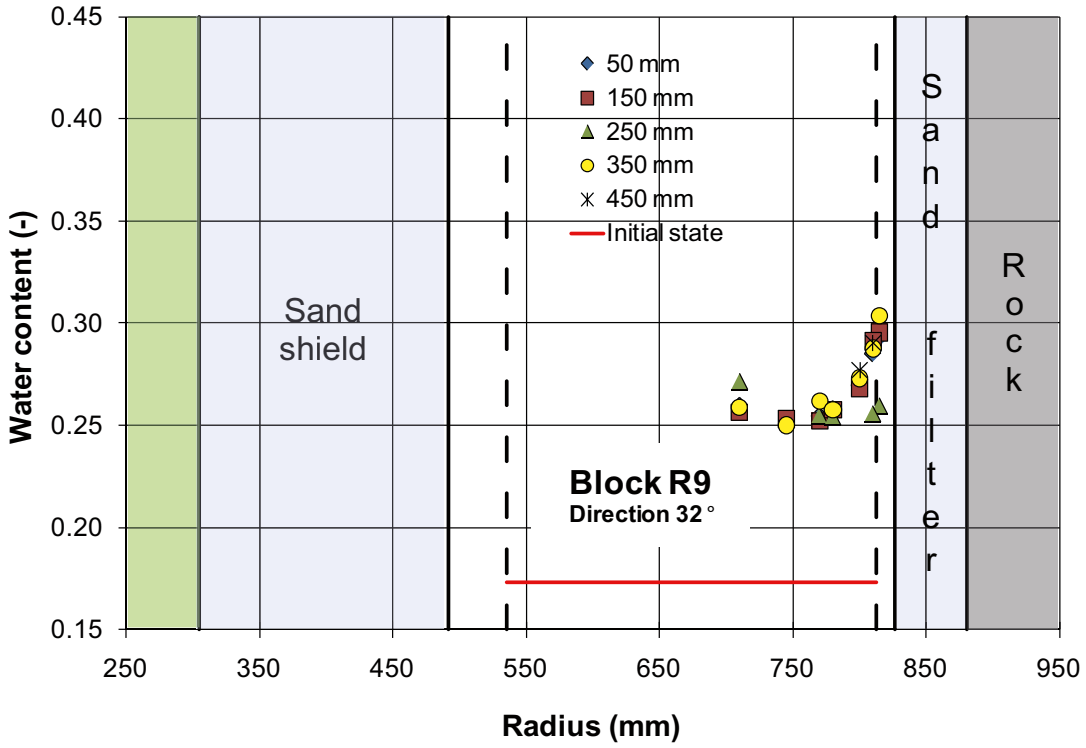
Results from measurements made in block R9

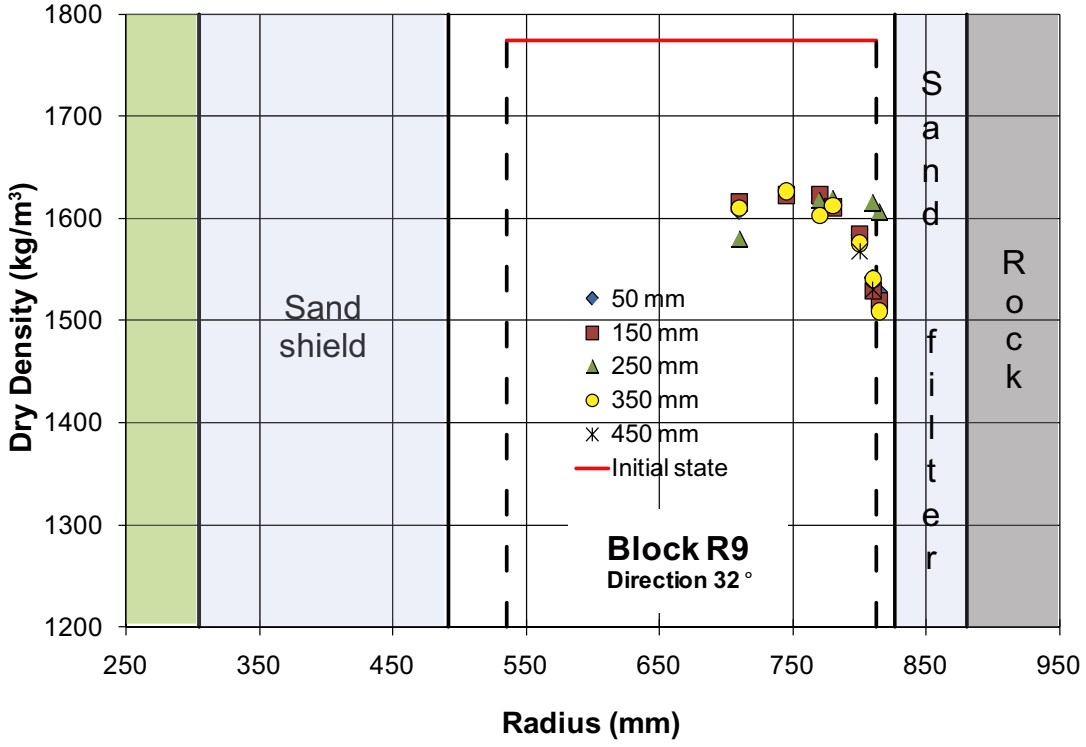


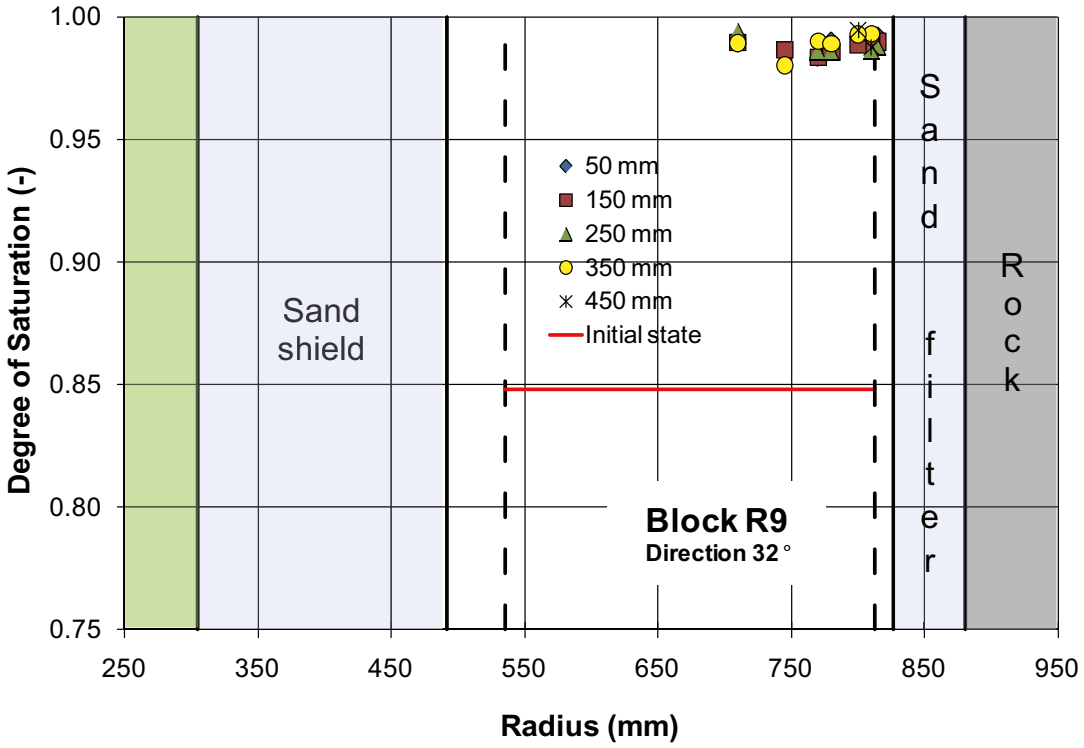


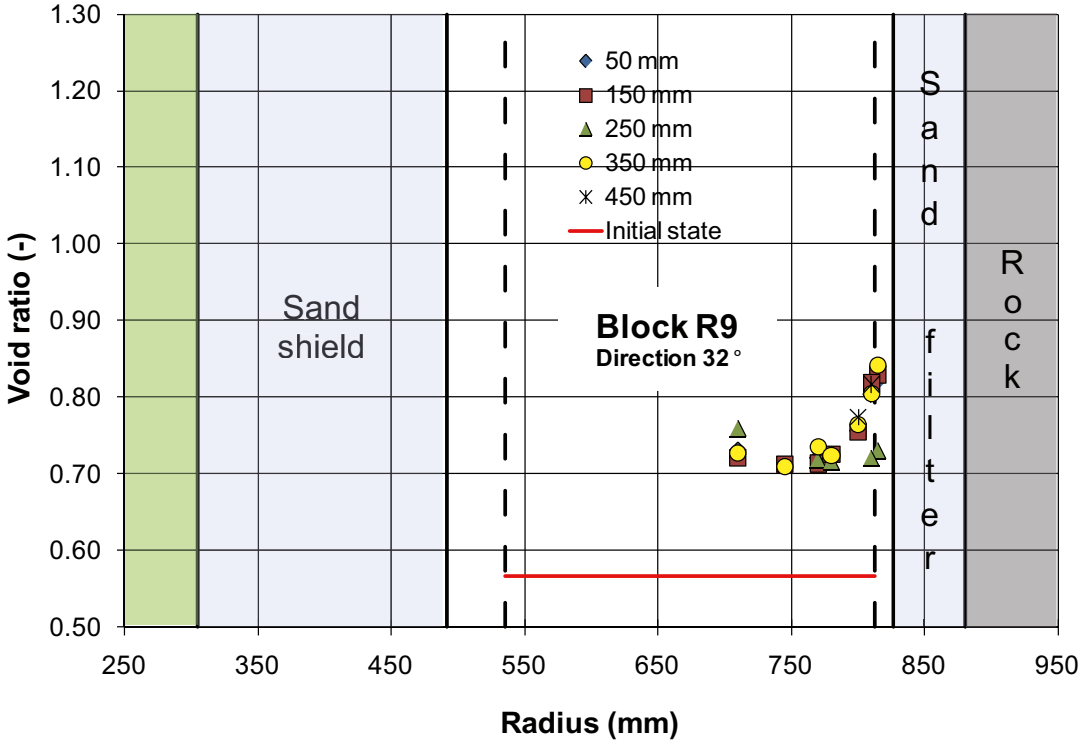

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Block R9
32
122
212
302
Initial state
Sand filter
Rock


Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Block R9
Sand shield
32
122
212
302
Initial state
Sand filter
Rock

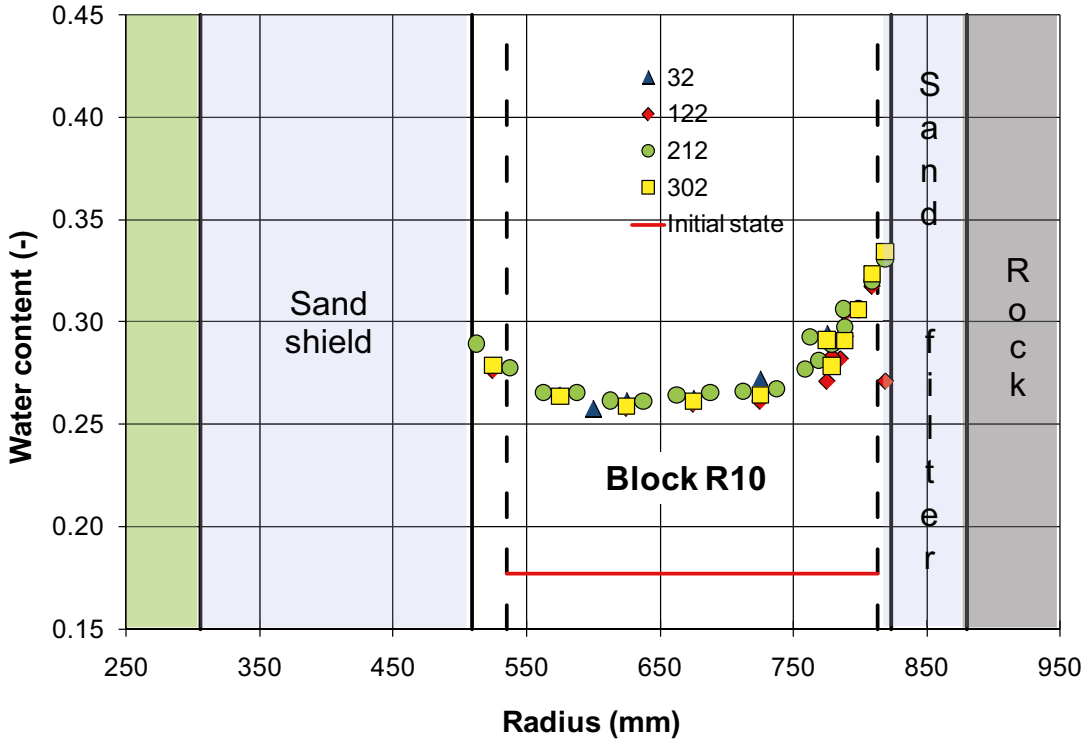

Water content (-)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Sand filter
Rock
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R9
Direction 32 °

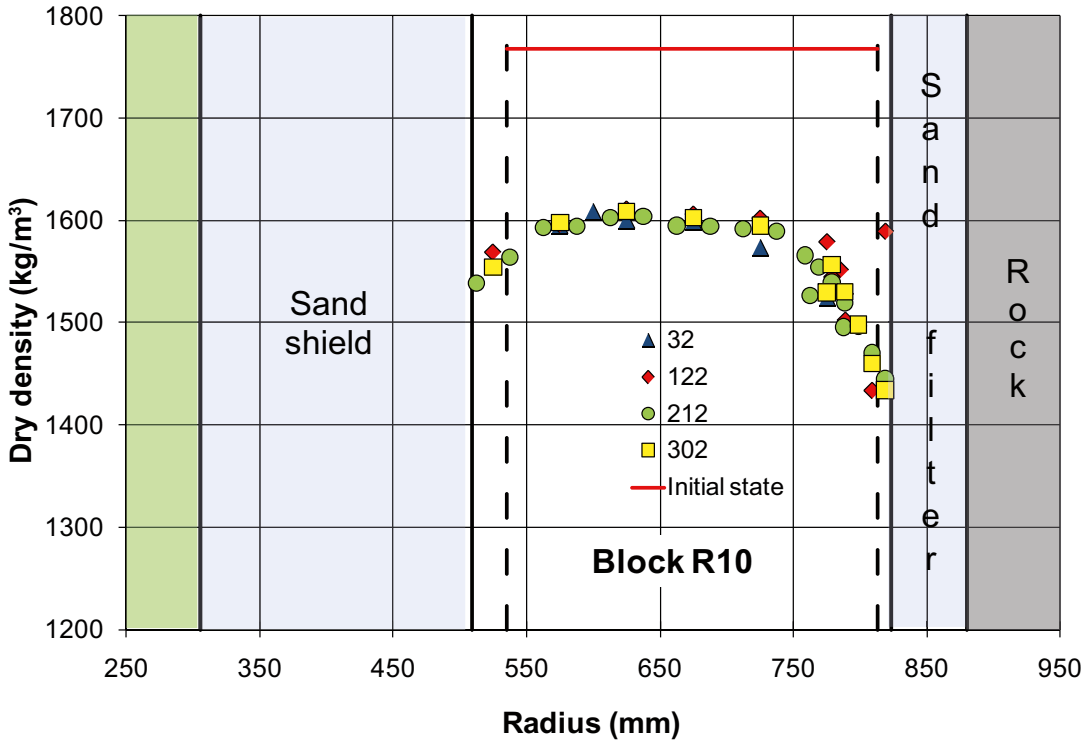

Dry Density (kg/m³)
1800
1700
1600
1500
1400
1300
1200
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Sand filter
Rock
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R9
Direction 32 °

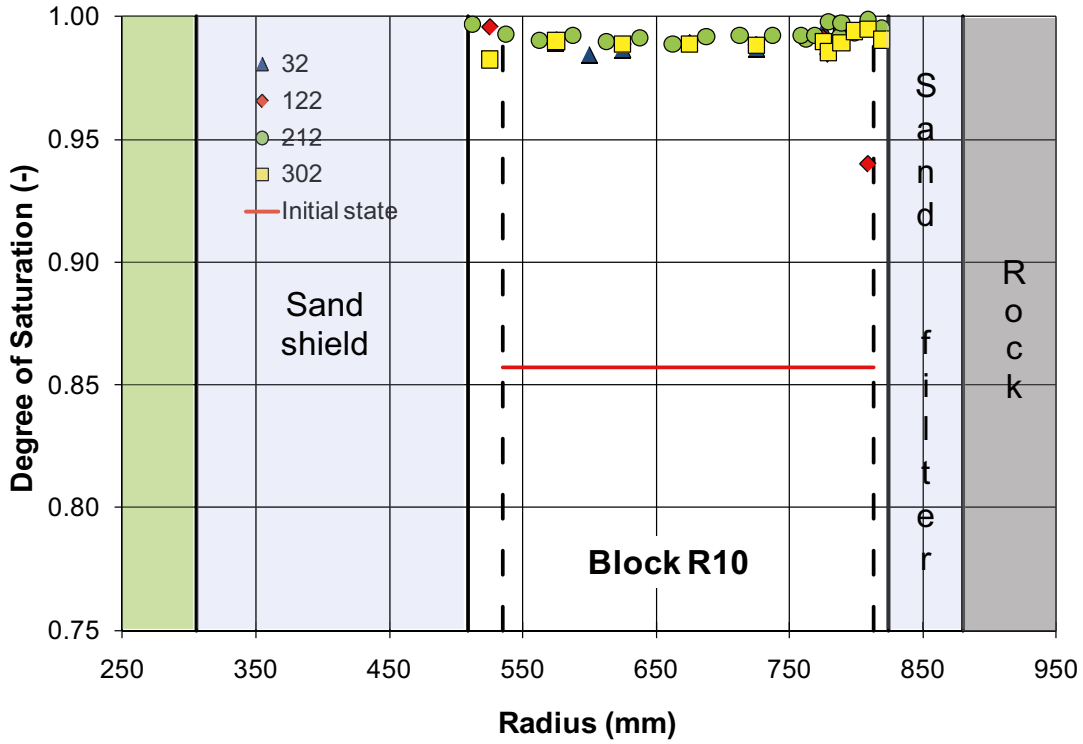

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Sand filter
Rock
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R9
Direction 32°

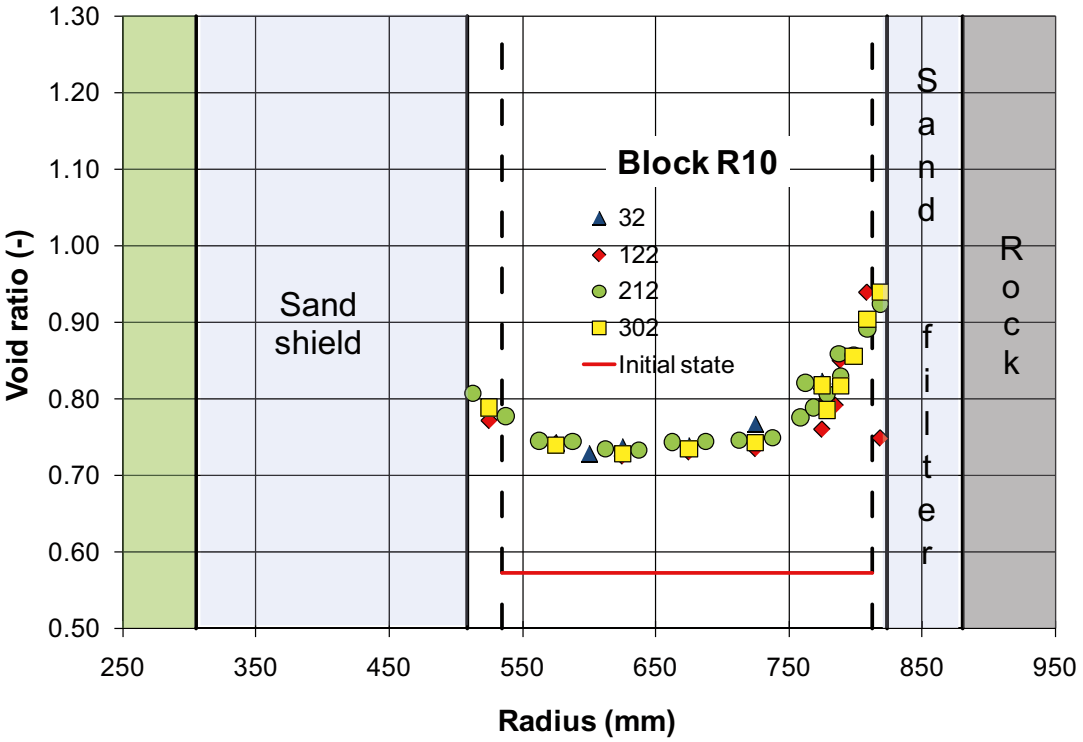

Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Sand filter
Rock
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R9
Direction 32°

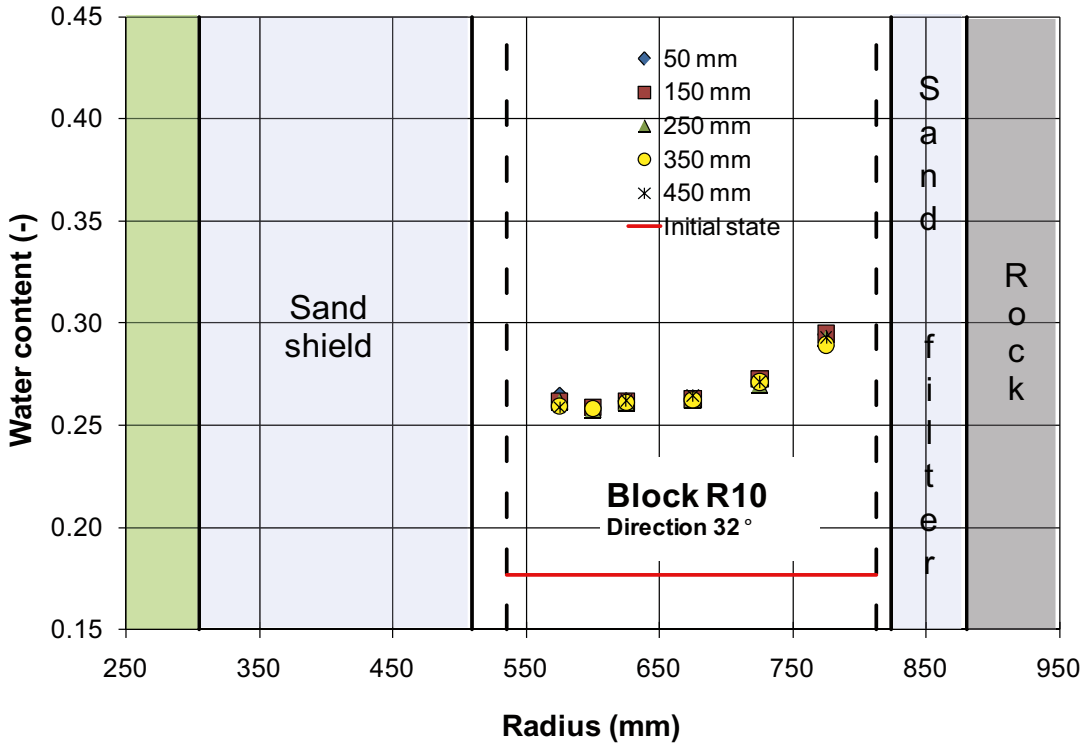
Results from measurements made in block R10

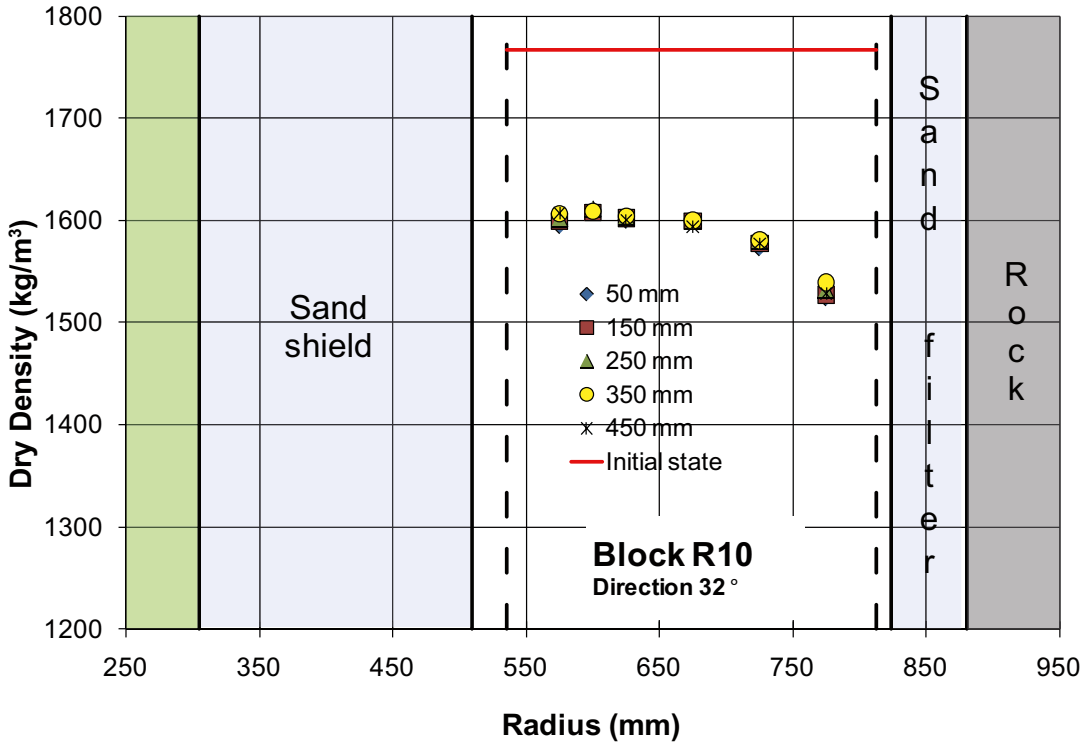


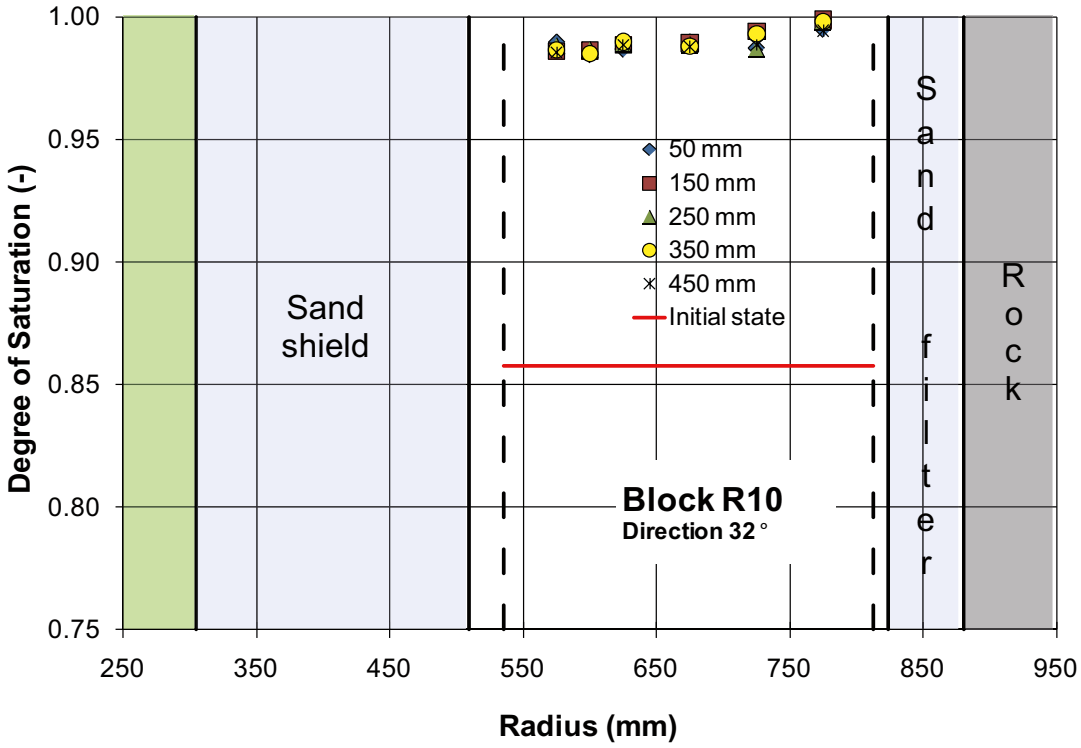


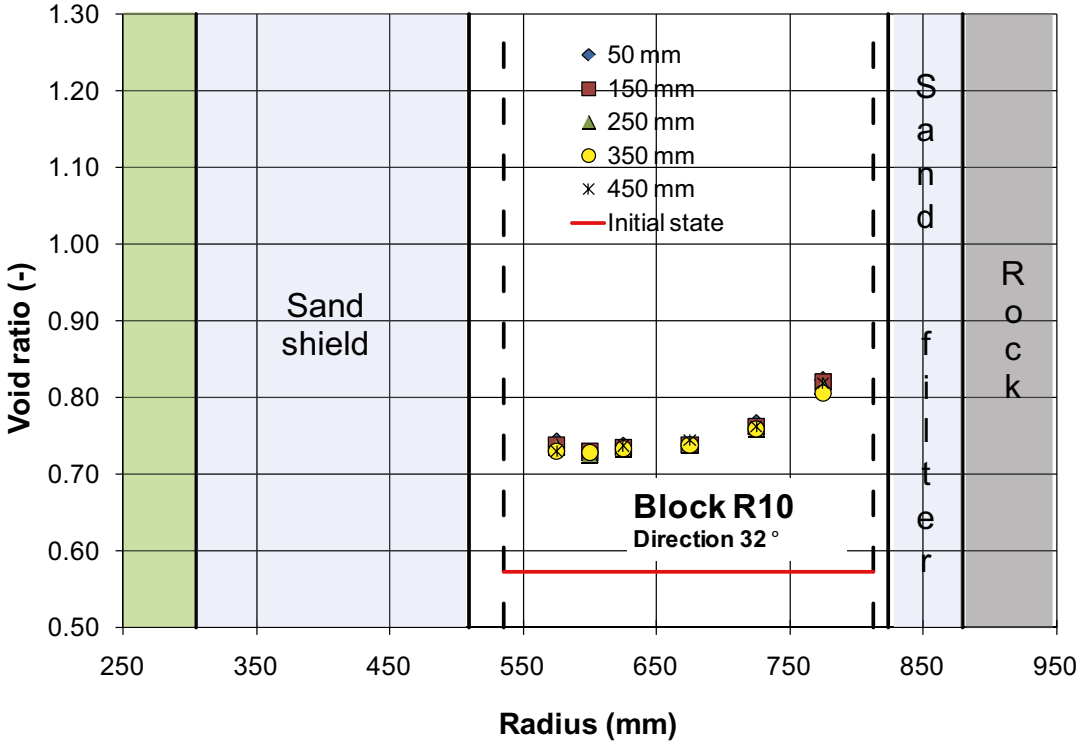

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
32
122
212
302
Initial state
Sand shield
Block R10
Sand filter
Rock


Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Block R10
32
122
212
302
Initial state
Sand shield
Sand filter
Rock

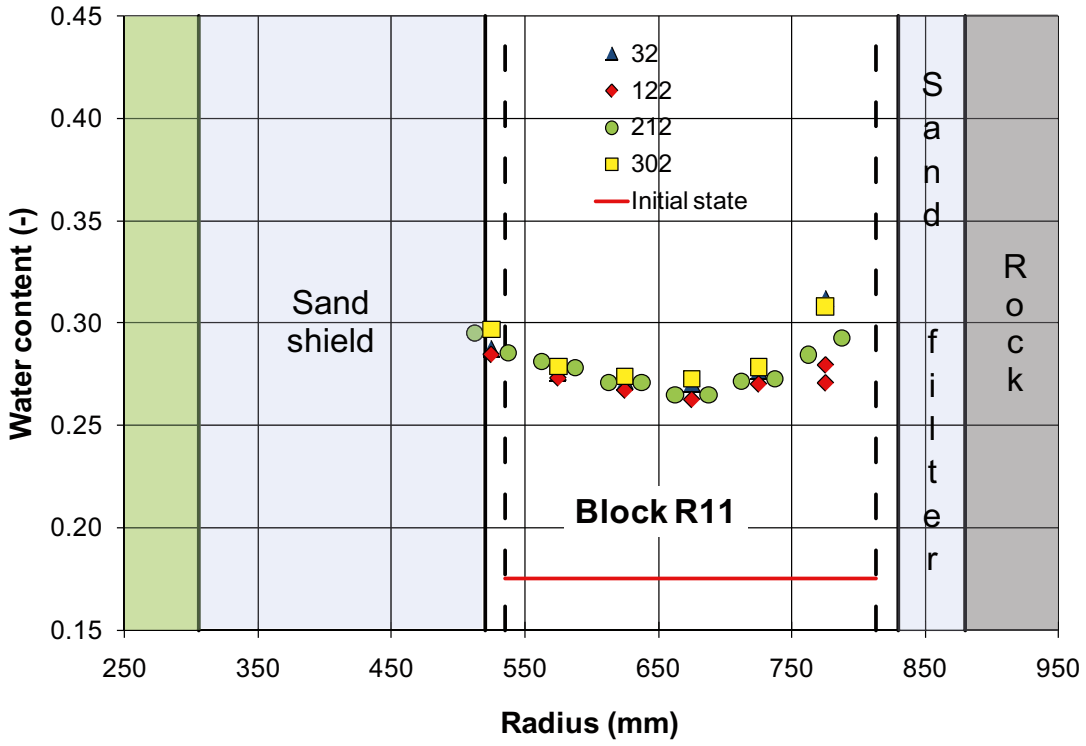

Water content (-)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Sand filter
Rock
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R10
Direction 32 °

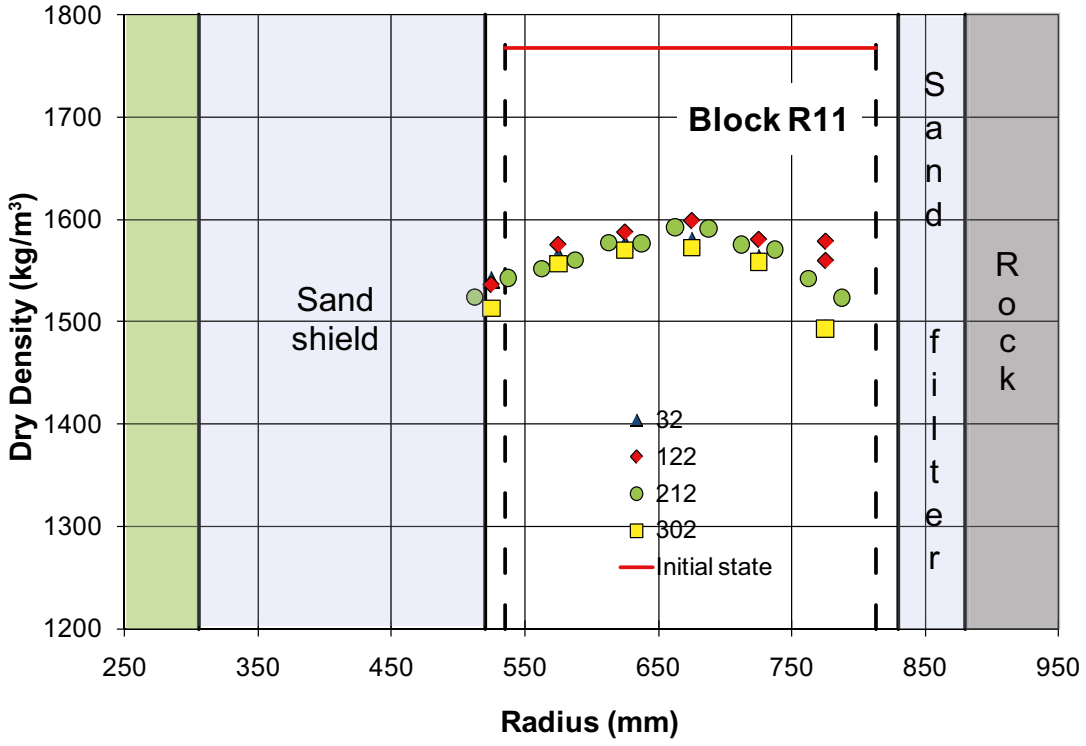

Dry Density (kg/m³)
1800
1700
1600
1500
1400
1300
1200
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Sand filter
Rock
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R10
Direction 32 °

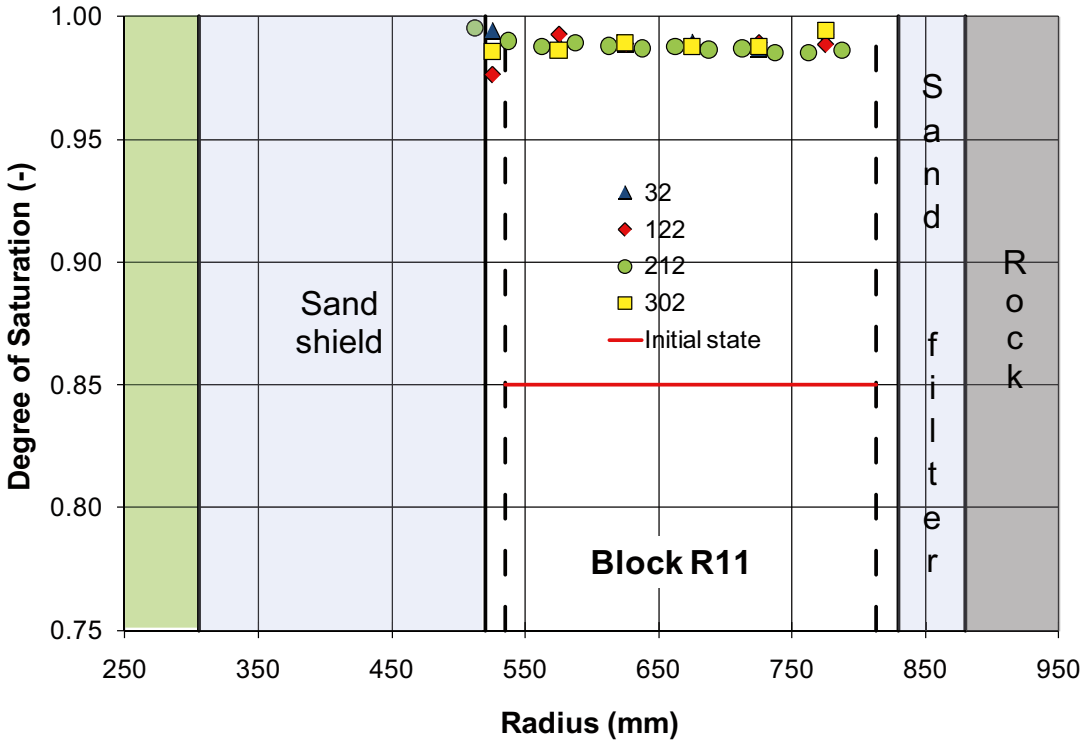

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Sand filter
Rock
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R10
Direction 32 °

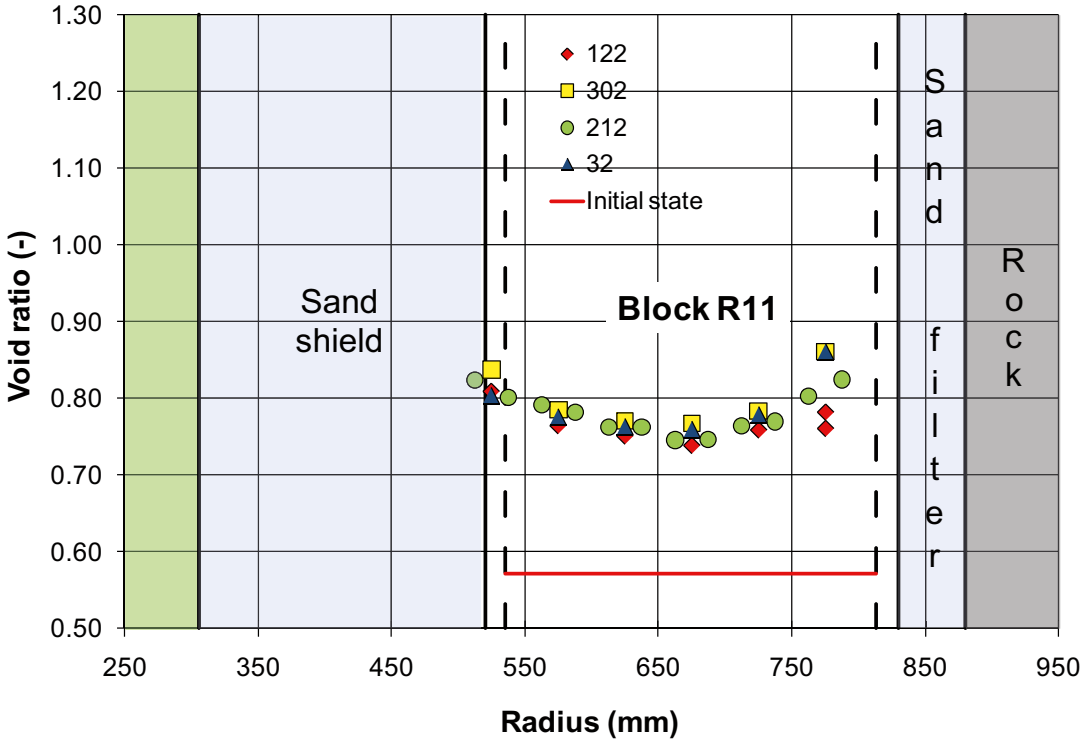

Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Sand filter
Rock
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R10
Direction 32 °

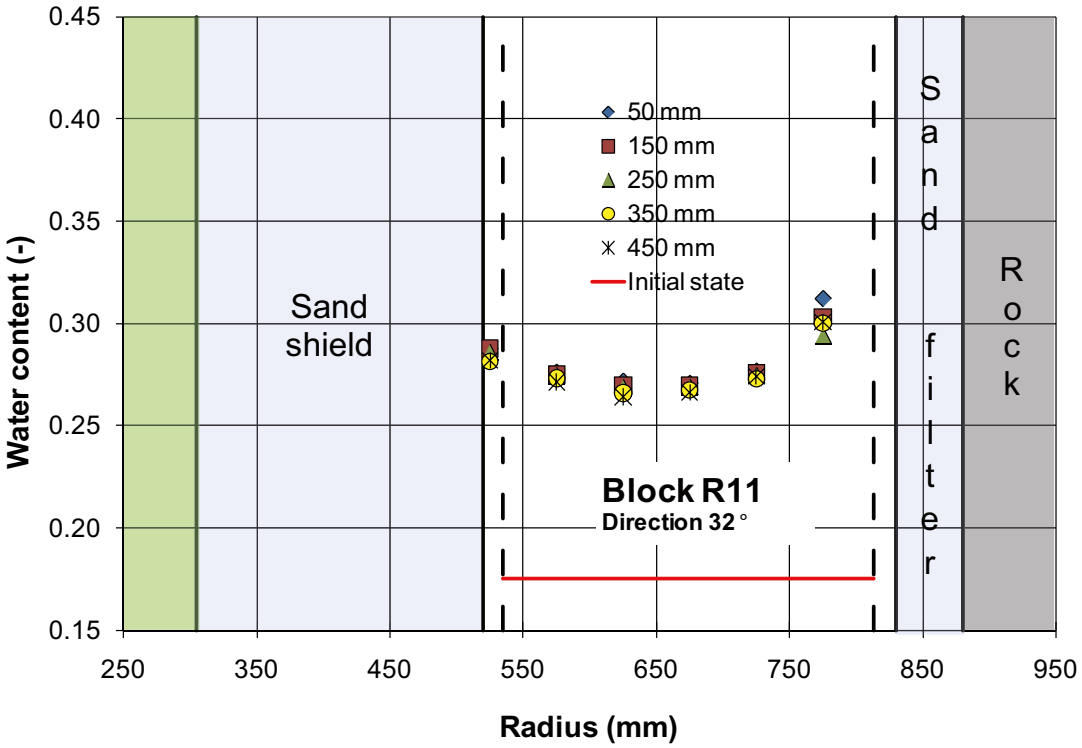
Results from measurements made in block R11

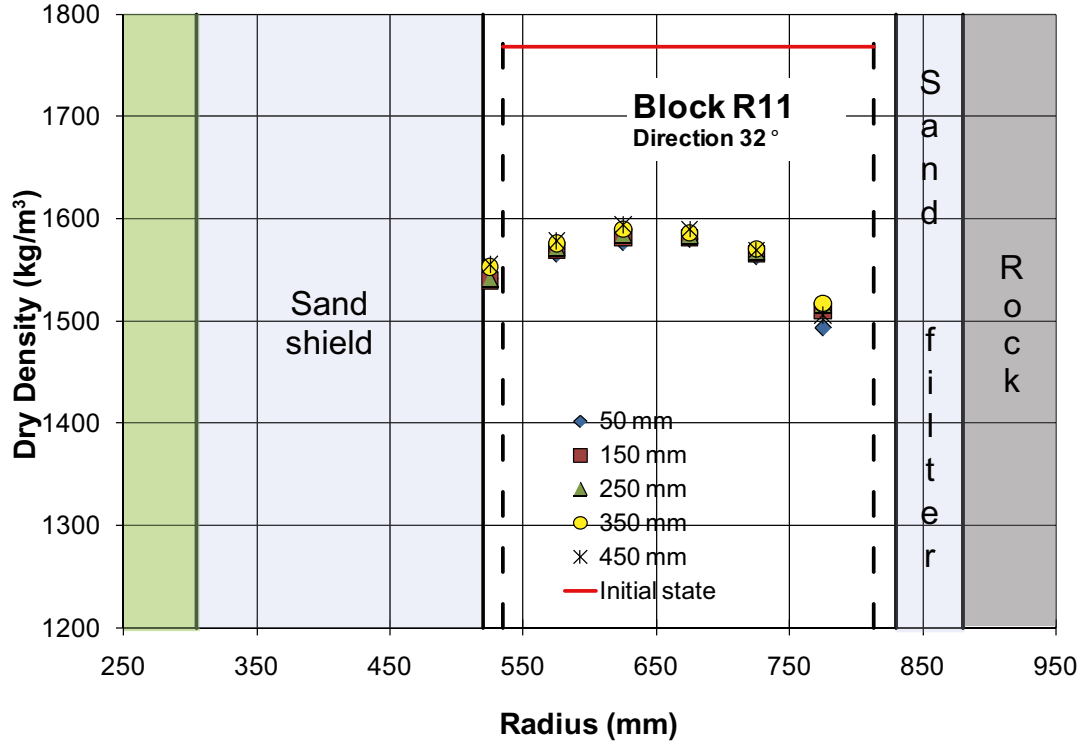


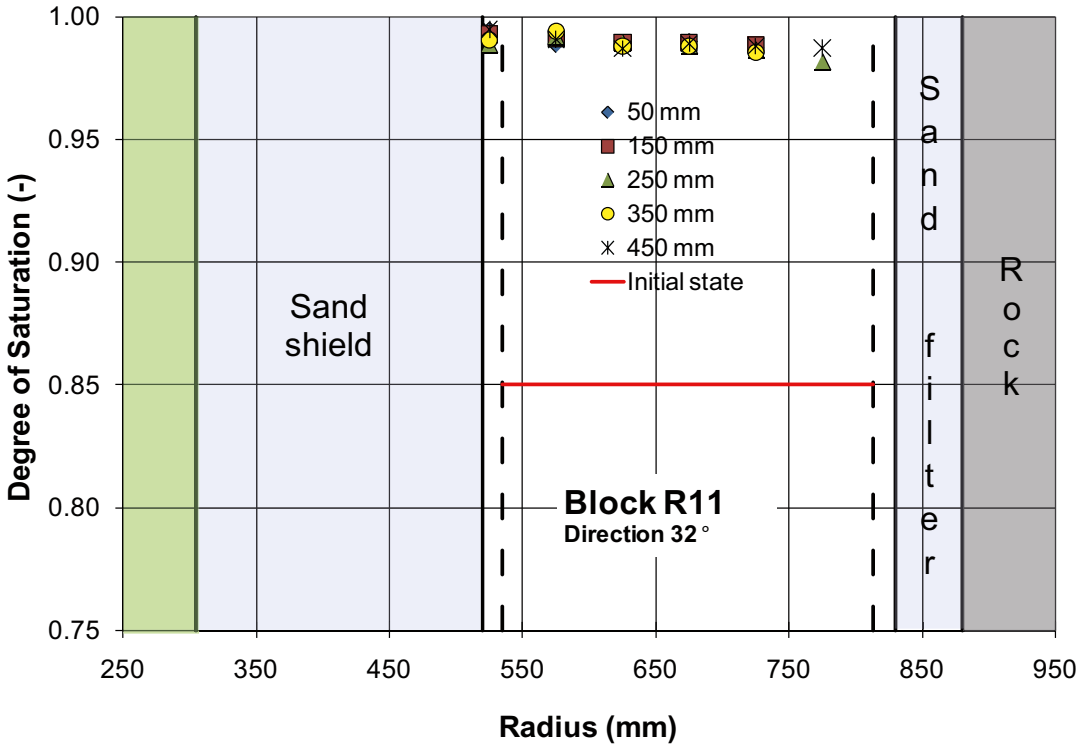


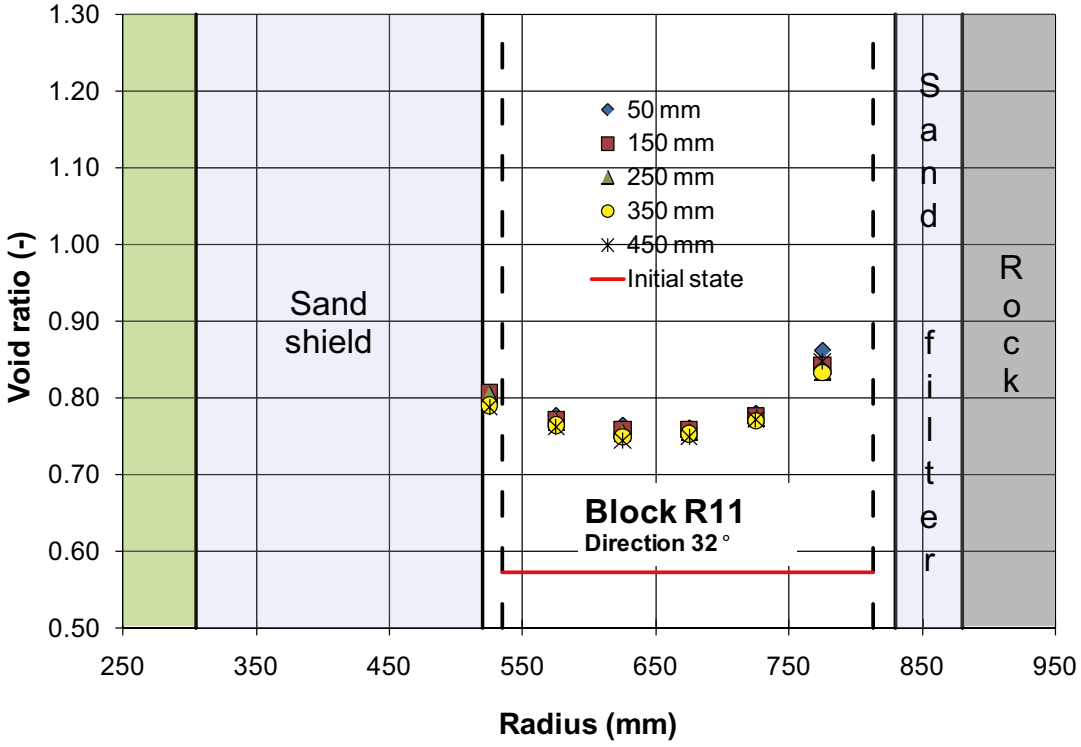

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Block R11
Sand filter
Rock
32
122
212
302
Initial state


Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Block R11
Sand filter
Rock
122
302
212
32
Initial state

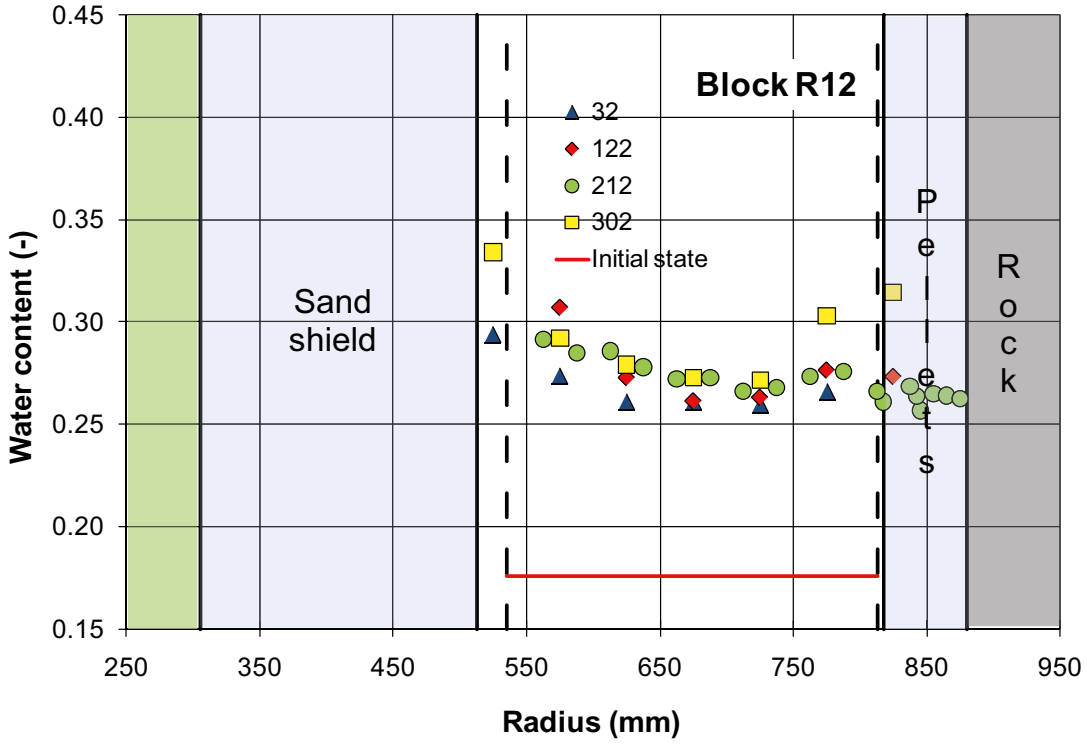

Water content (-)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Sand filter
Rock
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R11
Direction 32°

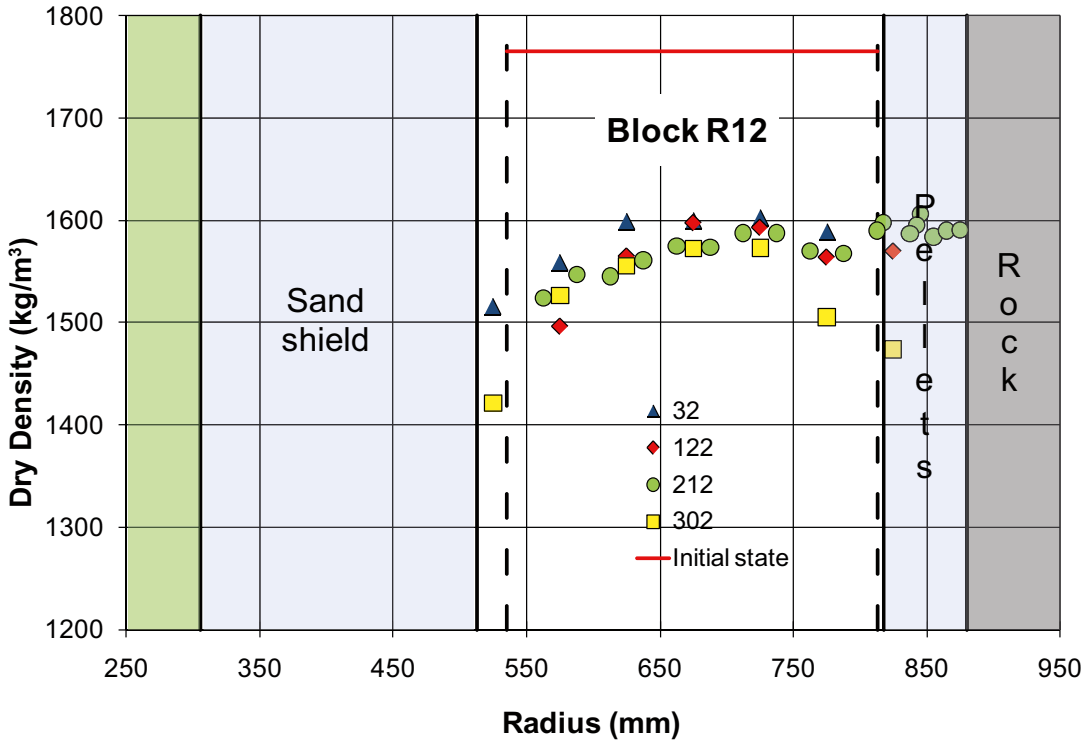

Dry Density (kg/m³)
1800
1700
1600
1500
1400
1300
1200
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Sand filter
Rock
Block R11
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state

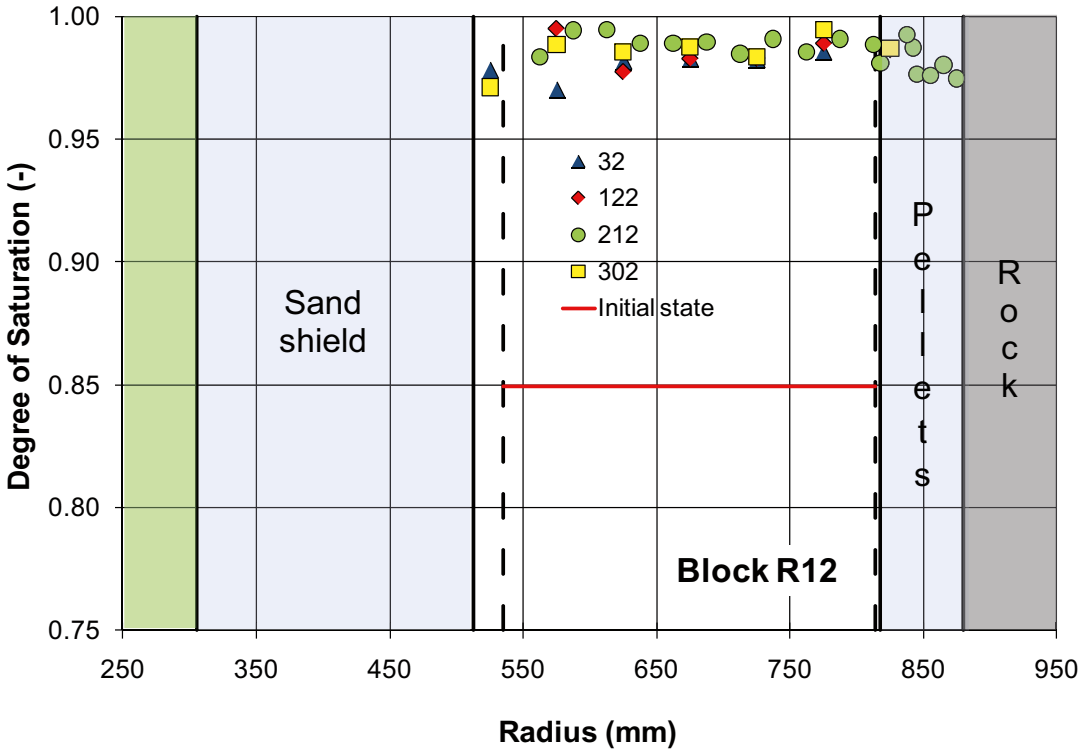

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R11
Direction 32°
Sand filter
Rock

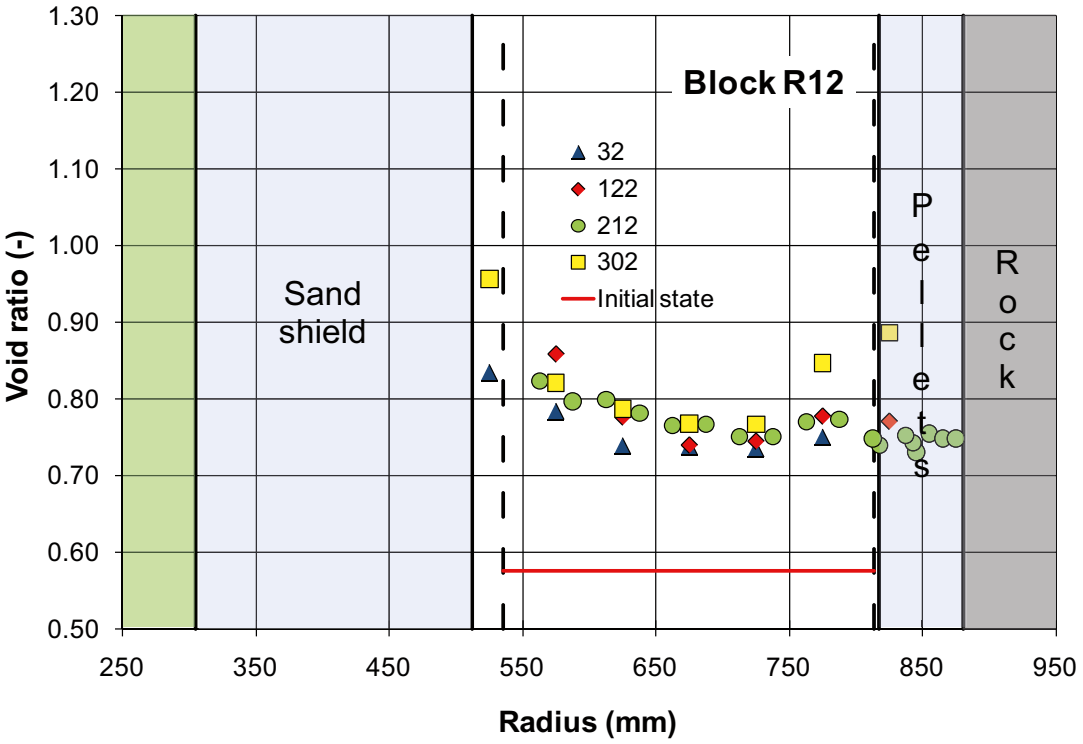

Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R11
Direction 32°
Sand filter
Rock

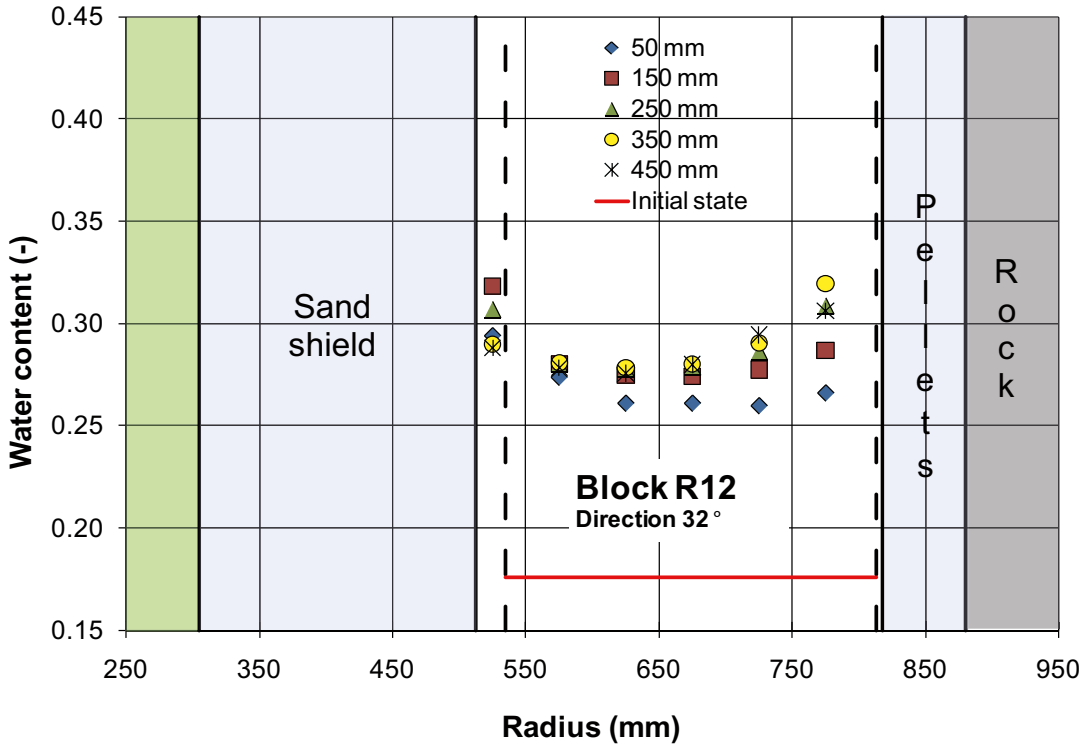
Results from measurements made in block R12

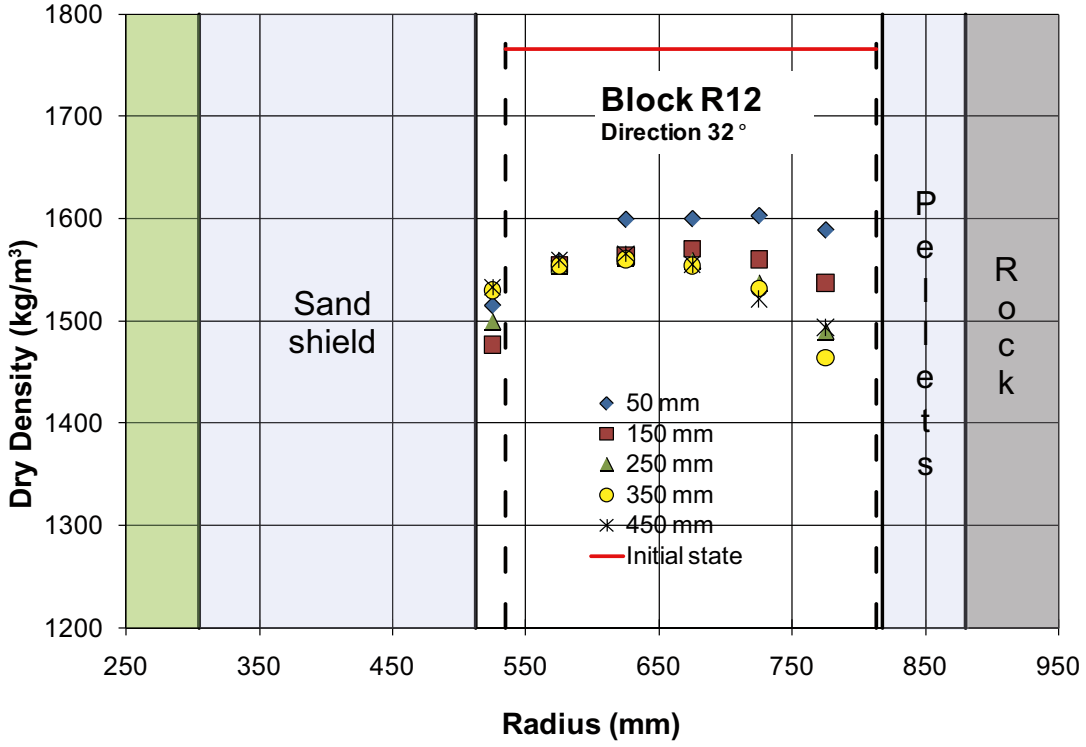


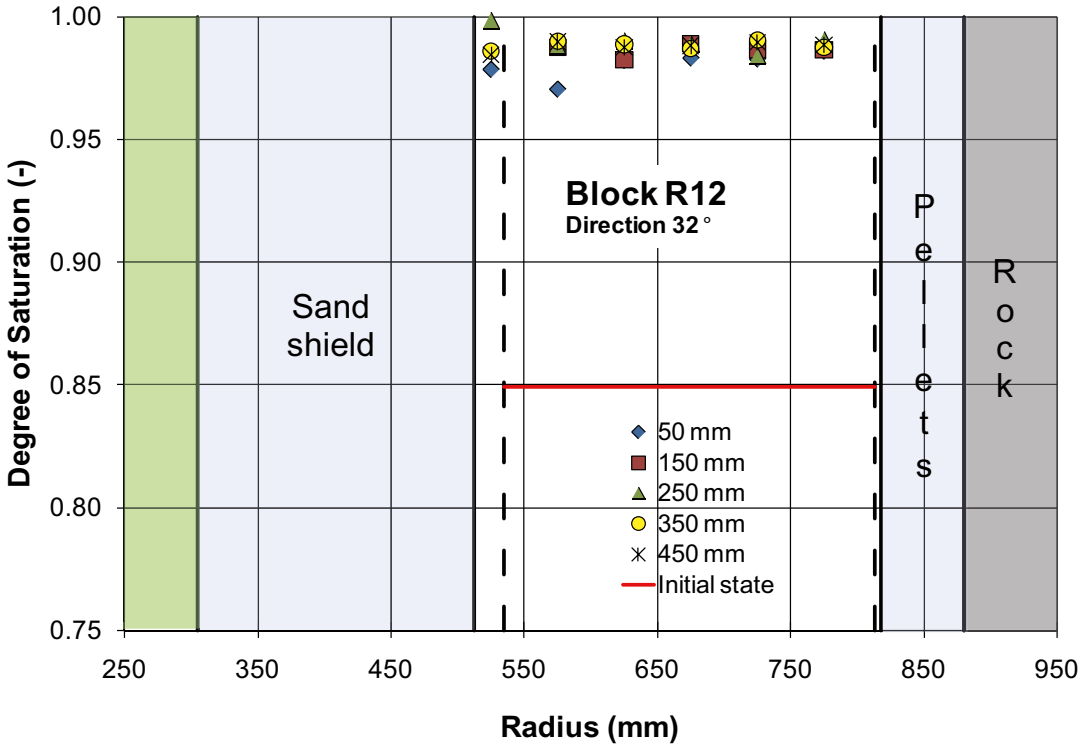


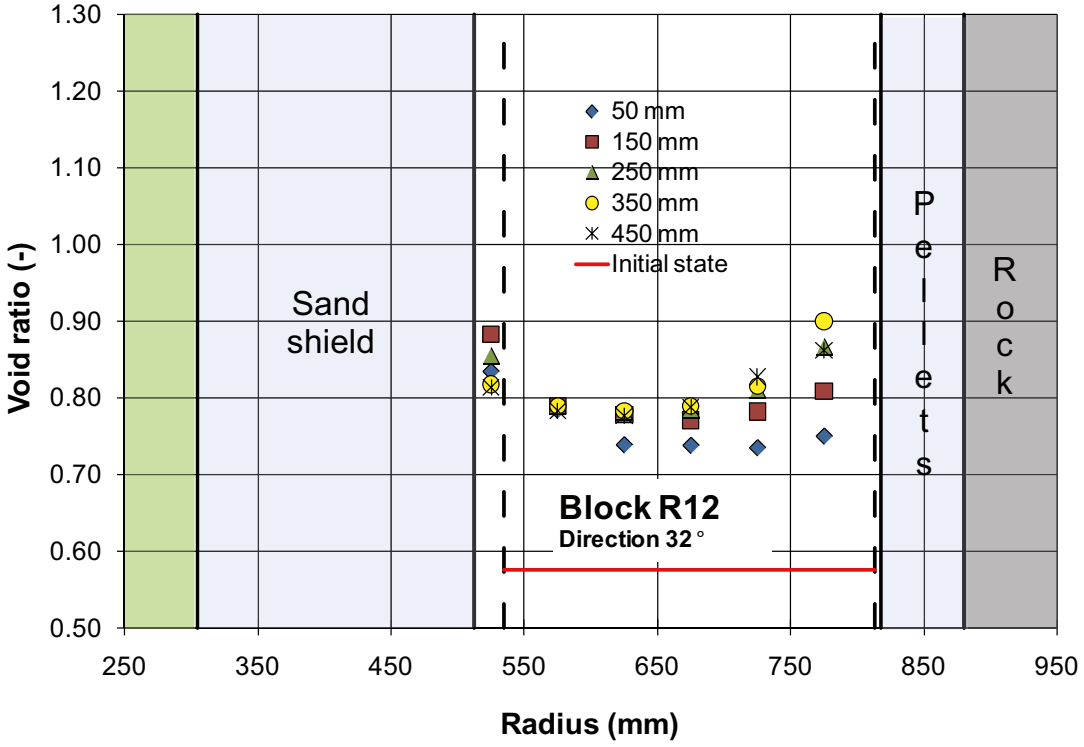

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
32
122
212
302
Initial state
Block R12
Pellets
Rock


Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Block R12
Sand shield
32
122
212
302
Initial state
Pellets
Rock

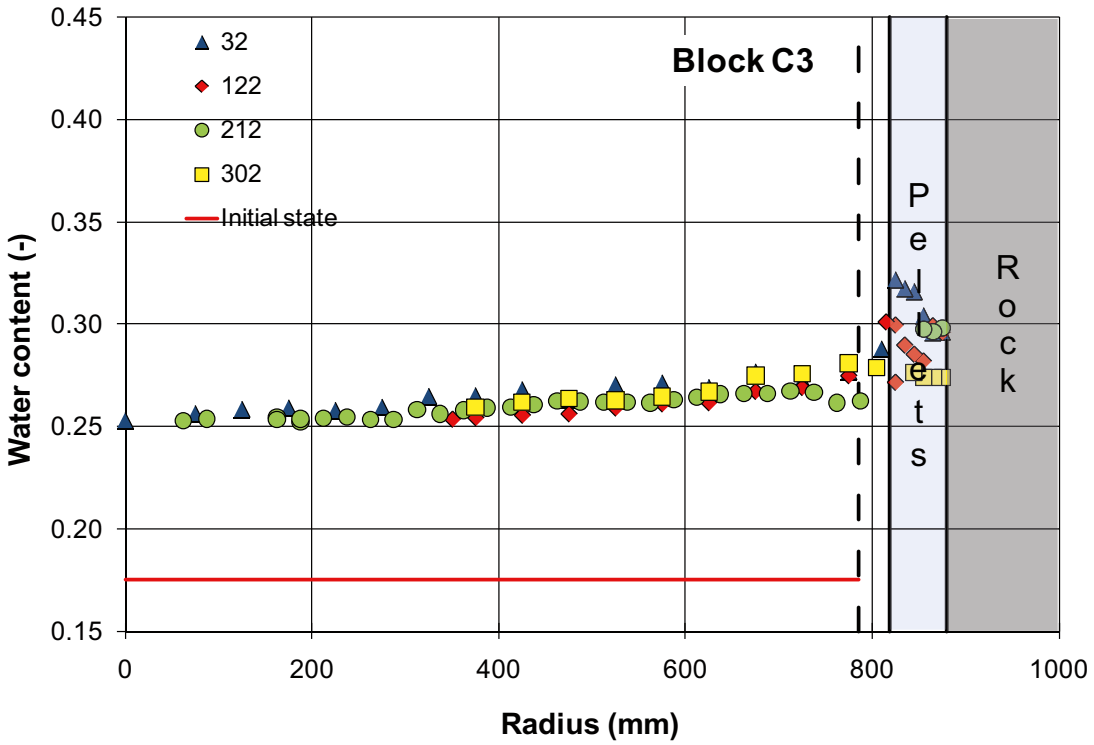

0.45
0.40
0.35
0.30
0.25
0.20
0.15
Water content (-)
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Pellets
Rock
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block R12
Direction 32°

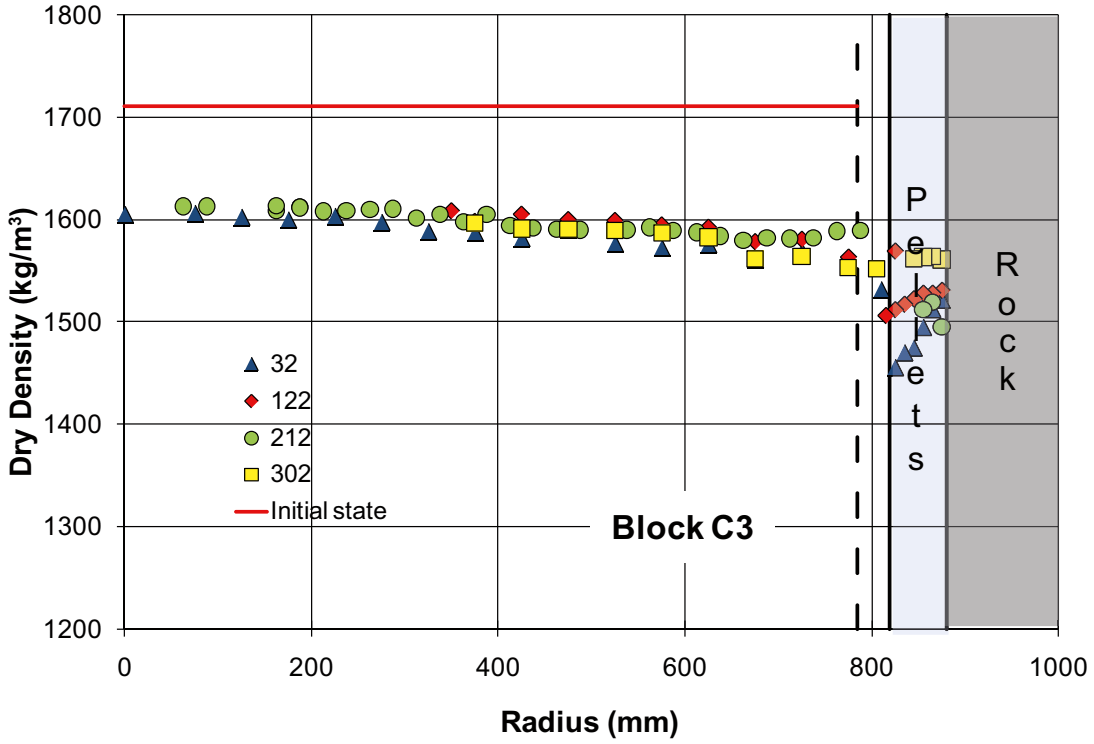

1800
1700
1600
1500
1400
1300
1200
Dry Density (kg/m³)
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Pellets
Rock
Block R12
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state

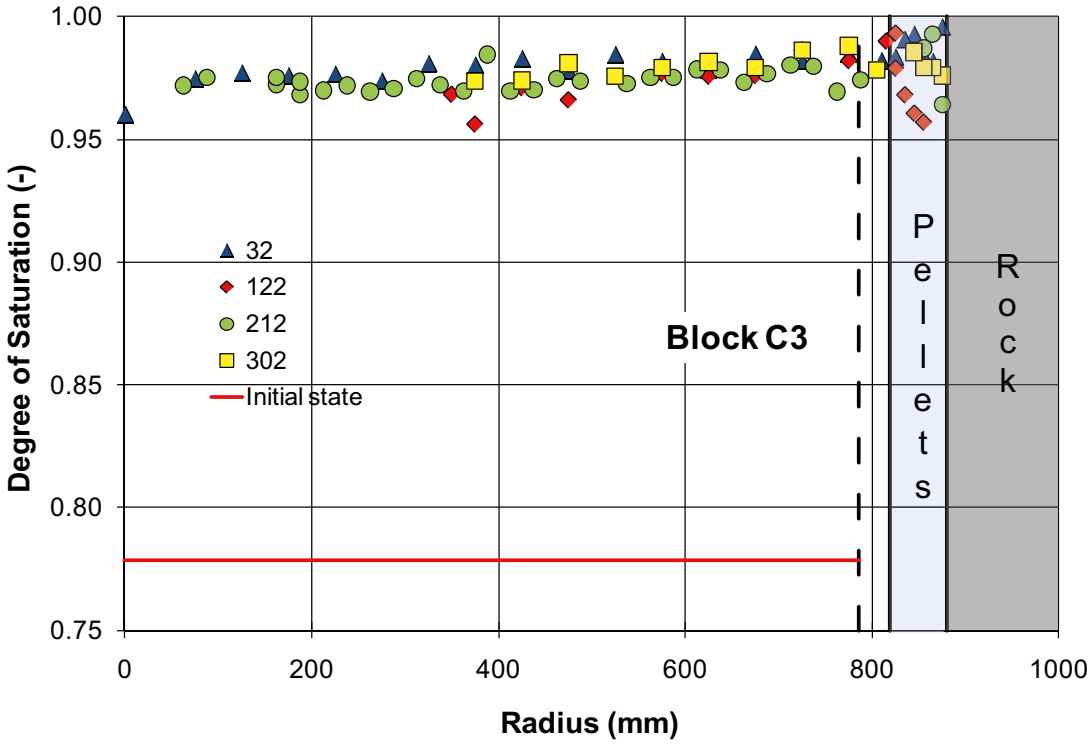

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Block R12
Direction 32°
Pellets
Rock
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state

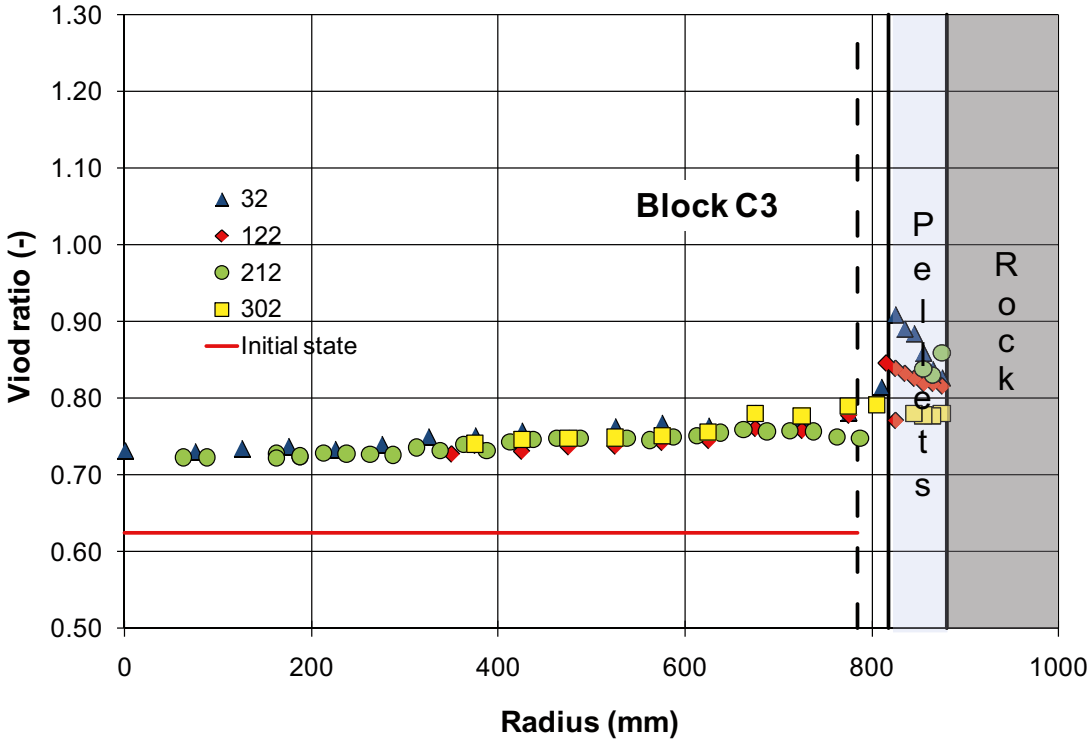

Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
250
350
450
550
650
750
850
950
Radius (mm)
Sand shield
Block R12
Direction 32°
Pellets
Rock
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state

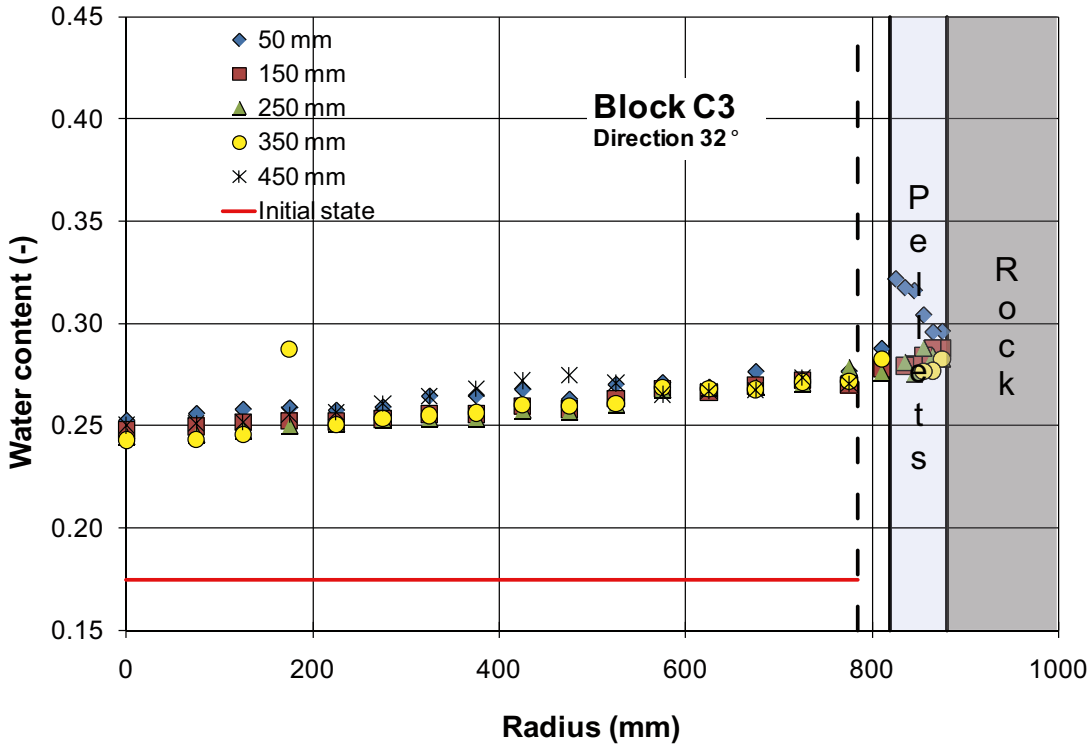
Results from measurements made in block C3

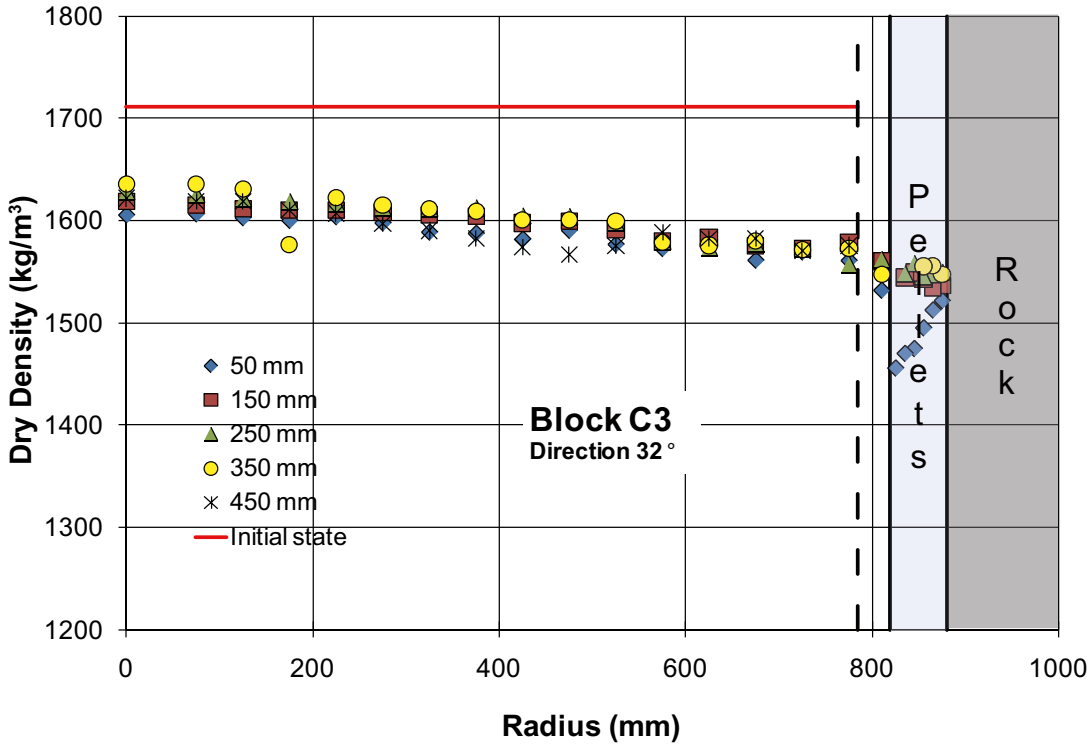


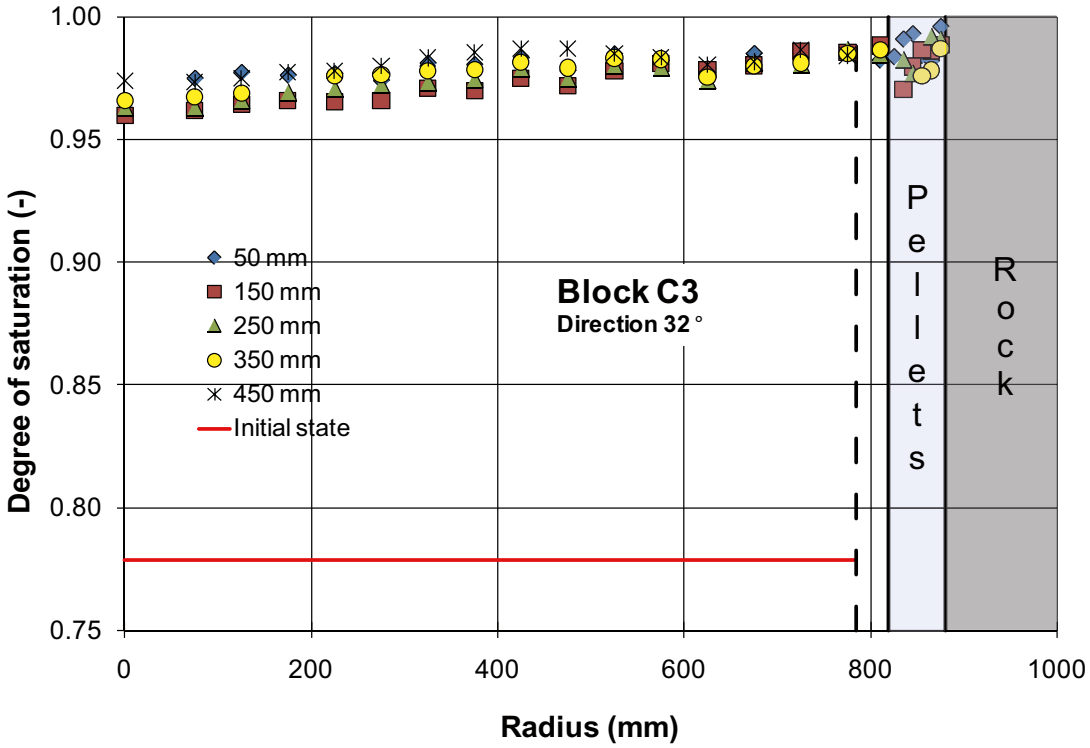


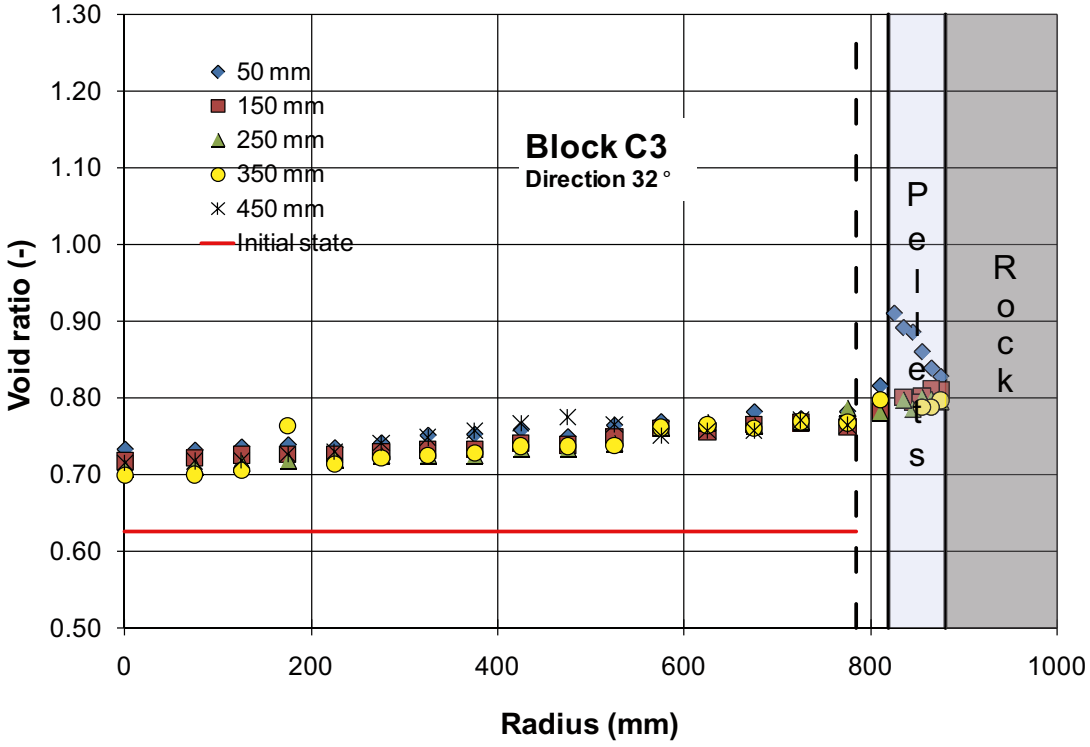

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
0
200
400
600
800
1000
Radius (mm)
32
122
212
302
Initial state
Block C3
Pellets
Rock


Viod ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0
200
400
600
800
1000
Radius (mm)
32
122
212
302
Initial state
Block C3
Pellets
Rock

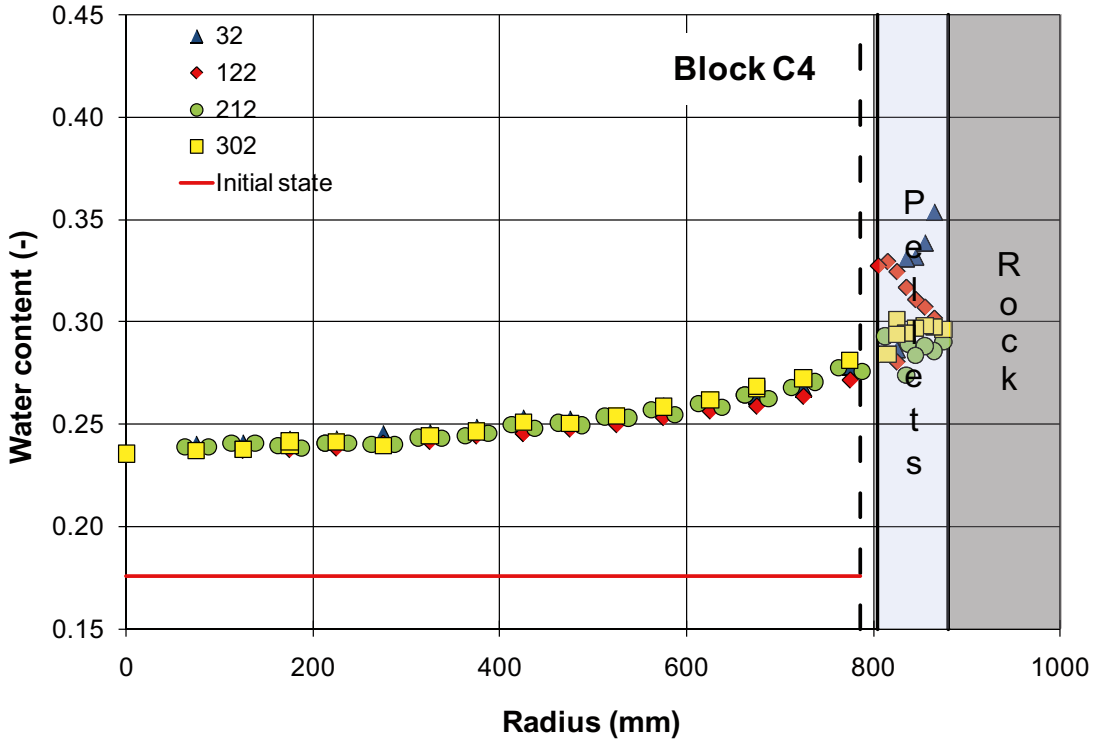

Water content (-)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0
200
400
600
800
1000
Radius (mm)
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block C3
Direction 32 °
Pellets
Rock

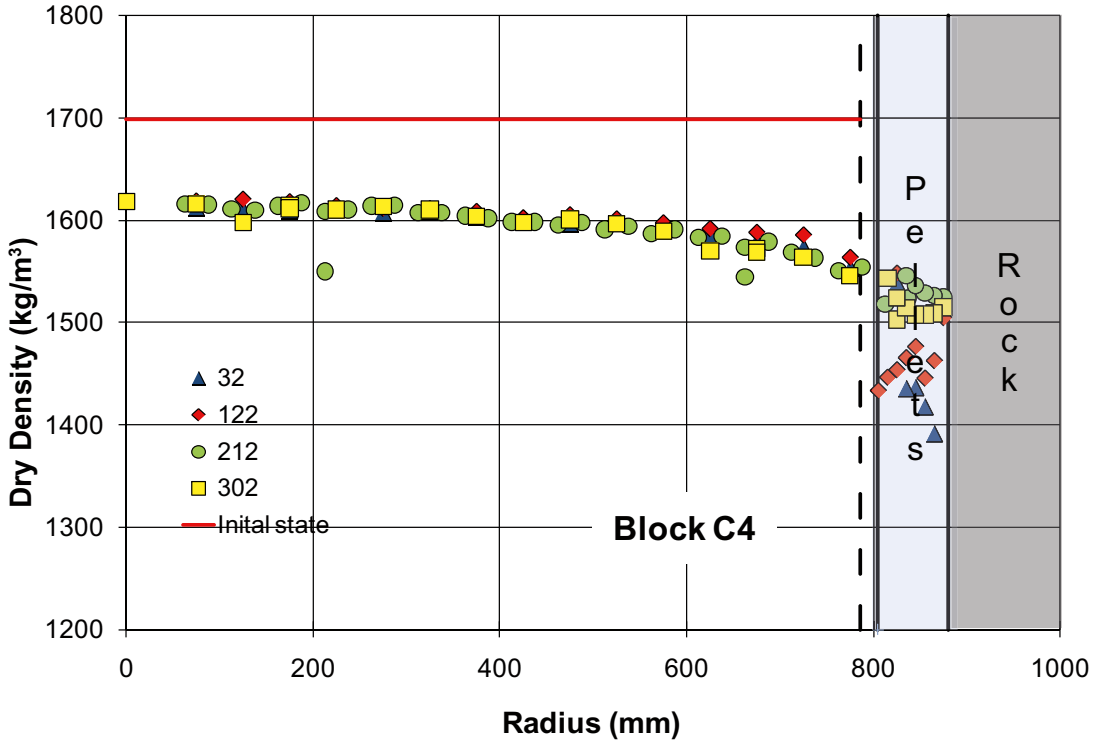

Dry Density (kg/m³)
1800
1700
1600
1500
1400
1300
1200
0
200
400
600
800
1000
Radius (mm)
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block C3
Direction 32 °
Pellets
Rock

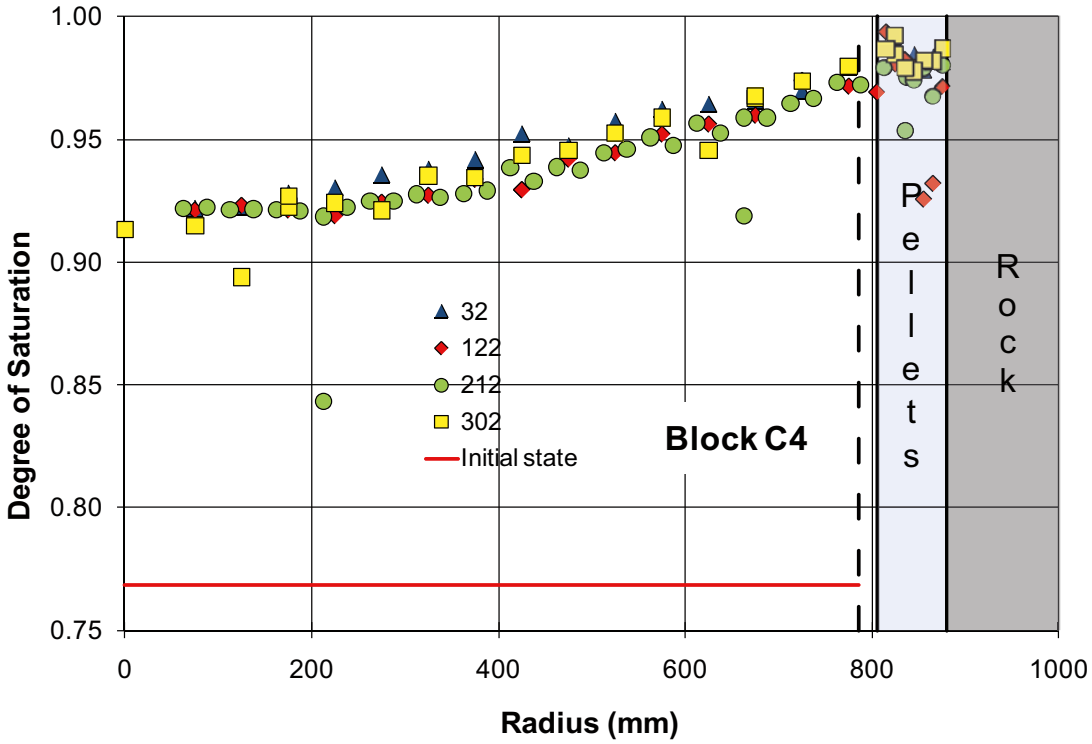

Degree of saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
0
200
400
600
800
1000
Radius (mm)
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block C3
Direction 32 °
Pellets
Rock

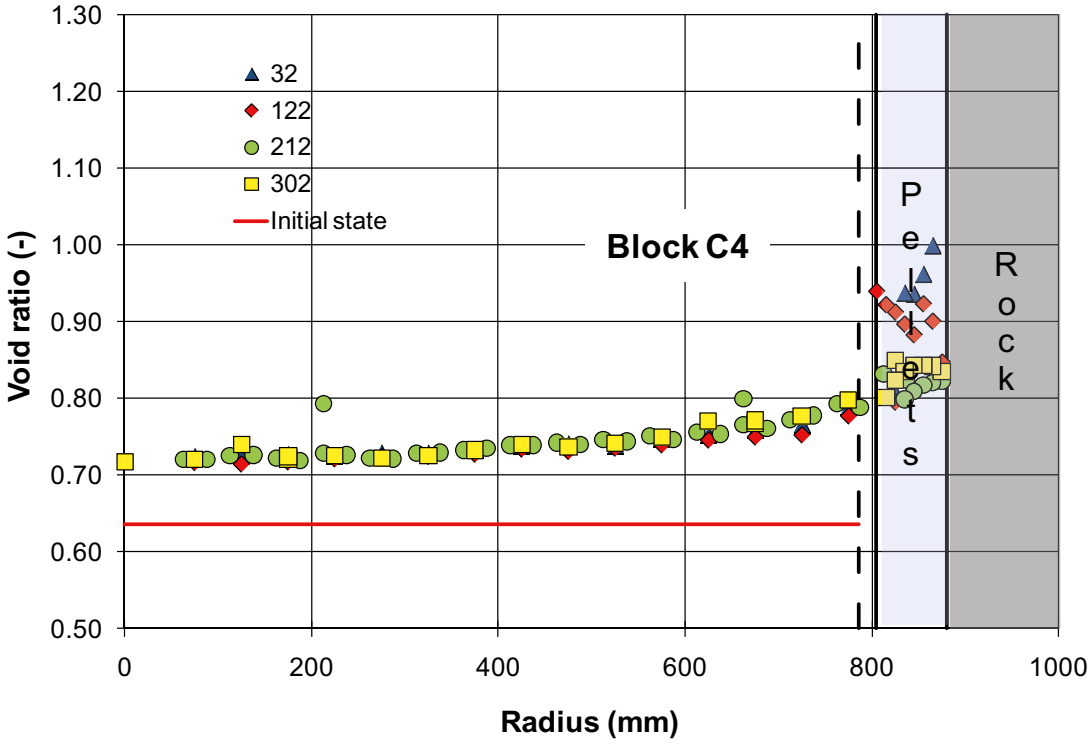

Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0
200
400
600
800
1000
Radius (mm)
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block C3
Direction 32 °
Pellets
Rock

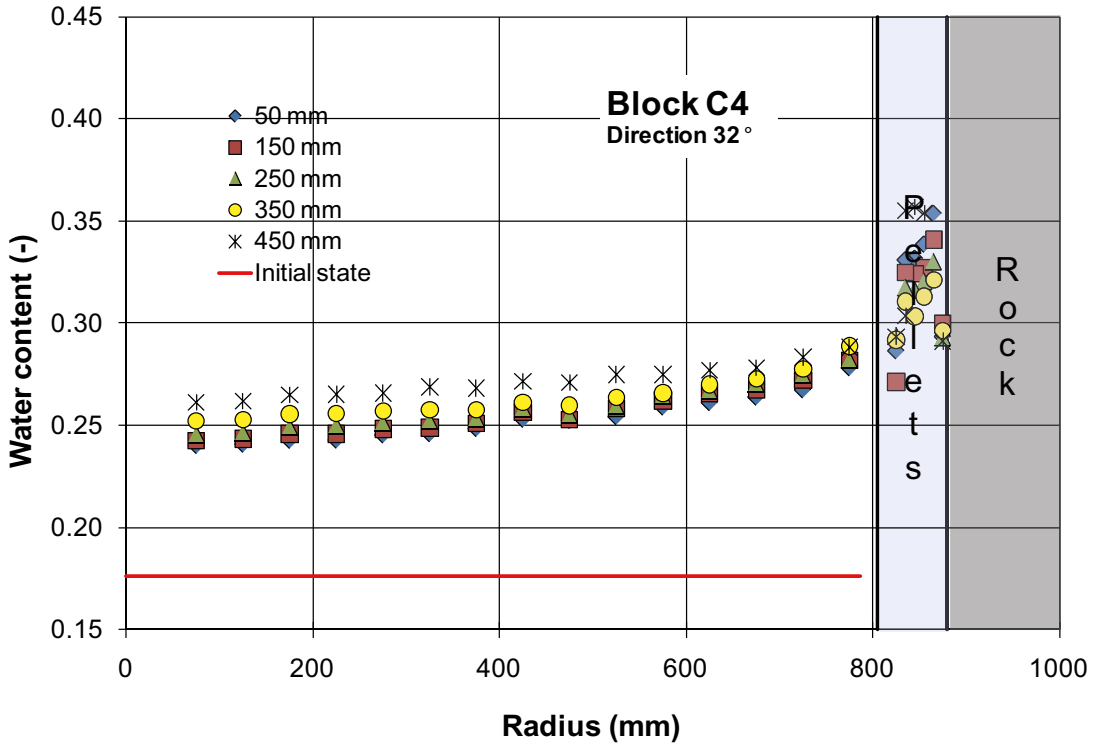
Results from measurements made in block C4

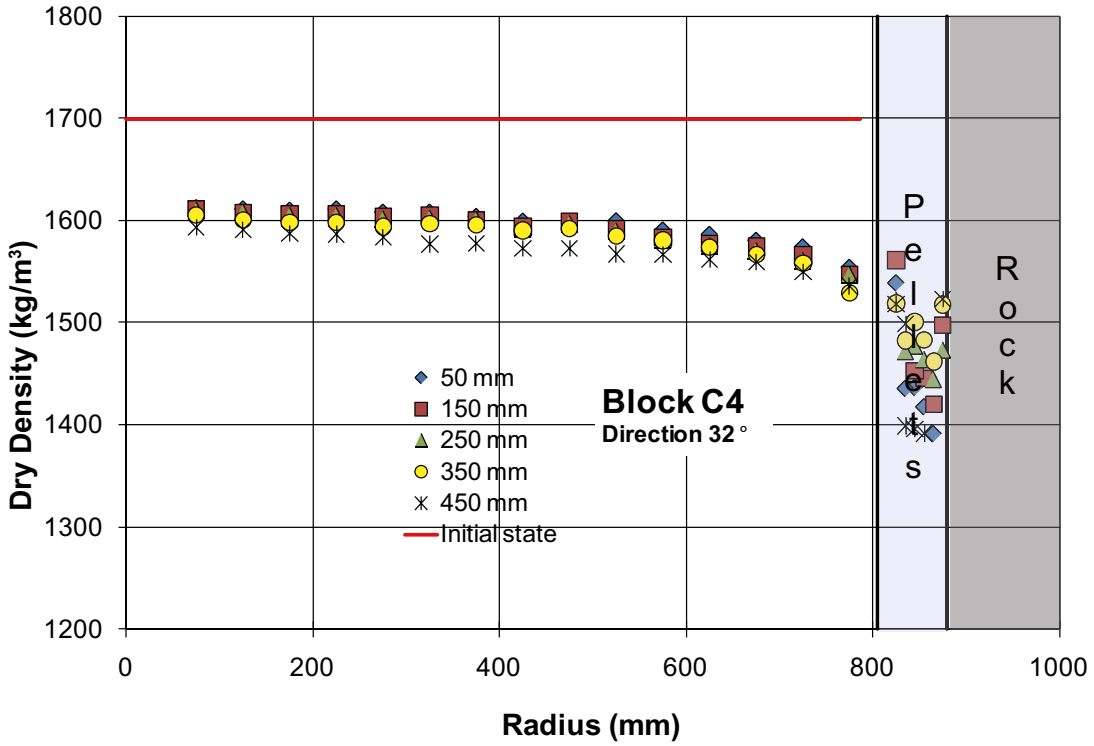


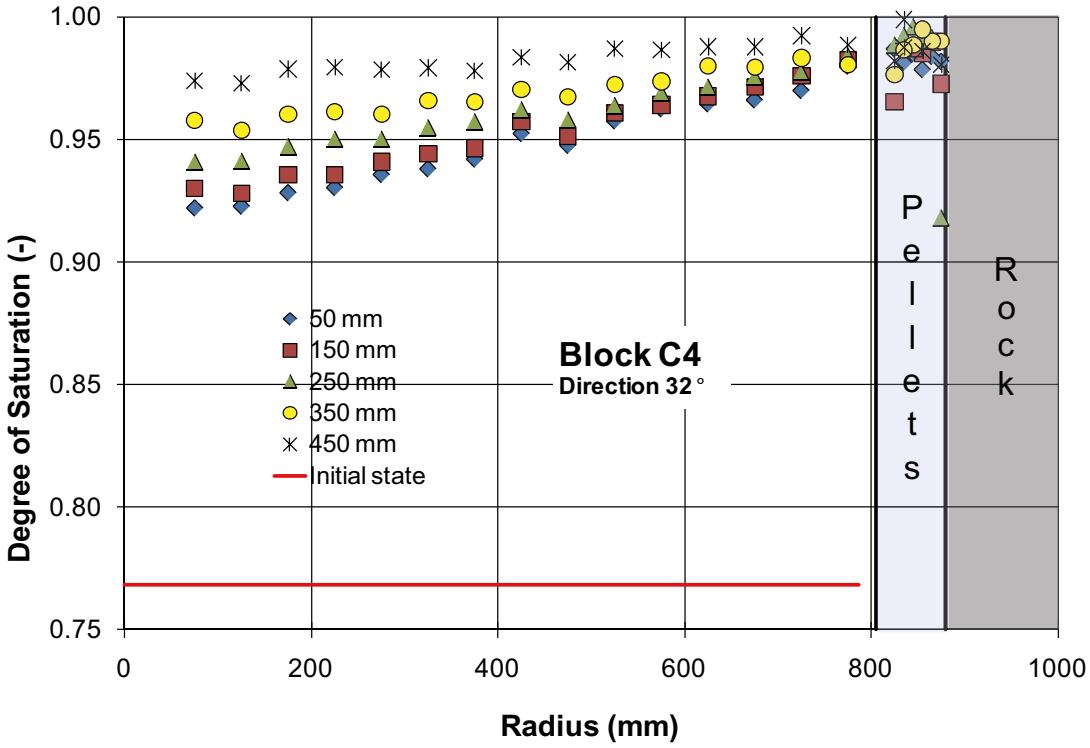


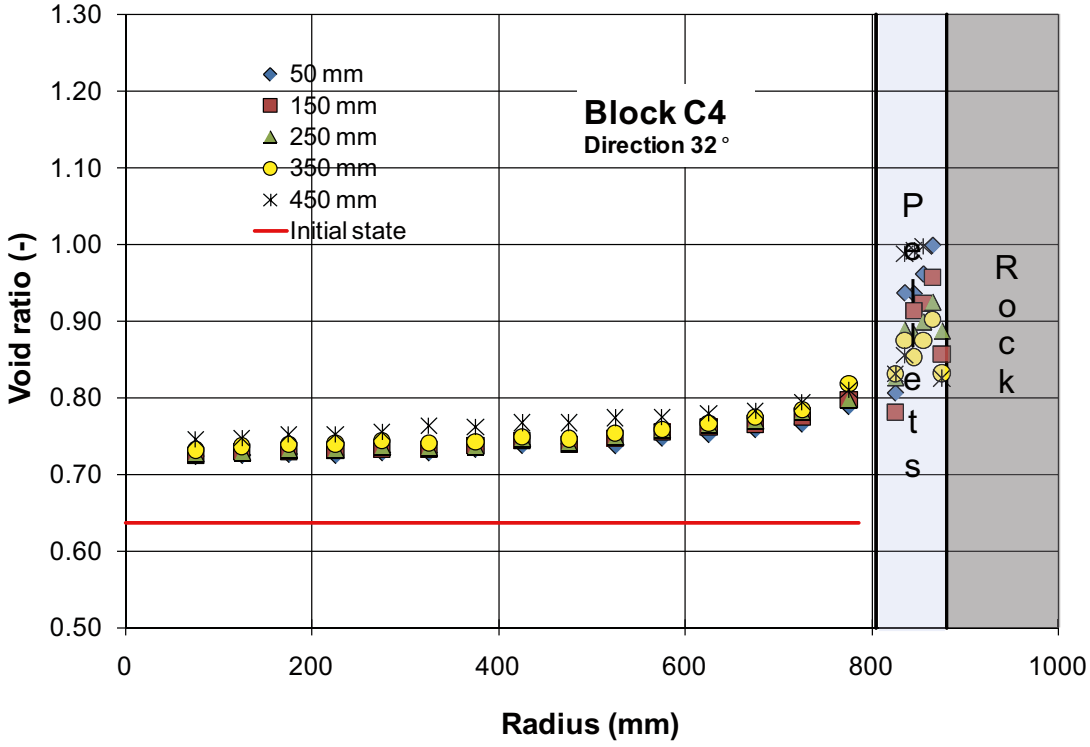

Degree of Saturation
1.00
0.95
0.90
0.85
0.80
0.75
0
200
400
600
800
1000
Radius (mm)
32
122
212
302
Initial state
Block C4
Pellets
Rock


Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0
200
400
600
800
1000
Radius (mm)
32
122
212
302
Initial state
Block C4
Pellets
Rock

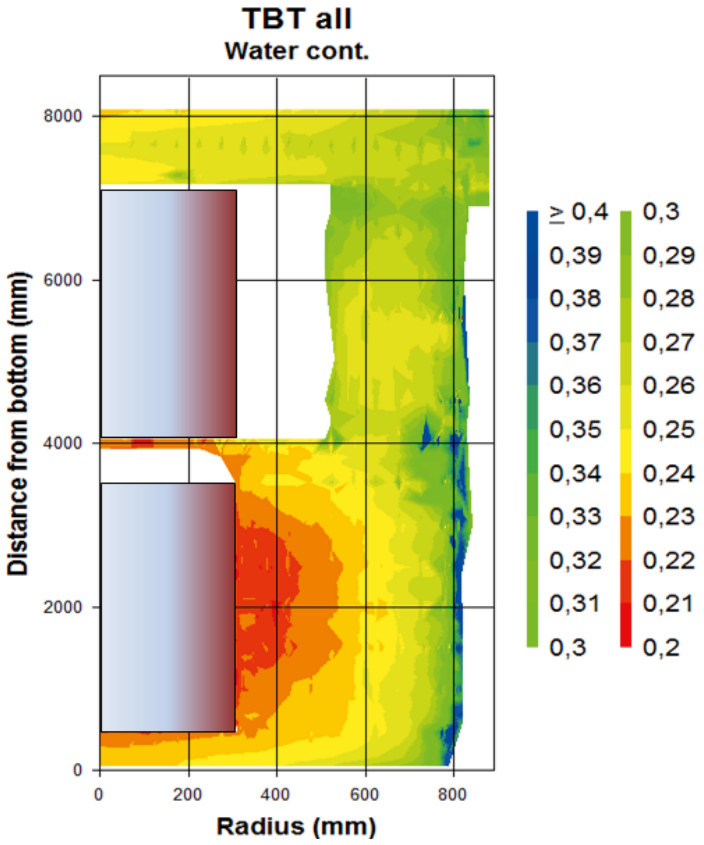

Block C4
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Water content (-)
Radius (mm)
Pellets
Rock

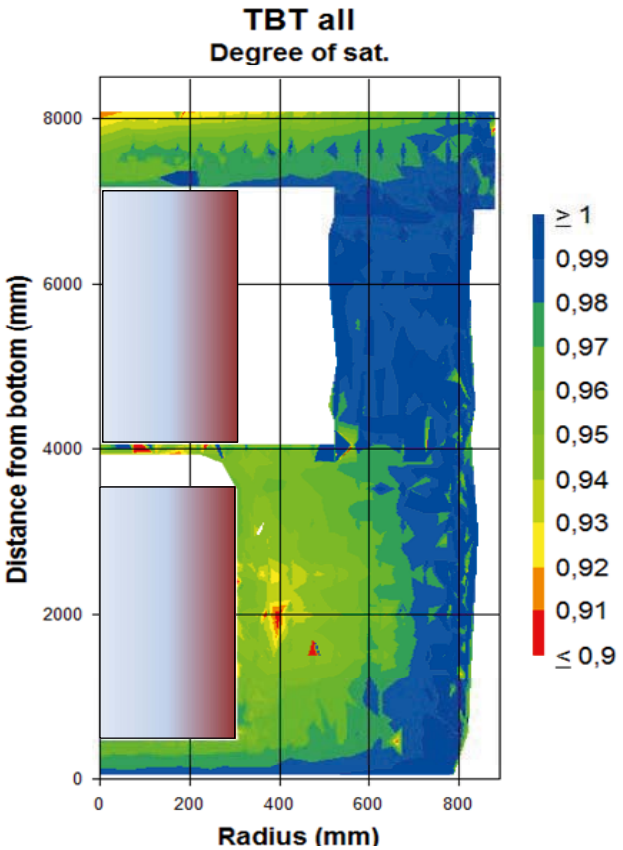

Block C4
Direction 32°
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Dry Density (kg/m³)
Radius (mm)
Pellets
Rock

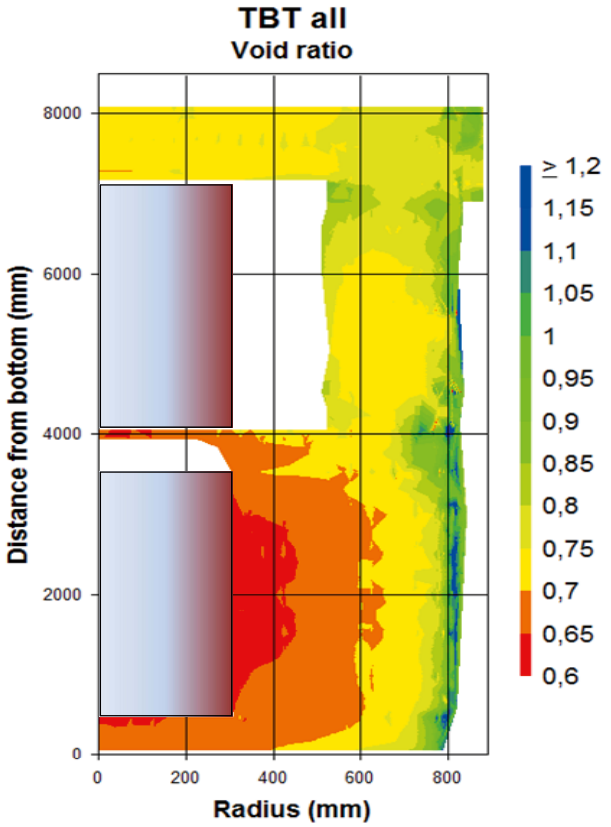

Degree of Saturation (-)
1.00
0.95
0.90
0.85
0.80
0.75
0
200
400
600
800
1000
Radius (mm)
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block C4
Direction 32°
Pellets
Rock

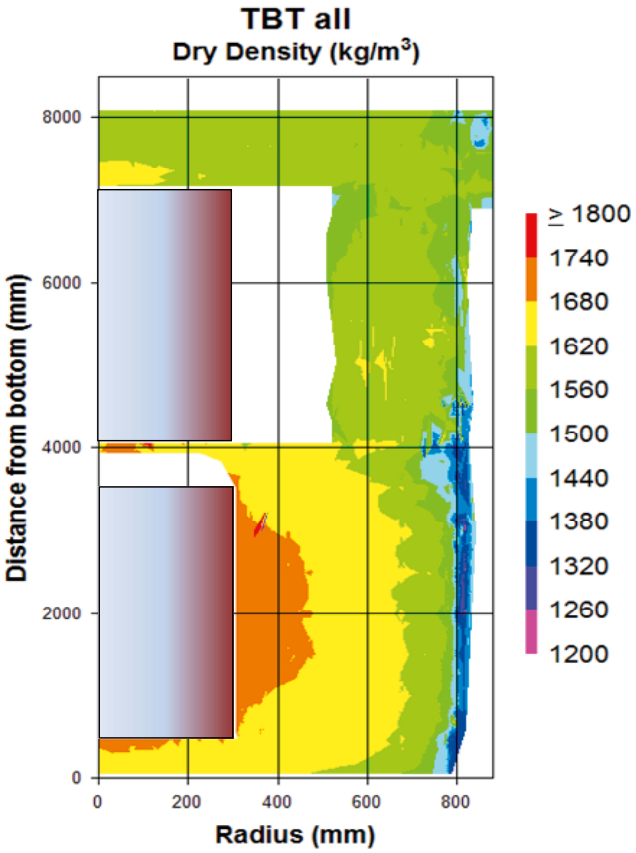

Void ratio (-)
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0
200
400
600
800
1000
Radius (mm)
50 mm
150 mm
250 mm
350 mm
450 mm
Initial state
Block C4
Direction 32°
Pellets
Rock

Contour plots of the measured water content, density and degree of saturation






TBT all
Void ratio
Distance from bottom (mm)
8000
6000
4000
2000
0
0
200
400
600
800
Radius (mm)
≥ 1,2
1,15
1,1
1,05
1
0,95
0,9
0,85
0,8
0,75
0,7
0,65
0,6


TBT all
Dry Density (kg/m3)
Distance from bottom (mm)
8000
6000
4000
2000
0
0
200
400
600
800
Radius (mm)
≥ 1800
1740
1680
1620
1560
1500
1440
1380
1320
1260
1200

Appendix 21

Results from measurements close to installed sensors

Sample No.	Date	Water content	Bulk density (kg/m^3)	Degree of sat.	Void ratio	Dry density (kg/m^3)
C3:WB:231	2009-11-25	0.26	1,980	0.945	0.773	1,568
C3:WB:232	2009-11-25	0.27	1,994	0.973	0.769	1,571
C3:WB:233	2009-11-25	0.27	1,996	0.978	0.771	1,570
C3:WB:234	2009-11-25	0.28	1,986	0.986	0.795	1,549
C3:WB:235	2009-11-25	0.30	1,960	0.991	0.846	1,506
R10:WB 227	2009-12-14	0.29	1,981	0.989	0.806	1,540
R10:WB 229	2009-12-14	0.32	1,928	0.978	0.897	1,465
R10:WB 230	2009-12-14	0.30	1,941	0.967	0.861	1,494
R10:WB 228	2009-12-14	0.28	1,995	0.996	0.785	1,557
R10:WB 226	2009-12-14	0.27	2,006	0.990	0.762	1,578
R10:WB 224	2009-12-14	0.27	2,007	0.985	0.756	1,583
R9:PB206	2009-12-16	0.26	2,023	0.997	0.738	1,599
R9:PB220	2009-12-16	0.23	2,029	0.934	0.686	1,649
R9:PB225	2009-12-16	0.44	2,023	1.252	0.983	1,402
R9:PB219	2009-12-16	0.31	2,043	1.105	0.786	1,557
R9:PB218	2009-12-16	0.26	2,029	0.991	0.723	1,613
R9:PB221	2009-12-16	0.26	2,027	0.993	0.728	1,609
CR9:PB223	2009-12-16	0.27	2,014	0.989	0.747	1,592
R9:PB224	2009-12-16	0.34	1,869	0.952	0.993	1,395
R9:PB222	2009-12-16	0.26	2,032	0.996	0.722	1,614
R9:VB207	2009-12-16	0.26	2,021	0.984	0.733	1,605
R9:VB208	2009-12-16	0.29	1,984	0.991	0.802	1,543
R9:Peekkopp125	2009-12-16	0.33	1,945	1.016	0.898	1,465
C2:PB:215	2010-02-09	0.27	2,006	0.989	0.760	1,579
C2:PB:214	2010-02-09	0.27	2,010	0.983	0.750	1,589
C2:PB:216	2010-02-09	0.25	2,029	0.970	0.709	1,626
R4:WB 213	2010-03-04	0.27	2,013	0.994	0.752	1,587
R4:WB 209	2010-03-04	0.24	2,026	0.946	0.699	1,636
R3:PB 208	2010-03-05	0.23	2,042	0.949	0.675	1,660
R3:PB 204	2010-03-12	0.21	2,034	0.895	0.655	1,680
R3:PB 210	2010-03-12	0.26	2,023	0.985	0.729	1,608
R3:PB 211	2010-03-12	0.25	2,028	0.965	0.707	1,629
R3:PB 207	2010-03-12	0.24	2,032	0.965	0.701	1,634
C1:WB 204	2010-04-27	0.32	1,890	0.951	0.949	1,427
C1:PB 201	2010-04-27	0.25	2,019	0.969	0.725	1,611
C1:PB 202	2010-04-27	0.26	2,026	0.991	0.729	1,608