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Glossary of terms for use with the 'A million hectares for the future' salinity management workshops

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GLOSSARY OF TERMS

FOR USE WITH THE *A MILLION HECTARES FOR THE FUTURE*
SALINITY MANAGEMENT WORKSHOPS



GLOSSARY OF TERMS

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GLOSSARY OF TERMS

A

- Absorption bank** – a *bank* with an uphill channel constructed to control *surface water flows* where there is no safe disposal. Constructed in the upper *landscape*. Both ends are turned upwards to allow maximum storage of *surface flows*. These structures may increase *salinisation* of the lower *landscape* and are no longer recommended by the Department of Agriculture.
- Active discharge** – *groundwater* that returns to the ground surface as a saturated flow driven by the hydraulic *gradient*. Examples of active discharge include springs, *soaks* or *saline* flats where *aquifers* intersect the ground surface.
- Alley farming** – a *farming system* in which belts of *perennial* vegetation (e.g. trees, *saltbush*) are interspersed with alleys of land for productive use of *annual plants* (crops, understorey).
- Alluvial** – of, or pertaining to, material transported by water.
- Annual pasture** – pasture composed primarily of *annual plants*.
- Annual plant** – a plant that completes its life cycle within 12 months. In the south-west of WA, *annual pastures* usually begin growing in late autumn or early winter and complete their life cycles in late spring or early summer.
- Aquaculture** – the growing of aquatic organisms in controlled environments for any commercial, recreational or public purpose.
- Aquifer** – a geological formation comprising layers of rock, unconsolidated deposits or *regolith* that is capable of receiving, storing and transmitting significant quantities of water. The term is usually applied to saturated materials that currently contain water.
- Aquifer, confined** – an *aquifer* overlain by an *aquitard* (layer of low *permeability*) that restricts the upward movement of water. In a confined *aquifer* there is no *watertable* because the *aquitard* prevents water from rising (i.e. the *piezometric head* is above the *aquifer*).
- Aquifer, perched** – a sub-surface material containing *perched groundwater*, separated from a deeper *aquifer* by unsaturated materials.
- Aquifer, semi-confined** – an *aquifer* overlain by a layer that partly restricts the upward movement of water.
- Aquifer, unconfined** – an *aquifer* containing water that is not under pressure; the upper boundary is the top of the *zone of saturation*. In an *unconfined aquifer*, the water level in a well is the same as the *watertable* outside the well.
- Aquitard** – a saturated, but poorly permeable geological formation, which transmits water at a very slow rate, compared to an *aquifer*.
- Artesian aquifer** – a confined *aquifer* in which the *piezometric head* sits above the ground surface so that the pressure causes water to flow freely from bores drilled into the *aquifer*.
- Ash** – the residue that remains when something is burnt.

Ash content – the percentage of *ash* resulting from the complete combustion of a specific weight of cellulose material, in which all of the carbon, combustibles and volatile compounds are removed. It indicates the amounts of mineral salts, inorganic matter, filler, coating, pigmentation and chemical additives in the sample.

Available nutrients – the elements and minerals in the soil solution that can readily be taken up by plant roots.

Average recurrence interval (ARI) – the average or expected probability of an occurrence (in years) of a given rainfall, or other meteorological or hydrological, event. Often used in relation to an event that will cause an engineered water control structure to fail.

B

Bank – a long, linear mound of soil constructed across the local surface *gradient* to intercept and redirect surface water.

Basement – a general term for the solid rock that lies underneath the soil and other unconsolidated material. Also known as *bedrock*. When exposed at the surface it is referred to as *outcrop*.

Basement (or bedrock) high – an area in which the *bedrock* is closer to the ground surface than in the surrounding areas. On slopes with patches of shallow *bedrock*, *groundwater discharge* is often initiated as lateral flows are forced to the surface.

Batter – the excavated or constructed face of a *dam* wall, *bank* or cutting, produced as a result of earth moving operations involving cutting or filling.

Bedrock – a general term for the solid rock that lies underneath the soil and other unconsolidated material. Also referred to *basement*. When exposed at the surface it is referred to as rock *outcrop*.

Biomass – the amount of living material present in a given area at a given time.

Break of slope – an imaginary line across a *landscape* at which the surface slope is reduced and where the hydraulic *gradient* decreases.

Break of slope seep – *seepage* occurring where *groundwater* is discharged near the foot of a slope after being forced to the surface by a decrease in the slope of the *watertable*.

Breakaway – a *landform* found on the edge of a plateau or plateau remnant where a relatively flat upland ends abruptly in a low scarp that sits above a debris slope. Breakaways are common in *lateritic landscapes* in the *wheatbelt* and *woolbelt*.

Broadacre – a term used to describe farming or cropping enterprises that cover large areas of land, typical of farms in the *wheatbelt*. The term 'broadacre cropping' is used to differentiate the growing of crops such as wheat, lupins and canola from the intensive cropping practised in horticulture.

Broad-based channels – variations of *grade* or *level banks* that allow for machinery movement and tillage. They are built by a grader or bulldozer and have flat channels, gentle *batters* and low *banks*.

Buffer (in relation to soil water) – a portion of a soil profile in which the soil water storage is low (approaching *wilting point*) allowing for significant storage of *infiltration* before the soil saturates and *deep percolation* commences. Often used in reference to the dry portion of the soil profile created by summer and autumn *water use* by *perennial* plants.

C

- C3 plants** – plants that utilise the C3 pathway whereby the first organic product of carbon-fixation (during the *Calvin Cycle*) is a three-carbon compound. This pathway is less efficient during periods of high light intensity than the alternative (*C4* pathway). More nitrogen is also required per unit carbon fixed than by *C4 plants*. This category includes the vast majority of common plant species.
- C4 plants** – plants that utilise the C4 pathway whereby the first organic product of carbon-fixation is a four-carbon compound, which is formed prior to the *Calvin Cycle*. This adaptation is advantageous in hot regions with intense sunlight as it minimises *photorespiration* and maximises sugar production because the pathway is more water and nitrogen efficient. Sugarcane is an example of this type of plant.
- Calcrete** – a layer where cemented *carbonate* accumulation has occurred. The material must be hard.
- Calvin Cycle** – the mechanism by which plants and micro-organisms fix carbon from carbon dioxide.
- Capillary rise** – the unsaturated flow of water upward from the *watertable*. Capillary rise is driven by *matrix suction* maintained by *evapotranspiration* from the soil surface. The water moves upwards through fine pore spaces and as films around the soil particles.
- Carbonate** – a compound containing carbon and oxygen.
- Catchment** – the total area of land potentially contributing to water flowing through a particular point.
- Cementation** – the process by which *sedimentary rock* is formed from sediments being glued together by mineral deposits.
- Contour** – an imaginary line on the surface of the earth connecting points of the same elevation (i.e. the same height above sea level).
- Contour cropping** – the practice of sowing crops along the *contour* rather than cultivating up and down the slope.
- Craton** – a major unit of the Earth's crust, consisting of a large stable mass of rock, sometimes covered by a thin veneer of sediments.
- Crude protein** – the estimated protein content of plant material, including true protein and non-protein nitrogen. It is obtained by analysing the nitrogen content of feed, assuming that all nitrogen is present as protein and that all proteins contain 16% nitrogen. Hence it is obtained by multiplying the percentage of nitrogen content by 6.25.
- Cumulative** – increasing by successive addition.

D

- Dam** – a barrier, embankment or excavated earth structure constructed primarily to impound water for storage. Dams are generally built in or near *drainage* lines. Dam walls can range from large concrete structures such as the Wellington Dam to the small earthen walls typical of many farm dams.
- Deep drainage** – the removal of *groundwater* using *deep open drains* or sub-surface drains. The term is often also used to describe water flowing past the *root zone* of plants under the influence of gravity. In this context, deep drainage will often become *groundwater recharge*. The terms, *deep percolation* or *deep seepage* can be used to avoid confusion.

Deep open drains – drains designed to intercept and remove *groundwater*. Deep open drains are constructed with a bulldozer or excavator and are left uncovered. They are more than 0.6 m deep and typically 1.2-2.5 m deep.

Deep percolation or deep seepage – water that flows, under the influence of gravity, below the *root zone* towards a deeper *watertable* and cannot be used by plants.

Deflocculation – the breaking down of soil aggregates to micro-aggregates and primary particles (e.g. sand or *silt*) caused by rapid wetting or a marked change in soil solution chemistry or pH.

Degradation – the decline in the quality of natural resources such as soils, water and plants.

Digestibility – the ability of a substance to be digested.

Discharge – water that moves from a *groundwater* body to the ground surface (or into a surface water body such as a lake or the ocean). Discharge typically leaves *aquifers* directly through *seepage* (*active discharge*) or indirectly *through capillary rise* (*passive discharge*). The term is also used to describe the process of water movement from a body of *groundwater*.

Discharge area – where significant amounts of *groundwater* come to the surface, either as liquid water or as vapour by *evaporation*.

Dispersion (soil) – the process whereby soil aggregates break down in water into their constituent particles (sand, *silt*, clay) due to *deflocculation*. The clay particles go into suspension. Dispersion affects the structure and coherence of a soil and its pores become clogged by the loose clay particles, reducing its *permeability* and often resulting in *waterlogging*.

Dispersive – describes a soil prone to *dispersion*.

Dolerite – medium-grained mafic *igneous rock* which occurs mainly as *dykes*, sills or small plugs. Important in the South-West Agricultural Region because dolerite *dykes* are often associated with soil *salinity*.

Drain – a channel or tunnel constructed to intercept and remove water.

Drainage – the removal of water from a site or soil profile. **Site drainage** relates to the rate at which water is removed from a particular site. Soil or **profile drainage** relates to the rate at which water is removed from a particular soil profile. The term is also used to describe systems that are artificially constructed to improve site or soil drainage (e.g. *deep drains*, *seepage interceptors* or pumping systems).

Drainage depression – a level to gently inclined shallow, open depression with smoothly concave cross-section that conveys *run-off* only during or immediately after periods of heavy rainfall.

Drainage line – a channel where surface water naturally concentrates and flows regularly, either permanently or for short periods. Examples include streams and the floors of *drainage depressions*.

Drainage system – a network of *drainage lines* and *waterways* (either natural or artificial) through which water falling on an area is transported to an end point. Natural drainage systems typically consist of all the rivers and streams in a *catchment*. Artificial drainage systems usually comprise a series of connected drains and *waterways* designed and constructed to remove excess surface or *groundwater* from an area.

Drawdown – the lowering of a *watertable* resulting from the removal of water from an *aquifer* or reduction in hydraulic pressure.

Dry matter – the percentage of feed, or other material, that is not water.

Dryland salinity – the *salinisation* of land that is not irrigated. The term does not imply that the land is dry, as affected areas are typically also *waterlogged*.

Duplex (soil) – a soil with an abrupt change in *texture* between the topsoil and *subsoil*, e.g. sand over clay.

Dyke – a sheet-like body of *igneous* rock cutting across the bedding or structural planes of the host rock. Dykes typically appear on the surface as relatively narrow, linear features. They are important in the South-West Agricultural Region because they are often associated with shallow *groundwater* and therefore *secondary salinity*.

E

Earthwork – a structure made out of earth (soil and *regolith*) and designed or constructed to intercept, divert, retain, detain or dispose of *run-off* or *throughflow*.

EC – abbreviation for electrical conductivity, a measure of the ability of a medium to conduct electricity. EC is used often as a surrogate measure of *salinity* levels in water or soil as the conductivity of a solution generally increases in proportion with its salt content. Three types of electrical conductivity measurements are made on soils:

- EC_a measurements are taken in the field using an electromagnetic induction meter
- EC_e measurements on a saturation extract paste from soil samples
- EC_{1.5} measurements on a solution obtained by mixing one part soil with five parts distilled water.

EM – abbreviation for electromagnetic. An electromagnetic induction meter estimates the apparent electrical conductivity (EC_a) of land. Common ground-based, EM induction meters are the EM38 and EM31. The EM38 has two modes – vertical, which measures the electrical conductivity of the top 1 m of soil, and horizontal, which measures the top 0.5 m of soil. The EM31 measures the soil profile to about 4–6 m. Other electromagnetic induction meters can be airborne and some are designed to be lowered down boreholes.

Erodability (soil) – a term used to describe a soils susceptibility to *erosion*. Usually rated as high, moderate or low.

Erosion – the wearing away of the land surface by running water, waves, wind or by other processes such as mass wasting and corrosion (solution and other chemical processes). **Geological erosion** refers to natural erosion processes occurring over long (geological) time spans. **Accelerated erosion** generically refers to erosion in excess of what is presumed or estimated to be naturally occurring levels, as a direct result of human activities such as cultivation.

Evaporation – the conversion of a liquid into a vapour. In the *hydrological cycle*, evaporation involves heat from the sun transforming water (held in surface storages in soil) from a liquid into a gaseous state. This allows the water to move from water bodies or the soil and enter the atmosphere as water vapour.

Evaporation basin – a shallow excavated earth tank or natural pond that can be used to store water (usually *saline*) and allow it to evaporate. For this reason, evaporation basins can be used as a method of disposal of *groundwater* that has been extracted from sub-surface *aquifers* or *deep drains*.

Evapotranspiration – the transfer of soil water to the atmosphere from vegetated land through the combined processes of *evaporation* from soils and *transpiration* from plants.

F

Farm water storage – any structure or natural feature that is used to hold water for later use on an agricultural property. Examples include *gully wall dams*, *soaks* and concrete tanks.

Farming system – a combination of the crops, pastures, livestock and agricultural practices (e.g. cultivation technique and fertiliser regime) that are used on a farm.

Fault line – a fracture or fracture zone of the Earth's crust with displacement along one side in respect to the other.

Field capacity – the soil water content at which vertical *drainage* under the influence of gravity undergoes a marked decrease.

Flood plain – a plain built up by periodic *flooding* and *alluvial* deposition.

Flooding – a condition in which free standing water occurs above the soil surface. *Waterlogging* usually coincides with flooding, but many waterlogged soils are not flooded.

Flow rate – the amount of surface water or *groundwater* flowing past a given point or line over a defined period of time. Measured as volume, depth or area of water per unit time.

Flow systems – the portion of the *hydrological cycle* that involves the movement of water across the land surface or through the ground. Includes *surface flows* (*run-off* and stream flow), temporary sub-surface flows and permanent *groundwater* flows.

Flow system, intermediate – an *aquifer* having a flow length of between 10 and 50 km.

Flow system, local – a flow system transporting *groundwater* in which *discharge* and *recharge* occur within a few kilometres of each other. Flows may be permanent or temporary and the water is typically transported down a hill-slope through an *unconfined aquifer* that is relatively thin (<20 m) and close to the surface.

Flow system, regional – an *aquifer* with a flow length of 50 km or more. Some definitions require that 50 km or more separates the *aquifer recharge* and *discharge* areas, but this is not relevant in the WA context. The *aquifer* materials are commonly *sedimentary* deposits and the *aquifer* is often *confined* or *semi-confined* over much of its length.

Flow velocity – the speed at which surface water or *groundwater* flows. Measured as a distance per unit time (e.g. mm/hr, or m/day).

Fodder shrub – a woody plant smaller than a tree, usually multi-stemmed, with leaves that are a good source of food for livestock.

Fractured rock aquifers – rocks that are capable of receiving, storing and transmitting significant quantities of water due to the presence of numerous cracks, fissures or fractures in what would otherwise be an *impermeable* material.

G

Geological constriction – a narrowing of a *valley floor* caused by *outcrop*, *dykes*, *basement highs* or some other factor governed by the local geology that impedes the flow of water (*groundwater* or surface water) down the valley.

Geomorphology – the science of describing and interpreting *landform* patterns and processes of *landscape* formation.

- Grade bank** – a *bank* built across a slope (on a slight *gradient* off the *contour*) to collect and direct *run-off* water. Grade banks can be built with a grader, plough or bulldozer. Grade banks are sometimes incorrectly referred to as contour banks. The term ‘contour bank’ is ambiguous and should be avoided.
- Gradient** – the degree of inclination of a slope, usually expressed as a ratio of the change in height over a particular distance. For example, a gradient of 1:500 means the slope drops by a metre over every 500 m. Gradients of steeper slopes are expressed as a percentage, with a 100% slope being the equivalent of a 1:1 gradient, a 25% slope being the equivalent of a 1:4 gradient and a 10% slope being the equivalent of a 1:10 gradient. Gradients can be measured on hill-slopes, *valley floors*, *watertables* and *earthworks*.
- Grass** – plant of the Poaceae family. Grasses are characterised by rounded, hollow or pithy, jointed stems and narrow sheathing leaves with parallel veins. The leaves alternate on two sides of the stem. Flowers are borne in reduced spikes (spikelets).
- Gross margin** – the profitability after the costs of production have been paid: selling price minus production costs.
- Ground cover** – any matter that protects the soil surface from *erosion*. Ground cover is usually the same as vegetation cover (i.e. living plants) but can include dead plant matter, stones or gravel.
- Groundwater** – water stored below the ground surface that saturates the soil and is at greater than atmospheric pressure and will therefore flow freely into a bore or well. This term is most commonly applied to permanent bodies of water found under the ground.
- Groundwater drainage** – artificial *drains* (*deep open* and/or *sub-surface* drains) that are designed to intercept and remove *groundwater* and thereby lower *watertables*.
- Groundwater equilibrium** – describes the state of a *groundwater flow system* in which *discharge* equals *recharge* and the *watertable* level therefore remains constant or rises and falls around a long-term average.
- Groundwater flow** – the movement of *groundwater* in soil, *regolith* and rocks that are fully saturated.
- Groundwater flow, lateral** – movement of *groundwater* in a non-vertical direction. Lateral *groundwater* flows are usually, although not always, more or less parallel to the ground surface.
- Groundwater management** – a management system designed to lower *watertables*, usually with the aim of preventing the additional accumulation of salts, while allowing rainfall to *leach* salt from the upper soil profile. Groundwater management systems can involve *drains*, bores with pumps or *relief wells* to extract the water.
- Groundwater pumping** – the extraction of water from an *aquifer* with electric, wind powered or compressed air pumps. *Groundwater* pumping involves drilling bores down into *aquifers*. Usually a number of bores and pumps are required to have any effect on the *watertable* in a particular area.
- Growing season** – the length of the period each year when plants are growing actively. In the south-west of WA the term usually refers to the growing season of *annual plants*, which extends from late autumn into spring. There is little growth over the summer when *evaporation* exceeds rainfall.
- Gully** – a small channel with steep sides cut by running water and through which water ordinarily runs only after rain. They are greater than 0.3 m deep, but can reach several metres in depth due to the cutting force of the running water. They often have branches and usually cannot be crossed by farm machinery.

Gypsum – natural hydrated calcium sulphate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) that can be used to stabilise the structure of *sodic* soils.

H

Halophyte – highly salt-tolerant plant.

Hardpan – a hard soil layer cemented with organic matter, silica, oxides of iron or aluminium, *gypsum* or calcium carbonate or formed by physical compaction of the soil.

Hardsetting – describes a soil, the surface of which is compact, hard and apparently without structure when dry, but softens on wetting.

High rainfall district – a loose term used to describe areas close to the coast that receive more rainfall than inland areas. In an agricultural context, typically applied to the districts receiving more than 600 or 800 millimetres per year on average.

Hillside seep – the *discharge* of *groundwater* on a hill-slope. This *discharge* is usually associated with a *local flow system* and often occurs where the *groundwater* flow is forced to the surface by a barrier.

Hydraulic conductivity – a measure of the potential rate of flow of a fluid through soil or rock. As such, it takes into account the nature of the fluid, the degree of saturation and the *permeability* of the material the fluid passes through. The hydraulic conductivity of a material can be measured in either the saturated or unsaturated states. The unsaturated hydraulic conductivity will change as a material becomes wetter, but the saturated hydraulic conductivity of a material remains constant. Hydraulic conductivity is expressed in units of length per unit time, typically millimetres per hour (mm/hour) or metres per day (m/day).

Hydrogeology – the study of *groundwater* movement through soil, sediment or rock under natural or induced conditions.

Hydrological cycle – the continuous circulation of water between the land, sea (or other water surface) and the atmosphere.

Hydrology – the study of water and water movement in relation to the land. Deals with the properties, laws, geographical distribution and movement of water on the land or under the Earth's surface.

I

Igneous rock – rock formed as magma from the core of the Earth cools and becomes solid on or near the surface. Includes volcanic rocks (e.g. basalt) that form when magma erupts on the surface, and plutonic rocks (e.g. *dolerite* and granite) that form under the ground.

Impermeable – describes the nature of solid material that will not allow fluids to pass freely.

In situ – Latin description of a material that occurs in the position in which it was originally formed or deposited.

Infiltration – the process whereby water enters the soil through its surface. The downward movement of water into the soil profile.

Infiltration excess run-off – *run-off* (overland water flow) that occurs because the amount of water falling on (or being applied to) the ground surface exceeds the soil's *infiltration* capacity.

Infiltration rate – the speed at which water soaks into, or is absorbed by a soil. Expressed in units of depth per unit time (e.g. mm/hour).

Interception loss – the amount of water intercepted by plants and returned to the atmosphere by *evaporation* during a rainfall event.

Interceptor drain – see '*seepage interceptor drains*'.

Inundation – describes the situation where water lies stationary on the soil surface. Sometimes referred to as *surface ponding*. Inundation is commonly confused with *waterlogging* because both processes often occur at the same time. In certain situations, soils can become inundated without being waterlogged, with the soil surface sealing and water lying on the ground but not *infiltrating*.

L

Landform – any physical, recognisable form or feature of the Earth's surface, having a characteristic shape and range in composition, and produced by natural causes. Landforms provide an empirical description of similar portions of the Earth's surface and can range in size from several metres across up to 100 km long.

Landscape – a collection of related, natural *landforms*; usually the land surface that the eye can comprehend in a single view.

Laser grading – see *laser levelling*.

Laser levelling – use of a rotating laser beam to control land levelling and achieve a land surface of uniform slope.

Laterite – a material composed of the secondary oxides of iron and/or aluminium and created *in situ*. A laterite profile typically grades from an iron-rich crust or gravel, down through a leached zone of deeply weathered *bedrock* to consolidated *bedrock*.

Leach – to wash material from the soil, either in solution or suspension. The process by which nutrients, chemicals or contaminants are dissolved and carried away by water, or are moved into a lower layer of soil.

Leaf area index (LAI) – the ratio of leaf area in a plant canopy to the area of the land beneath that canopy.

Leakage – in *groundwater*, the flow of water from or into an *aquifer* through an underlying or overlying semi-pervious layer, although the term may be used in a less formal sense to imply any slow movement of water through a soil or geological formation.

Legume – any plant from the Fabaceae family (including peas, clovers and soybeans). They are important in nitrogen fixation as, generally, they possess nitrogen-fixing bacteria in nodules on their roots. These bacteria convert atmospheric nitrogen into compounds that can be taken up by plants and animals.

Levee bank – an embankment (long, narrow mound of earth) constructed by a grader or bulldozer along a *waterway* to contain or exclude floodwaters.

Leveed waterways – a narrow sloping area with *levee banks* installed on either side. Leveed waterways are designed to confine and dispose of water flows.

Level banks – embankments built on upper slopes and designed to control *surface flows* where there is no safe way of disposing the water. They consist of a *bank* and an uphill channel. One or both ends of level banks are left open to allow overflow during heavy *run-off* and this differentiates them from *absorption banks*. No longer recommended by the Department of Agriculture.

Low rainfall district – a loose term used to describe inland areas that receive less rainfall than areas closer to the coast. Typically applied to districts receiving less than 400–500 mm/year on average.

Lower recharge farming system – a farming system that minimises *groundwater recharge*, typically through a combination of strategies. These can include incorporating trees, *fodder shrubs*, *perennial* grasses and higher water use crops into the farming system as well as effective agronomic practices with an alternative, economically viable system that reduces *deep percolation* of water beyond the *root zone*.

Lucerne – a *perennial* pasture *legume* of the Fabaceae family. Considered an important pasture plant in southern Australia because of its ability to fix nitrogen, provide green feed during summer and autumn, and use more water than *annual pastures*.

M

Matrix flow – water that passes through the interconnected pores in the *soil matrix* as opposed through *macropores* as *preferential flow*.

Matrix suction – the negative pressure (less than atmospheric pressure) which holds water in the pores of a soil or other porous medium. The formal definition is the work per unit quantity of pure water that has to be done to overcome the attractive forces of water molecules and the attraction of water to solid surfaces.

Meckering Line – a major geological boundary in the South-West Agricultural Region. To the east of the Meckering Line, *drainage* is very sluggish and water rarely flows along the entire length of the *drainage systems*. To the west of the Meckering Line, rejuvenated drainage has resulted in the formation of more recent valleys with creeks and rivers that flow in defined courses every winter.

Metabolisable energy – the amount of energy available for absorption by an animal after digestion and fermentation (in the case of ruminants) of feed has occurred. It is needed by animals for body function, and is generally the main constraint to sheep production from pastures. The amount of energy the sheep derives from fodder is directly and positively related to the digestible organic matter in the *dry matter*.

Metamorphic rock – rock of any origin altered in mineralogical composition, chemical composition or structure by heat, pressure, or movement at depth in the Earth's crust. Examples of metamorphic rocks include schist, gneiss and quartzite. Most have parallel bands of minerals evident.

Meteoric water – water derived from *precipitation*.

Mole drain – a tubular hole (50–100 mm diameter) created by pulling a metal foot and trailing expander through the soil. The foot and expander create a cavity that may conduct water rapidly to a nearby *drain*.

Mounding – the construction of a low pile of earthy material that is raised above a *waterlogged* area, usually to provide a growing medium for plants.

N

Net present value (NPV) – the future stream of benefits and costs converted into equivalent values for today. This is done by assigning monetary values to benefits and costs, discounting future benefits and costs using an appropriate discount rate, and subtracting the sum total of discounted costs from the sum total of discounted benefits.

O

Orthoquartzite – a *sandstone* converted to *quartzite* with grains cemented only through *infiltration* and pressure. The cementing agent is usually *quartz*.

Outcrop – the total area over which a particular rock unit occurs at the surface, whether visibly exposed or not. The term exposure is sometimes used as a synonym.

P

Passive discharge – describes the situation where *groundwater* rises to the surface indirectly through *capillary rise*. Passive discharge is due to matrix suction, which is maintained by *evapotranspiration* from the soil surface.

Peak flow – the maximum instantaneous rate of water flow past a point for an individual rainfall event. Can apply to flows in a river, stream or *drain* as well as to flood events and *run-off*.

Perched groundwater – *groundwater* in an *unconfined aquifer* near the land surface and separated from deeper *groundwater* by unsaturated materials. Perched groundwater is typically shallow, thin and ephemeral (i.e. temporary or seasonal) and sits on top of materials of low *permeability*, such as clay and *hardpan*, which restrict the downwards flow of water.

Percolation – the downward movement of water through soil and *regolith*.

Perennial (plant) – a plant whose life cycle continues for more than one season. Includes trees, *shrubs* and many species of *grasses* and herbs e.g. *lucerne*.

Permeability – the capacity of a material to transmit a fluid such as water. Permeability is a characteristic of the soil or rock only, and is not a measure of the rate at which water passes through the material (i.e. it is different from *hydraulic conductivity*). A material that is highly permeable will have few restrictions to the passage of water. A material with low permeability will provide major restrictions to the movement of water.

Photorespiration – during hot, dry conditions plants close their *stomata* to conserve water. This causes oxygen to accumulate in leaf tissues and in *C3 plants* inhibits the binding of carbon dioxide to the enzyme involved in photosynthesis.

Piezometer – a borehole cased and completed with a seal(s) adjacent to the slotted section to observe the *groundwater* pressure over the slotted interval rather than the elevation of the *watertable*.

Piezometric head – the elevation to which water will rise in a *piezometer* connected to a point in an *aquifer*. Differences in piezometric head determine the hydraulic *gradient* and therefore the direction of *groundwater* flow.

Plasticity (soil) – the degree to which a soil is plastic or able to be permanently deformed by moulding or shaped manually or by machine.

Ponding – a form of *inundation* whereby water collects on the soil surface in puddles.

Pore water pressure – pressure exerted by fluid in the void space of soil or rock. It is usually expressed with respect to atmospheric pressure so that positive pressures indicate that the porous medium is saturated and negative pressures indicate that it is unsaturated.

Precipitation – water falling to the earth due to the force of gravity. Includes rain, hail, sleet and snow.

Preferential flow – rapid soil water flow that occurs through *macropores* or any other structure significantly more permeable than the bulk soil.

Preferred pathway – a channel or pore in a soil layer that has low *permeability* through which water flows preferentially. Old tree root channels are preferred pathways in many clayey *subsoils* in the South-West Agricultural Region.

Primary salinity – land that is intrinsically *saline* in its natural state as opposed to land that has become *saline* because of human actions.

Q

Quartz – a mineral composed of *silica* found worldwide in many different types of rocks including *sandstone*.

Quartzite – a rock formed from *sandstone* that has been subjected to considerable heat and pressure.

R

Recharge – the water that moves into a *groundwater* body and therefore replenishes or increases sub-surface storage. Recharge typically enters an *aquifer* by rainfall infiltrating the soil surface and then percolating through the zone of aeration (unsaturated soil). Recharge can also come via *irrigation*, the *leakage* of surface water storage or *leakage* from other *aquifers*. Recharge rate is expressed in units of depth per unit time (e.g. mm/year).

Recharge area – an area of land from which a significant amount of *groundwater* recharge occurs. In the agricultural areas of WA most of the cleared land that is not discharging *groundwater* contributes some *recharge*.

Regolith – all unconsolidated earth materials occurring above solid *bedrock*. Regolith includes soil, unconsolidated sediments and weathered *bedrock*. Soil scientists regard soil as being only that part of the regolith that is modified by organisms. Most engineers describe the whole regolith, even to a great depth, as soil.

Relief well – an *artesian* well used to remove excess *groundwater* from a lower (often *semi-confined*) *aquifer*. A borehole is drilled through which *groundwater* is discharged under hydraulic pressure. A pipe is connected to the bore to *discharge* the water into a *waterway*.

Retention basin – a basin (either natural or constructed) used to hold *run-off* or stream flow and thus reduce *peak flows* and the risk of *flooding*. Some of the water may be stored permanently in the basin, while the remainder is released at a controlled rate.

Revegetation – the process of returning *perennial* plants to land that was cleared. Land can be revegetated with native or introduced species.

Rill erosion – the removal of soil by *run-off* from the land surface in numerous small channels (rills), usually down to the base of the cultivation layer. The rills are commonly 0.05-0.1 m deep but can be up to 0.3 m deep. Rills typically form on recently cultivated land, disturbed soils and on overgrazed paddocks during summer storms.

Roaded catchment – an artificial *catchment* area for a *dam* or earthen tank constructed by compacting the soil in a similar manner to that used to form the surface of an earth road. Roaded catchments consist of many parallel ridges with smooth and impervious

surfaces that minimise *infiltration* and maximise *run-off*. Roaded catchments are commonly used in areas receiving less than 420 mm annual rainfall.

Root zone – the portion of the soil profile where the majority of plant roots are found, for *annual plants* typically within the top 0.3–0.5 m.

Rooting depth – the depth to which plant roots can penetrate the soil without being restricted by a physical or chemical barrier.

Run-off – water flowing downslope over the ground surface, also known as overland flow. *Precipitation* that does not *infiltrate* into the soil and is not stored in depressions becomes run-off.

Run-on – free moisture that moves from where it originally contacted the soil to the area of interest where it settles before it either *infiltrates* or *evaporates*.

S

Saline (soil) – a soil containing sufficient soluble salts to reduce productivity.

Saline (water) – a term used to describe water that has high *salinity* levels (in excess of 5,000 mg/L) which limit its suitability for many uses.

Saline seep – an area where saline *groundwater* is *discharged*.

Salinisation – the process of accumulation of soluble salts in soil.

Salinity – an accumulation of soluble salts in the soil *root zone*, at levels where plant growth or land use is adversely affected. Also used to indicate the amounts of various types of salt present in soil or water.

Saltbush – common name for species from the genus *Atriplex*.

Salt store – refers to the total amount of salt present within the *regolith* (both saturated and unsaturated) under a certain area of land. Usually expressed in terms of tonnes per hectare.

Salt-tolerant – a term used to describe plants and animals that are capable of living in *saline* soil or water.

Sandplain seep – where *groundwater* is discharged from the base of sandy or gravelly deposits as they thin out at the base of a slope.

Sandstone – a *sedimentary rock* consisting of sand consolidated with some cement.

Saturated excess run-off – occurs when water that falls on (or is applied to) the ground surface becomes *run-off* (overland water flow) because the soil is already saturated and cannot accept any more water.

Secondary salinity – describes the situation where *salinity* levels (of soil and water) increase as a result of human activities changing the *water balance*. Secondary salinity often occurs as a result of agricultural development and can be responsible for preventing large areas of agricultural land from being productive.

Sedimentary rock – any rock that has formed from the consolidation of sediment.

Sedimentation – the deposit of sediment, usually by water. Sedimentation is the result of *water erosion* and involves soil particles being washed downslope or downstream before being deposited.

Seep – point at where *seepage* occurs.

Seepage – occurs where the *watertable* intersects the ground surface and water flows out. This is *active discharge* and is driven by the hydraulic *gradient*.

Seepage interceptor drains – sub-surface *drains* constructed in *duplex soils* on hill-slopes to drain *waterlogged* areas as well as to intercept water moving towards *waterlogged* areas. A channel is dug through the topsoil into the clayey *subsoil* to collect water seeping through the highly permeable topsoil. In conventional seepage interceptor drains the *spoil* is mounded on the downslope side of the channel where both *run-off* and *seepage* are collected. In reverse seepage interceptor drains the *spoil* is placed upslope and acts as a *grade bank* intercepting *run-off*, while *seepage* enters the channel.

Shale – a fine-grained *sedimentary rock* comprised of clays and other finely sized mineral particles.

Silcrete – fine grained *orthoquartzite* formed by *cementation* of *shale* or *siltstone* with *silica*.

Silica – a chemical compound comprised of *silicon* and oxygen.

Silicon – a non-metallic element found in minerals and rocks.

Silt – soil particles between clay and sand that range in diameter from 0.002 to 0.05 mm.

Siltstone – a *sedimentary rock* comprised of *silt*-size particles cemented together.

Slaking (soil) – the partial breakdown of soil aggregates in water due to the swelling of clay and the expulsion of air from pore spaces.

Soak – a water supply structure constructed by excavation in an area receiving *seepage* or where the *watertable* is close to the surface. The *spoil* is sometimes used to construct a *dam wall* to capture *run-off* in addition to the *seepage*.

Sodic (soil) – soil in which the *subsoil* has a high exchangeable sodium percentage (ESP >6 in sodic soils, >15 in highly sodic soils). Sodic soils can be structurally unstable and plant growth may be adversely affected. Clays in sodic soils disperse when exposed to water and are highly erodible. Low *permeability* is often a feature.

Soil matrix – the framework of solid particles that make up a soil.

South-West Agricultural Region – the area inland from the main areas of State Forest and west of pastoral country in the south-west corner of Australia. The area includes the Western Australian *woolbelt* in the western portion and the *wheatbelt* in the eastern portion.

Spoon drain – a form of surface drain that is 3-4 metres wide, approximately 0.3 m deep and can be suitable for removing excess water from cropping land. Also known as a ‘U-drain’.

Spoil – soil, sediment, rock or other waste material produced as a result of excavation.

Stomata – microscopic pores on the surface of the leaves of a plant through which gas and vapor transfer with the atmosphere takes place. Stomata is the plural of stoma.

Subsoil – the lower part of the soil profile. In the agricultural region of WA, the lower layer/s are usually higher in clay and lower in organic matter than the upper layers (or topsoil). The subsoil is usually referred to as the B horizon/s and most typically begins at depths of 0.3–0.6 m.

Sub-surface drainage – systems that are designed to intercept and remove water stored in the saturate state below the soil surface.

Surface drainage – systems that are designed to intercept and remove excess surface water. Surface drainage works include *spoon drains* and *W-drains*.

Surface flow – a term used to describe the movement of water across the ground surface as *run-off* or stream flow.

T

Texture (soil) – proportion of gravel, sand, *silt* and clay in a soil. Heavy texture implies a higher proportion of smaller particles such as clay, while lighter texture involves more larger particles such as sand.

Throughflow – shallow, lateral *groundwater* flow, usually above a *perching* layer.

Time of concentration – the time required for water to flow from the farthest point in a *catchment* to a point of interest, either the *catchment* outlet or the location of a proposed or existing water control structure.

Transmissivity – the rate at which water is transmitted through a 1 metre wide slice across the entire depth of an *aquifer*. Transmissivity is recorded in units of square metres per day (m^2/day). It provides a better comparison of the possible yield of an *aquifer* than saturated *hydraulic conductivity* because it takes into account the saturated thickness of an *aquifer*.

Transpiration – the process by which water is absorbed from the soil by plant roots, is transported through the plant and is removed from the leaf surface by *evaporation*.

U

U-drain – see '*spoon drain*'.

V

V-drain – an excavated channel that is shaped like a 'V' with its sides meeting at the base.

Vadose zone – the portion of the soil profile above the permanent *watertable* (zone of saturation). Water in this zone is stored under unsaturated conditions, but saturation may occur temporarily in some areas (e.g. saturation following heavy rainfall as water moves down towards the *watertable*). The vadose zone is also known as the unsaturated zone or the *zone of aeration*.

Valley floor – a general term for the nearly level, lower part of a valley.

Vegetative cover – plants that cover the ground surface. Includes *grasses*, herbs, trees, shrubs and crops. Vegetative cover usually protects the soil from *erosion* and increases *evapotranspiration* rates.

W

Water balance – the relationship between input, storage and output within a hydrological system. If the amount of water entering the system is the same as the amount leaving, then storage remains constant and the system can be considered to be in equilibrium. Where input exceeds output, the water balance becomes altered and the amount of water stored in the system increases. Conversely, the balance can be altered as storage decreases in response to output exceeding input.

Water erosion – the detachment and transport of soil particles by water leading to the wearing away of the land surface.

Water harvesting – the capture, diversion and storage of fresh water from *surface* or *sub-surface flows*. Water harvesting often involves the construction of *dams*, *banks*, *drains* and/or *roaded catchments*.

- Water use (plant)** – describes the uptake of water from the soil by a plant. Most of this water is then *transpired* into the atmosphere.
- Waterlogging** – a condition in which a high or *perched watertable* is detrimental to plant growth. This inhibits the exchange of soil gases with the atmosphere.
- Watertable** – the upper surface of a body of *groundwater* occurring in an *unconfined aquifer*. At the watertable, pore water pressure equals the atmospheric pressure.
- Watertable, regional** – the upper surface of *groundwater* in a *regional aquifer*.
- Waterway** – a natural or constructed *drainage* line used for water disposal. Waterways run up and down a slope (not on a surveyed *gradient*). Artificial waterways are constructed to safely transport excess water from *grade banks*, grade furrows and *interceptor drains*. They should be designed so that they can handle *peak flows* and the channel should have a broad, flat or slightly dished floor. The term waterway is also applied broadly to all the surface water bodies (including creeks, rivers, lakes and estuaries) that are connected by stream flow.
- W-drain** – a form of surface drain in which the *spoil* is mounded between two shallow channels so that there is nothing impeding water flow from the surrounding flats. W-drains are approximately 3 m wide and 0.3 m deep and can be built with a grader or bulldozer.
- Weathering profile** – a section of soil and *regolith* formed by the weathering (physical disintegration, chemical decomposition or biologically induced changes) of rock on the Earth's surface over a long period of time of geological stability. In the south-west, deep weathering usually resulted in the formation of *laterite* and the weathered profile is usually referred to as the *lateritic profile*.
- Wheatbelt** – the eastern portion of the South-West Agricultural Region that is dominated by *broadacre* cereal cropping. The wheatbelt is characterised by low rainfall, subdued *landscape* and a relatively deep weathering profile.
- Wilting point** – traditionally defined as *soil water potential* at which plants (crops) will wilt and not recover (-15 bars), in reality it is a property of the soil and the plant. Sometimes referred to as the permanent wilting point. The difference between *field capacity* and wilting point defines the soil water storage freely available to plants for *transpiration*.
- Woolbelt** – the western portion of the South-West Agricultural Region that is dominated by wool production, lies inland from the main areas of State Forest and stretches from Bannister to Rocky Gully and east to the *Meckering Line*.

Z

- Zone of aeration** – the portion of the soil profile above the permanent *watertable* (*zone of saturation*). Water in this zone is stored under unsaturated conditions, but saturation may occur temporarily in some areas (e.g. following heavy rainfall as water moves down towards the *watertable*). The zone of aeration is also known as the *vadose zone* or the unsaturated zone.
- Zone of saturation** – an area below the ground surface that is permanently saturated. This zone is usually relatively deep below the surface and is thick, containing large volumes of water. The zone of saturation lies below the *watertable* in *unconfined aquifers*, and below the *aquitard* in *confined aquifers*.

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