Visual drainage assessment (VDA)

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Introduction:

- **In Ireland** - Site-specific land drainage system designs are usually disregarded in favour of haphazard land drainage designs.
- Formal measurement or monitoring of soil hydrological properties is **not practical** or accessible **for small scale drainage schemes**.
- Decisions and designs are often created in the field
- **We need an in-situ method to ascribe permeability to different soil layers**

Objectives:

- To develop a visual method of land drainage system design, based on visual approximations of soil horizon permeability.
- To evaluate the visual drainage assessment (VDA) method on six farms in southwest Ireland by comparing model estimate of performance of VDA prescribed systems with idealised site-specific designs and standard designs as used generally in the region.

Materials & Methods:

- The method is based on a number of "indicators" that can be readily identified and classified in soil test pits (Table 1).
- The indicators are assigned weights depending on their reliability for hydrological discrimination between soils (A=10, B=4, C=1).
- Each classification corresponds to a VDA score.
- The total VDA score for each horizon is calculated by multiplying each indicator score by its corresponding weighting and summing the results. Total VDA score is used to classify horizons as poorly, moderately or highly permeable.

Table 1. Visual indicators of soil permeability, their interpretation, assigned visual drainage assessment (VDA) score and weighting (A=10, B=4, C= 1)

Indicator	Classified by	Classified as	VDA score	Weighting
Water seepage	Presence	• Water seepage evident	1	A
		• No seepage evident	0	
Pan layers	Presence	• Present	-1	A
		• Not present	0	
Texture	Hand textured	• Medium & light texture soils	1	B
		• Heavy texture soils	0	
Porosity	Poor, moderate or good	• Good	2	C
		• Moderate	1	
		• Poor	0	
Consistence	Stickiness & plasticity	• Non-sticky, non-plastic soils	2	C
		• Sticky or plastic soils	1	
		• Sticky and plastic soils	0	
Stone content	Abundance	• Stone content > 15%	1	C
		• Stone content < 15%	0	
Roots	Presence	• Present	1	C
		• Not present	0	

Materials & Methods:

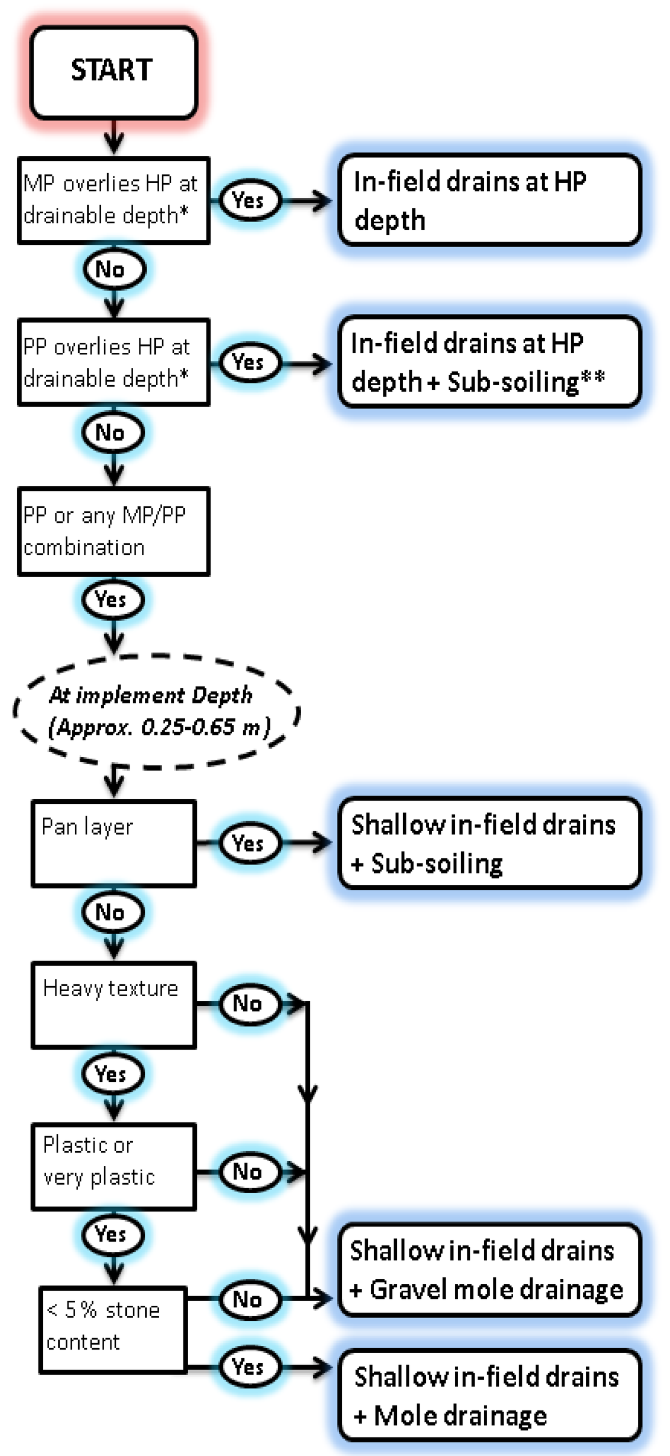

Figure 1. Flow chart used to prescribe drainage system type given permeability classifications as defined by VDA score and indicator classification.

- The permeability classification is used to prescribe a specific drainage system type using flow chart (Figure 1). Depth and spacing depend on drainage system type and field gradient
- Methodology deployed across six sites.
- Test pits were excavated, visually evaluated and soil samples were collected for hydraulic conductivity determination.
- This data was used for the formulation of idealised designs based on established design equations. A standard drainage design was also prescribed for each site (0.8 m deep drains at 15 m spacing)
- The three design options were compared by model estimate of drain discharge (mm/day) and watertable control (m) capacity.

Results:

- Mean estimated drain discharge and water table control capacity from VDA and ideal designs were significantly higher ($P<0.001$) than from "standard" designs (Table 2).

Table 2. Comparison of drainage design methodologies. Note: VDA = visual drainage assessment, WT = watertable, [a] assuming a minimum WT depth of 0.45m, [b] assuming a rainfall recharge of 12 mm/day

Site	Design methodology	Spacing (m)	Depth (m)	Rain recharge/ Drain discharge[a] (mm/day)	Minimum WT depth[b] (m)
Rossmore	VDA	15.0	1.60	15.6	0.73
	Ideal	17.2	1.50	12.0	0.45
	Standard	15.0	0.80	1.0	0.00
Lisselton	VDA	15.0	1.70	10.7	0.29
	Ideal	14.1	1.50	12.0	0.45
	Standard	15.0	0.80	0.6	0.00
Ballinagree	VDA	20.0	1.70	11.7	0.42
	Ideal	19.8	1.60	12.0	0.45
	Standard	15.0	0.80	0.9	0.00
Doonbeg	VDA	1.4	0.60	14.3	0.60
	Ideal	1.6	0.50	12.0	0.45
	Standard	15.0	0.80	0.1	0.00
Athea	VDA	1.5	0.45	13.9	0.45
	Ideal	1.7	0.50	12.0	0.45
	Standard	15.0	0.80	0.1	0.00
Castleisland	VDA	1.5	0.45	13.7	0.44
	Ideal	1.6	0.50	12.0	0.45
	Standard	15.0	0.80	0.0	0.00

Conclusions:

- The VDA methodology is promising and likely to be adopted in Ireland
- It provided a good approximation of an ideal design on all sites examined
- VDA Prescribed designs were shown by model estimate to offer significantly improved performance relative to standard designs
- It has the potential to improve effectiveness of land drainage works and increase returns from capital invested in land drainage