DRAINAGE DESIGN

FIELD DRAINAGE ASSOCIATION

Waterdrive

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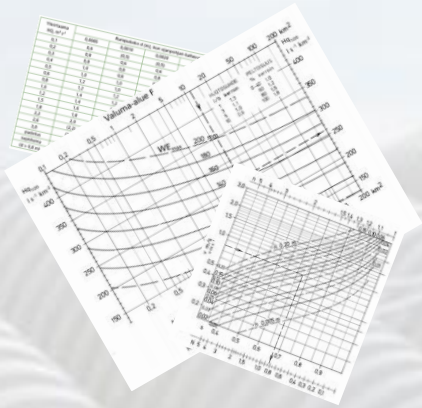
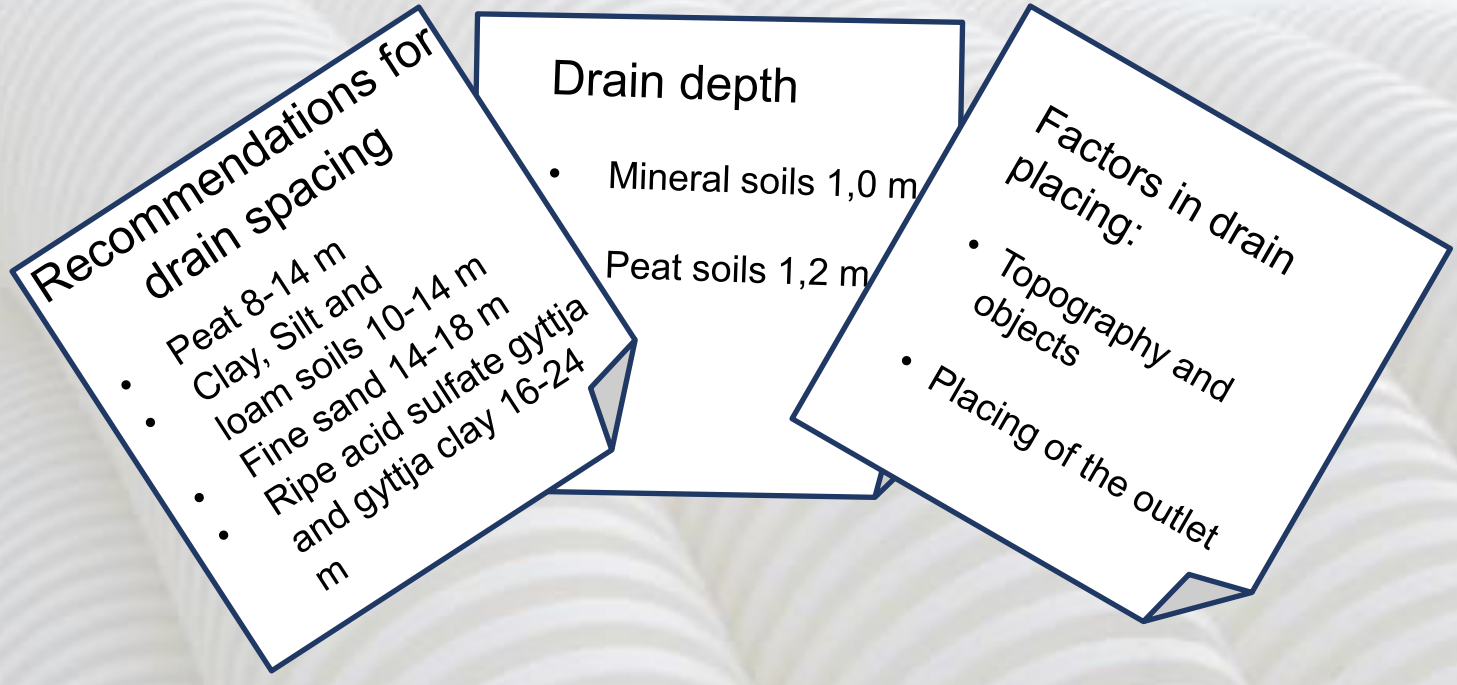
In drainage design, understanding of hydrology, basics of soil water balance, and the technical aspects of drain function are required.



To achieve a functioning drainage system, it should be designed by a professional drainage designer

Contact information of drainage designers and a model contract for a drainage design can be found in the Finnish Field Drainage Association homepage (in Finnish)

The most crucial job of the designer is to establish the optimal drain spacing, drain depth and location



These decisions affect the depth of groundwater after rain and snowmelt.

It is important that the farmers participate in the design process, because they know their fields, and other factors affecting the design

Preliminary assessment 1/3

- Location and information on the field plot
- Mapping of the plot on the national ETRS-TM35FIN –co-ordination system
- Topography of the field in the N2000 –system
- State of arterial drainage and placing of the outlet
- State of local drainage

SEE VIDEO

Preliminary assessment 2/3

- Directing external water away from the plot and confined groundwater
- Environmental issues, such as acid sulphate soils and groundwater areas
- Risk factors to drain function, such as formation of rust deposits

Preliminary assessment 3/3

- Soil information and hydraulic conductivity from surface to drainage depth
- Stones and difficulty in digging
- Other information, such as cables, water pipes and other constructs
- Surrounding landscape, such as shading from a forest
- The crop
- Field traffic and direction of cultivation



Preliminary assessment

Test pit is used to find out the soil profile (soil types, soil permeability, possible compaction, silting up etc)

Preliminary assessment

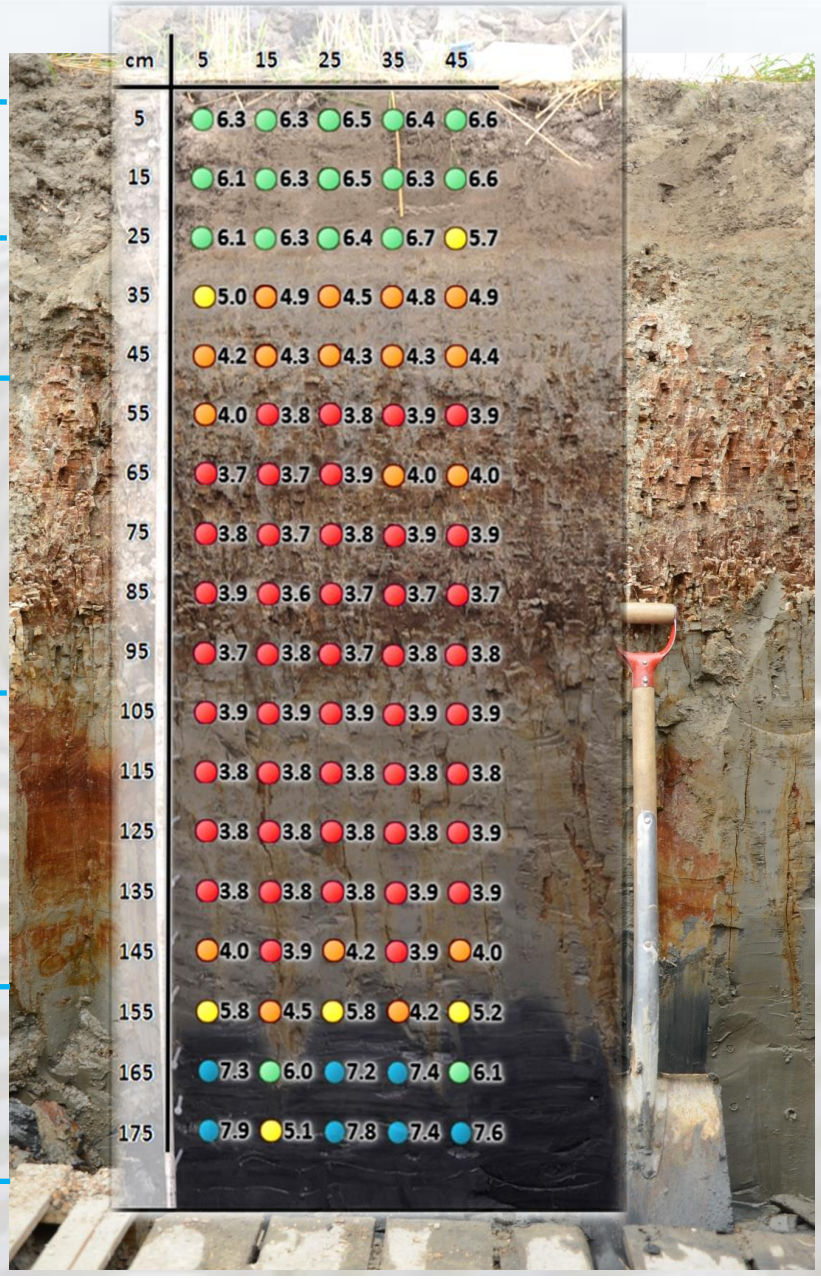
Notes for peatlands

- Type of peat (sphagnum or sedge)
- Level of decomposition
- Subsidence of the soil
- Hydraulic conductivity and water retention of the peat
- Depth of mineral soil

- Open ditches before drainage
- Deeper drainage than normal
- Tighter drain spacing than normal
- Controlled drainage decreases subsidence and greenhouse gas emissions

Preliminary assessment

pH-profile of an acid sulphate soil



Picture: Mattbäck, Dalhem, Åbo Academy

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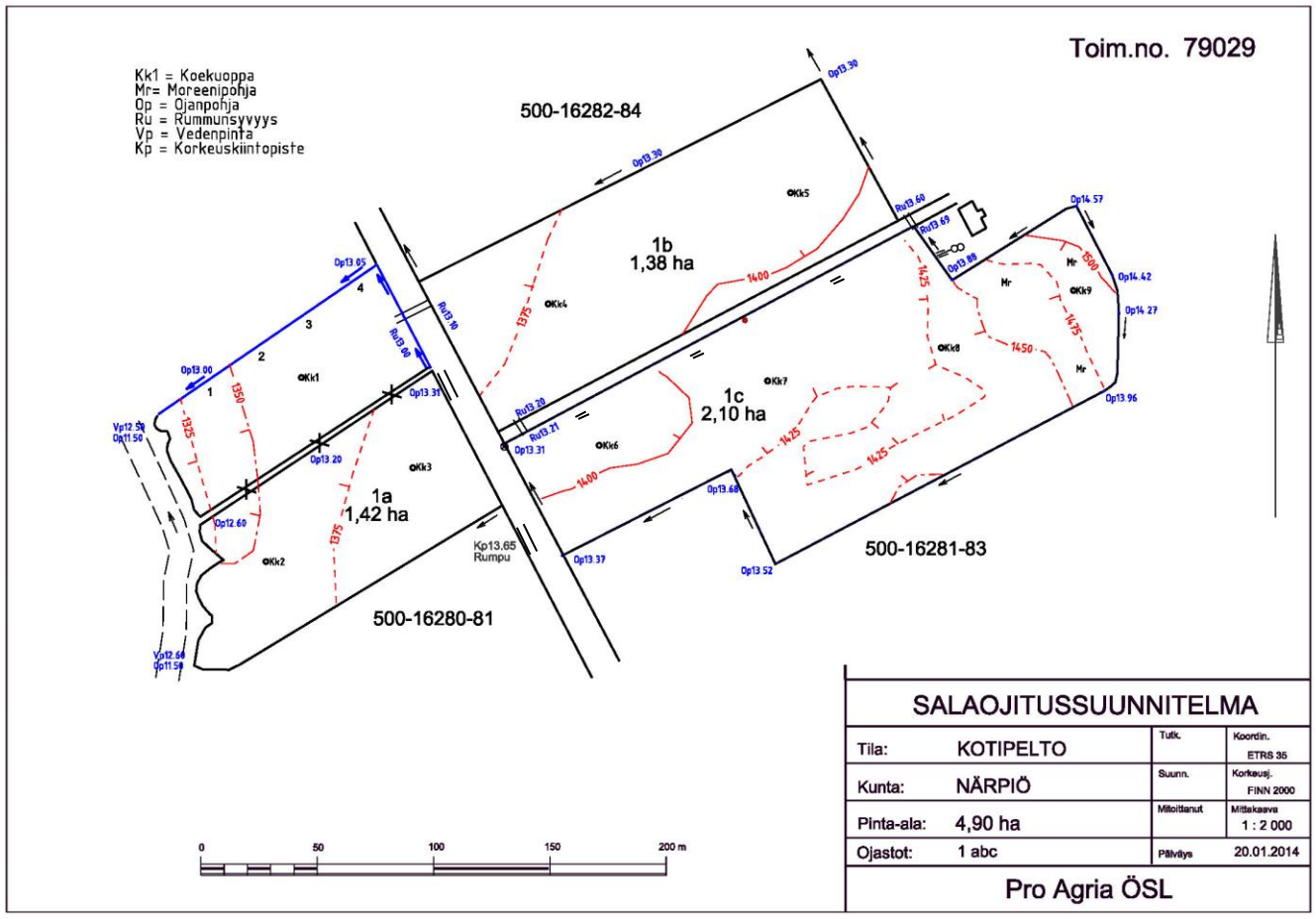
Preliminary assessment

A topographic map is drawn as a base of the drainage design



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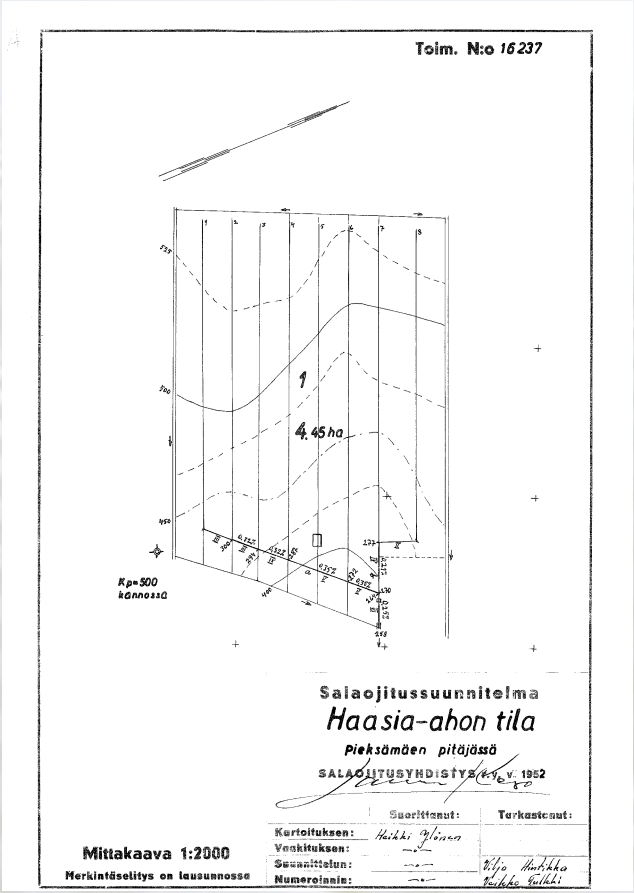
The Finnish Field Drainage Association has archived nearly all drainage maps since 1918.

A map of a drained field can be ordered from the Association

https://www.salaojayhdistys.fi/fi/kartat/



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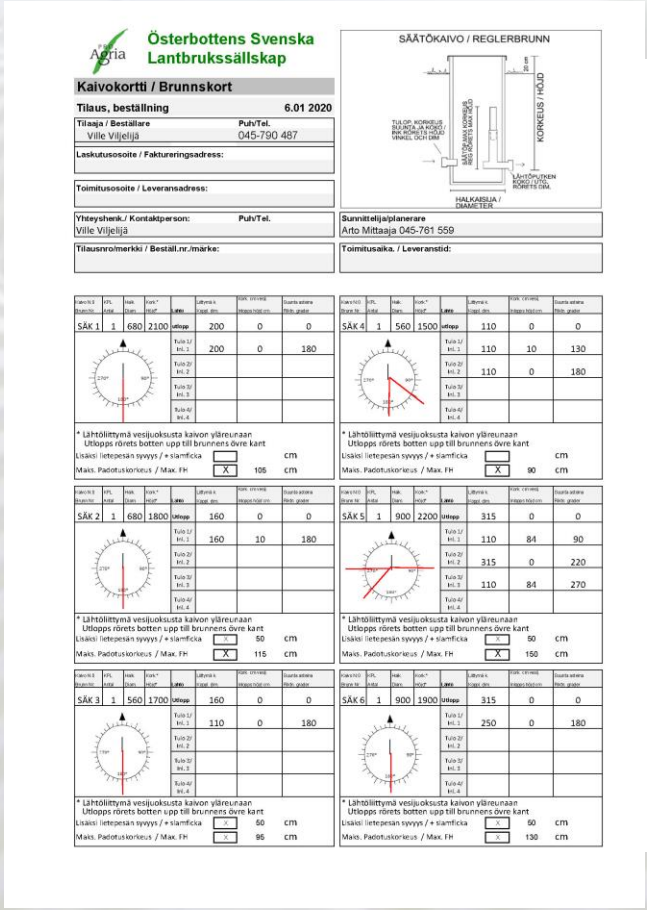
Based on the preliminary assessment, the designer

- Determines drained depth and design discharge
- Determines drain spacing and depth
- Places the drains and well on the map
- Quantifies the drainage pipes
- Makes a cost estimate and a work plan
- Draws a list of accessories and the chamber card
- Draws the drainage map



Österbottens Svenska Lantbrukssällskap

Kaivokortti / Brunnskort

Tilaus, beställning 6.01 2020

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Laskutusosoite / Fakureringsadress:

Toimitusosoite / Leveransadress:

Yhteyshenk./ Kontaktperson: Ville Viljelijä — Puh/Tel.

Suunnittelija/planerare: Arto Mittaaja 045-761 559

Tilausnro/merkki / Beställ.nr./märke:

Toimitusaika. / Leveranstid:

SÄÄTÖKAIVO / REGLERBRUNN

KORKEUS / HÖJD

HALKAISIJA / DIAMETER

SÄK 1	1	680	2100	utlopp	200	0	0
				Tulo 1/ Inl. 1	200	0	180
				Tulo 2/ Inl. 2			
				Tulo 3/ Inl. 3			
				Tulo 4/ Inl. 4			

* Lähtöliittymä vesijuoksusta kaivon yläreunaan / Utlopps rörets botten upp till brunnens övre kant

Lisäisi lietepesän syvyys / + slamficka: cm

Maks. Padotuskorkeus / Max. FH: X 105 cm

SÄK 4	1	560	1500	utlopp	110	0	0
				Tulo 1/ Inl. 1	110	10	130
				Tulo 2/ Inl. 2	110	0	180
				Tulo 3/ Inl. 3			
				Tulo 4/ Inl. 4			

* Lähtöliittymä vesijuoksusta kaivon yläreunaan / Utlopps rörets botten upp till brunnens övre kant

Lisäisi lietepesän syvyys / + slamficka: cm

Maks. Padotuskorkeus / Max. FH: X 90 cm

SÄK 2	1	680	1800	utlopp	160	0	0
				Tulo 1/ Inl. 1	160	10	180
				Tulo 2/ Inl. 2			
				Tulo 3/ Inl. 3			
				Tulo 4/ Inl. 4			

* Lähtöliittymä vesijuoksusta kaivon yläreunaan / Utlopps rörets botten upp till brunnens övre kant

Lisäisi lietepesän syvyys / + slamficka: X 50 cm

Maks. Padotuskorkeus / Max. FH: X 115 cm

SÄK 5	1	900	2200	utlopp	315	0	0
				Tulo 1/ Inl. 1	110	84	90
				Tulo 2/ Inl. 2	315	0	220
				Tulo 3/ Inl. 3	110	84	270
				Tulo 4/ Inl. 4			

* Lähtöliittymä vesijuoksusta kaivon yläreunaan / Utlopps rörets botten upp till brunnens övre kant

Lisäisi lietepesän syvyys / + slamficka: X 50 cm

Maks. Padotuskorkeus / Max. FH: X 150 cm

SÄK 3	1	560	1700	utlopp	160	0	0
				Tulo 1/ Inl. 1	110	0	180
				Tulo 2/ Inl. 2			
				Tulo 3/ Inl. 3			
				Tulo 4/ Inl. 4			

* Lähtöliittymä vesijuoksusta kaivon yläreunaan / Utlopps rörets botten upp till brunnens övre kant

Lisäisi lietepesän syvyys / + slamficka: X 50 cm

Maks. Padotuskorkeus / Max. FH: X 95 cm

SÄK 6	1	900	1900	utlopp	315	0	0
				Tulo 1/ Inl. 1	250	0	180
				Tulo 2/ Inl. 2			
				Tulo 3/ Inl. 3			
				Tulo 4/ Inl. 4			

* Lähtöliittymä vesijuoksusta kaivon yläreunaan / Utlopps rörets botten upp till brunnens övre kant

Lisäisi lietepesän syvyys / + slamficka: X 50 cm

Maks. Padotuskorkeus / Max. FH: X 130 cm

Design discharge

- Design discharge is usually 1 l/s/ha = 8,6 mm / day
- A smaller or larger design discharge can be used, depending on soil type, slope, and other conditions

Drained depth

- Distance between soil surface and groundwater level between the drains (at least 0,6 m)
- The necessary drained depth is determined by the crop and the load bearing requirements, defined by the field machinery

Hydraulic conductivity of the soil

- Both the particle size and the crumb structure of the soil affect hydraulic conductivity.

Drain spacing is affected by

- Design discharge
- Drained depth
- Hydraulic conductivity
- slope

Recommendation for drain spacing

- Peat soils: 8 – 14 m
- clay-, silt- and loam soils: 10 – 14 m
- Fine sand soils: 14 – 18 m
- ripe acid sulfate gyttja and gyttja clays: 16 – 24 m

Recommendation for drain depth

- Mineral soils: 1,0 m
- Peat soils: 1,2 m

If the soil is prone to alluviation, or it has signs of rust or confined groundwater, the drainage system should be planned flushable

Envelope material and backfill of the drain excavation

Ensuring the permeability of the drain excavation is especially important if the soil is poorly permeable

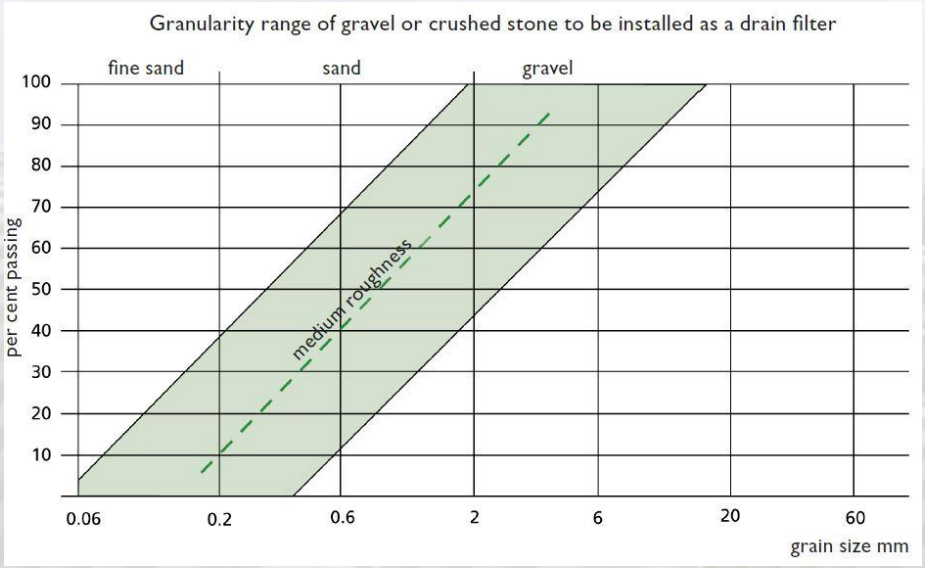
An envelope material is used to improve the permeability of the drain excavation and and soil surrounding the drain pipe, to prevent soil material from entering the pipe, and to protect the pipe under difficult installation conditions

Drain gravel is typically used as an envelope material

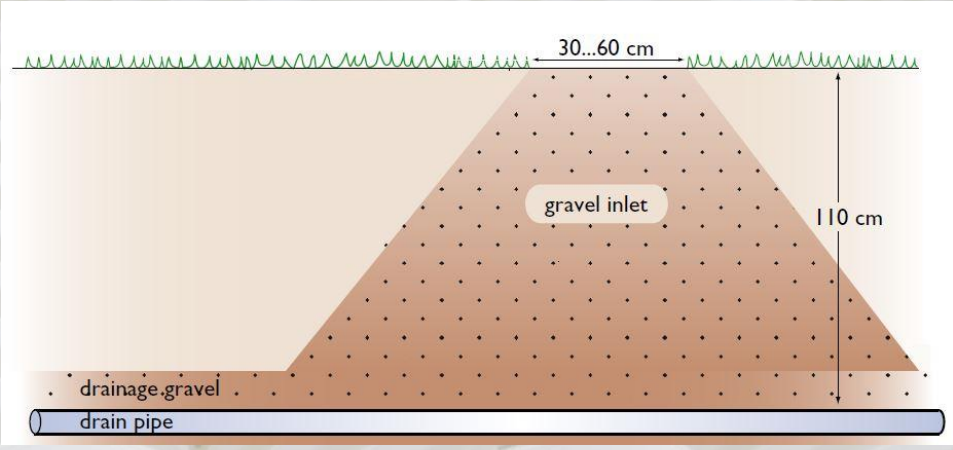
Other possible envelope materials include crushed stone or coating materials wrapped around the pipe

Coconut coir and organic or synthetic textiles are the most common coating materials

A layer of no less than 8 cm of gravel over the drainage pipe should be used, equalling 6–7 m^3 / 100 m (9,5-11 t / 100 m)



Drainage can be further enhanced with gravel inlets, where the excavation is filled entirely with gravel



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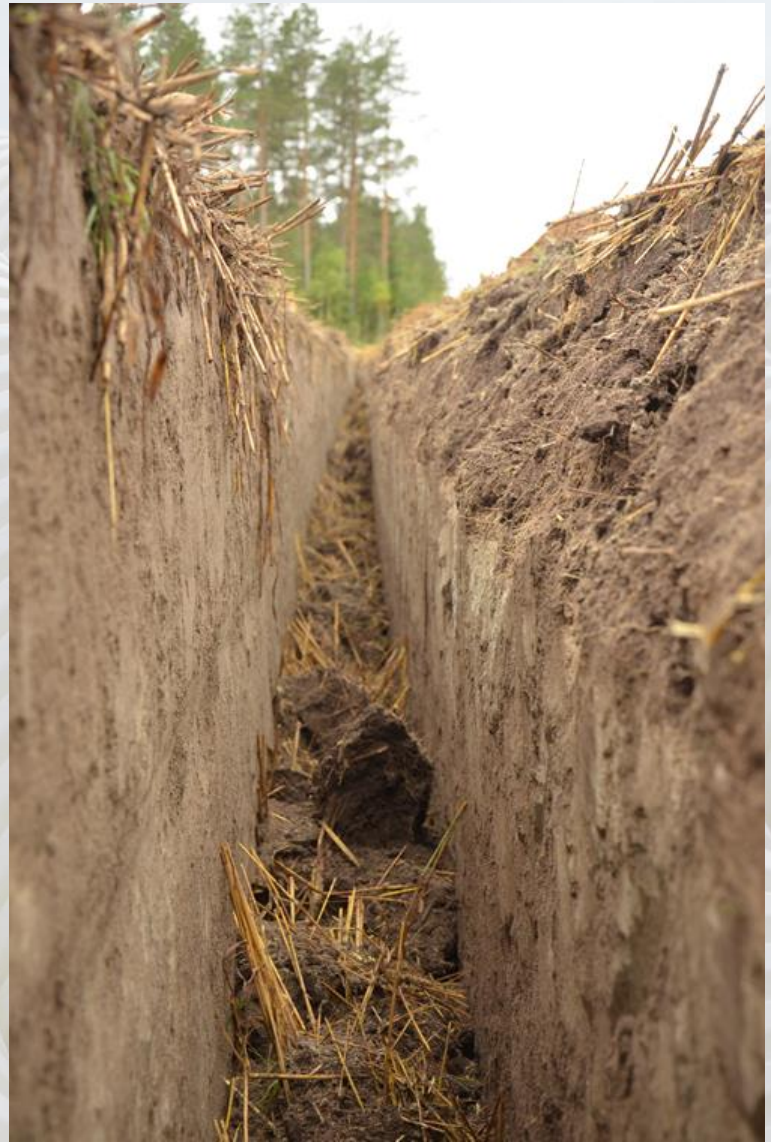
Topsoil is dropped into the drain excavation over the envelope material

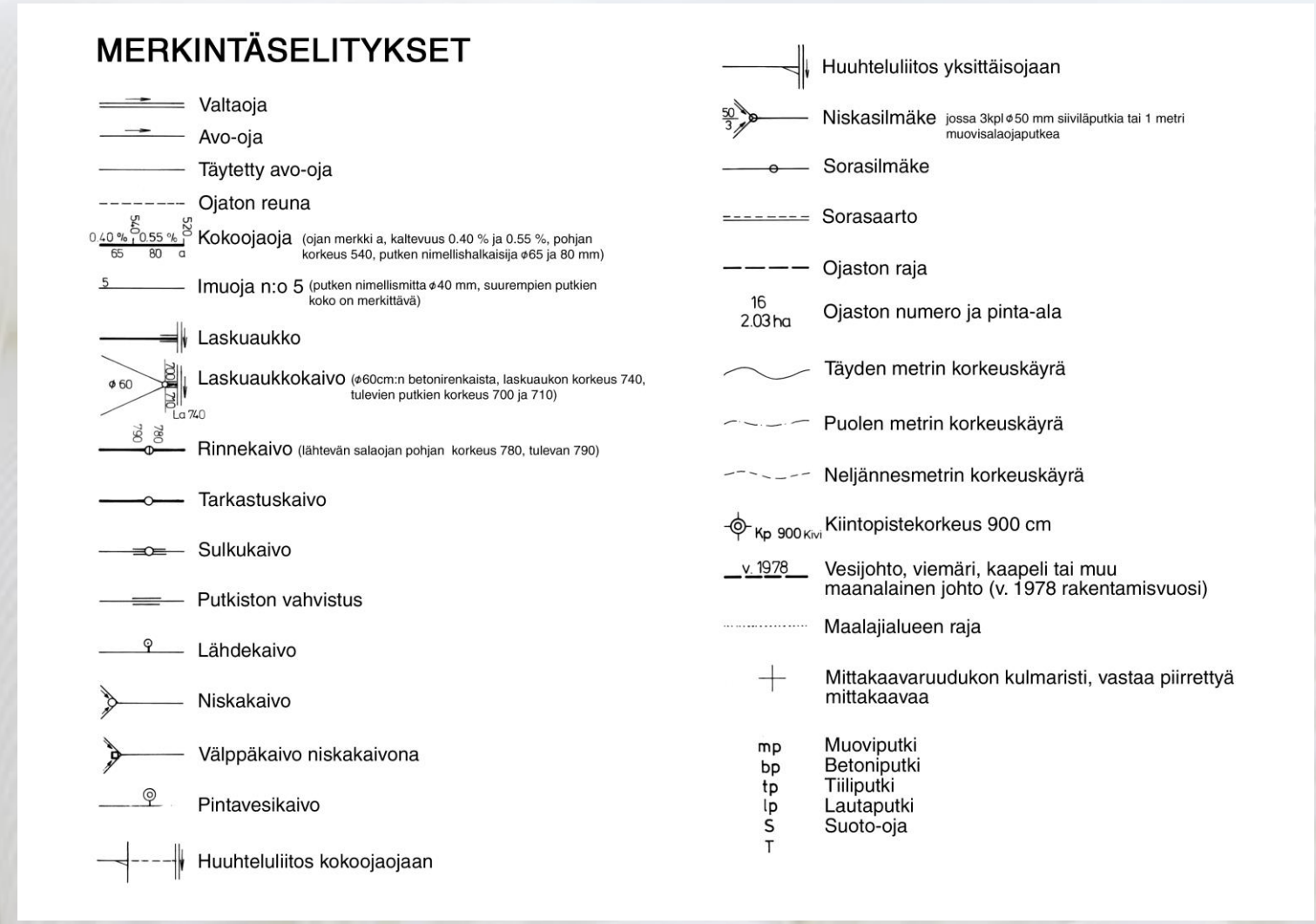
Topsoil, with a high organic matter content, is more permeable than solid subsoil



Drainage plan

- Design map
  (topography, installation depth of the drains, pipe sizes etc.)
- Written plan
- Cost estimate
- List of supplies and their unit prizes for each drainage system
- Other relevant detailed drawings and plans
- Instructions for the farmer and the contractor
- Forms required for the undertaking
- Qualification of the designer

Drainage plan –the map markings



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