Lecture Notes

Mole Drains, Drainage Wells, Leaching Requirements, and Irrigation & Drainage Water Quality

1. Mole Drains

1.1 Definition and Purpose
Mole drains are unlined, circular channels formed in clay soils using a mole plough. They are primarily used to improve drainage in heavy soils where conventional subsurface drainage is ineffective or uneconomical.

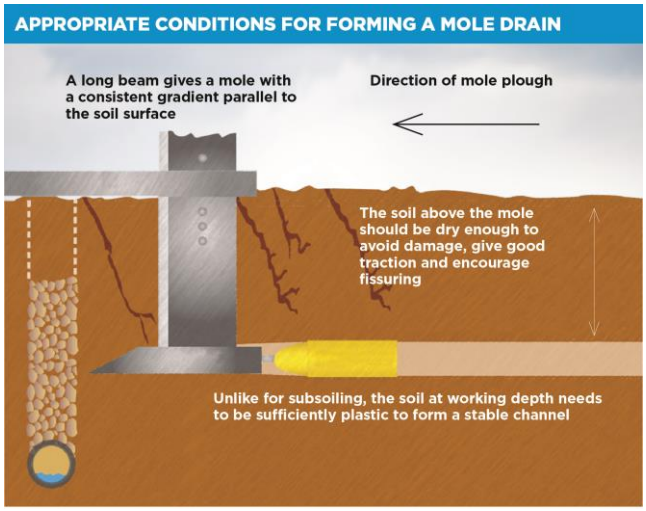
1.2 Construction and Mechanism
A mole plough consists of a narrow leg with a cylindrical foot, followed by an expander. As the plough is pulled through the soil, it creates a channel that allows water to flow, reducing waterlogging.

1.3 Advantages and Limitations
Advantages:
- Cost-effective for heavy clay soils.
- Improves soil aeration and root development.

Limitations:
- Short lifespan (typically 2–5 years).
- Effectiveness depends on soil type and moisture content during installation.

Reference: Ritzema, H.P. (1994). Drainage Principles and Applications. ILRI Publication 16.

Illustration of Mole Drain Construction:



2. Drainage Wells

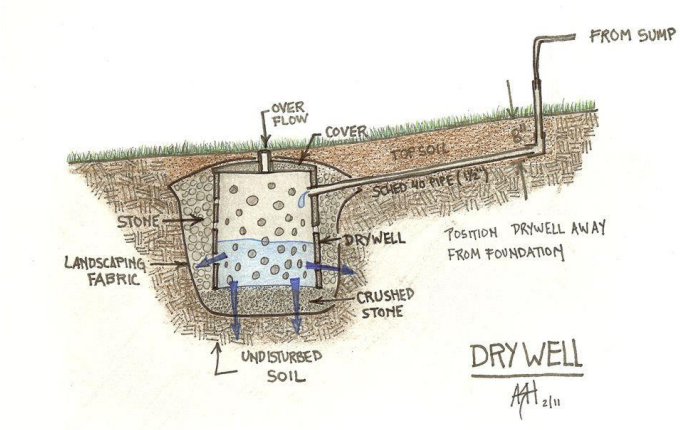
2.1 Definition and Types

Drainage wells are vertical structures designed to remove excess groundwater or surface water. They can be categorized into:

- Open Wells: Simple shafts that collect water.
- Recharge Wells: Facilitate the infiltration of surface water into aquifers.
- Relief Wells: Reduce hydrostatic pressure beneath structures.

2.2 Applications

- Lowering high water tables.
- Preventing waterlogging in agricultural fields.
- Protecting building foundations from uplift pressures.



Reference: Schwab, G.O., et al. (1993). Soil and Water Conservation Engineering. John Wiley & Sons.

3. Leaching Requirements

3.1 Concept
Leaching is the process of applying excess irrigation water to dissolve and flush out soluble salts from the root zone, essential in arid and semi-arid regions to prevent soil salinization.

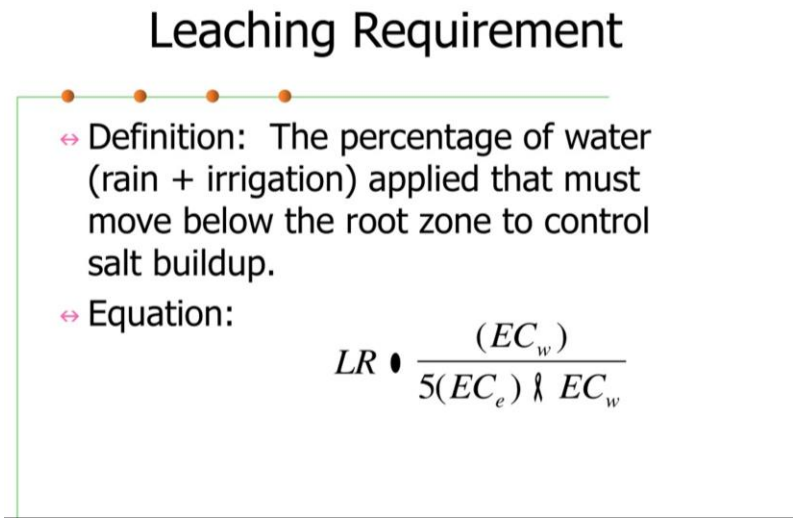
3.2 Calculation
The leaching requirement (LR) can be estimated using the formula:

LR = ECiw / (5 × ECdw - ECiw)

Where:
ECiw: Electrical conductivity of irrigation water.
ECdw: Electrical conductivity of drainage water.

Reference: Ayers, R.S., & Westcot, D.W. (1985). Water Quality for Agriculture. FAO Irrigation and Drainage Paper 29.

Leaching Requirement Equation:



$$LR = \frac{ECw}{5\ ECe - ECw}$$

where: LR = the minimum leaching requirement needed to control salts within the tolerance (EC_e) of the crop with ordinary surface methods of irrigation (Table 4)

EC_w = salinity of the applied irrigation water in dS/m

EC_e = average soil salinity tolerated by the crop as measured on a soil saturation extract (Table 4). It is recommended that the EC_e value that can be expected to result in at least a 90 percent or greater yield be used in the calculation.

4. Irrigation and Drainage Water Quality

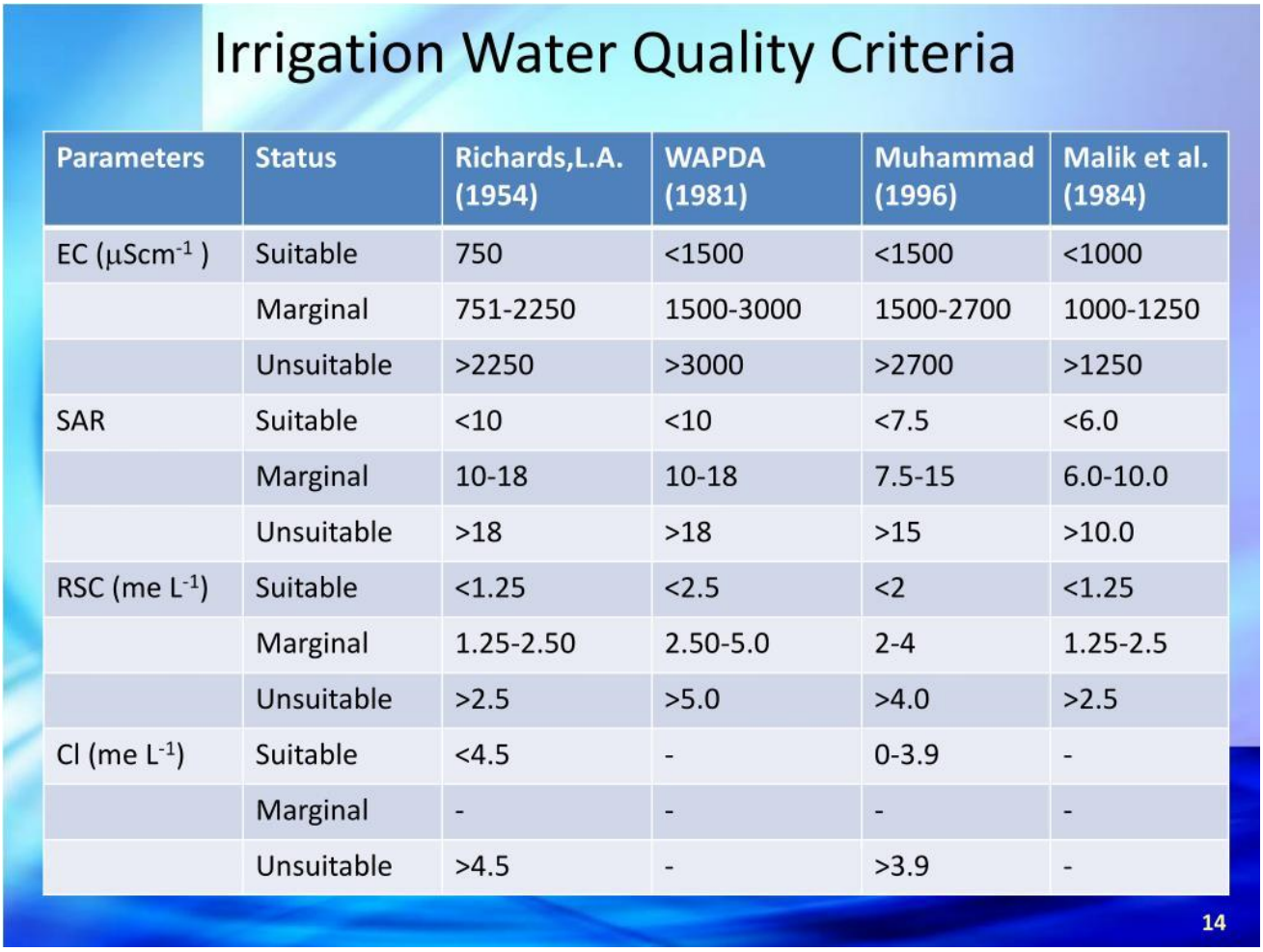
4.1 Importance
Water quality directly affects soil health and crop productivity. Poor-quality water can lead to salinity, sodicity, and toxicity issues.

4.2 Key Parameters
- Salinity (EC): High salinity reduces plant water uptake.
- Sodium Adsorption Ratio (SAR): High SAR can deteriorate soil structure.
- pH: Extreme pH levels can affect nutrient availability.

4.3 Guidelines
- EC: Should be below 0.7 dS/m for sensitive crops.
- SAR: Should be below 10 for most soils.
- pH: Optimal range is 6.5–8.4.

Reference: Ayers, R.S., & Westcot, D.W. (1985). Water Quality for Agriculture. FAO Irrigation and Drainage Paper 29.

Irrigation Water Quality Parameters:



Irrigation Water Quality Criteria

Parameters	Status	Richards,L.A. (1954)	WAPDA (1981)	Muhammad (1996)	Malik et al. (1984)
EC (μScm^{-1})	Suitable	750	<1500	<1500	<1000
	Marginal	751-2250	1500-3000	1500-2700	1000-1250
	Unsuitable	>2250	>3000	>2700	>1250
SAR	Suitable	<10	<10	<7.5	<6.0
	Marginal	10-18	10-18	7.5-15	6.0-10.0
	Unsuitable	>18	>18	>15	>10.0
RSC (me L^{-1})	Suitable	<1.25	<2.5	<2	<1.25
	Marginal	1.25-2.50	2.50-5.0	2-4	1.25-2.5
	Unsuitable	>2.5	>5.0	>4.0	>2.5
Cl (me L^{-1})	Suitable	<4.5	-	0-3.9	-
	Marginal	-	-	-	-
	Unsuitable	>4.5	-	>3.9	-

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5. Case Study: Leaching in Saline Soils

In the Indus Basin, Pakistan, excessive irrigation without proper drainage led to soil salinization. Implementation of leaching practices, combined with subsurface drainage, successfully reclaimed the affected lands, improving crop yields.

Reference: Ghassemi, F., et al. (1995). Salinization of Land and Water Resources. CABI Publishing.