SOIL BASICS

KATANNING

JANUARY 10TH 2015

Terra Perma Design
permaculture education & design

Soil Hugger Intro

- My background
- My future
- My blog – The Soil Hugger's Journey
- The information to be presented today will be freely available at:

www.terraperma.com.au

Soil Intro

- Soil should be considered and treated as a single, but large living organism.

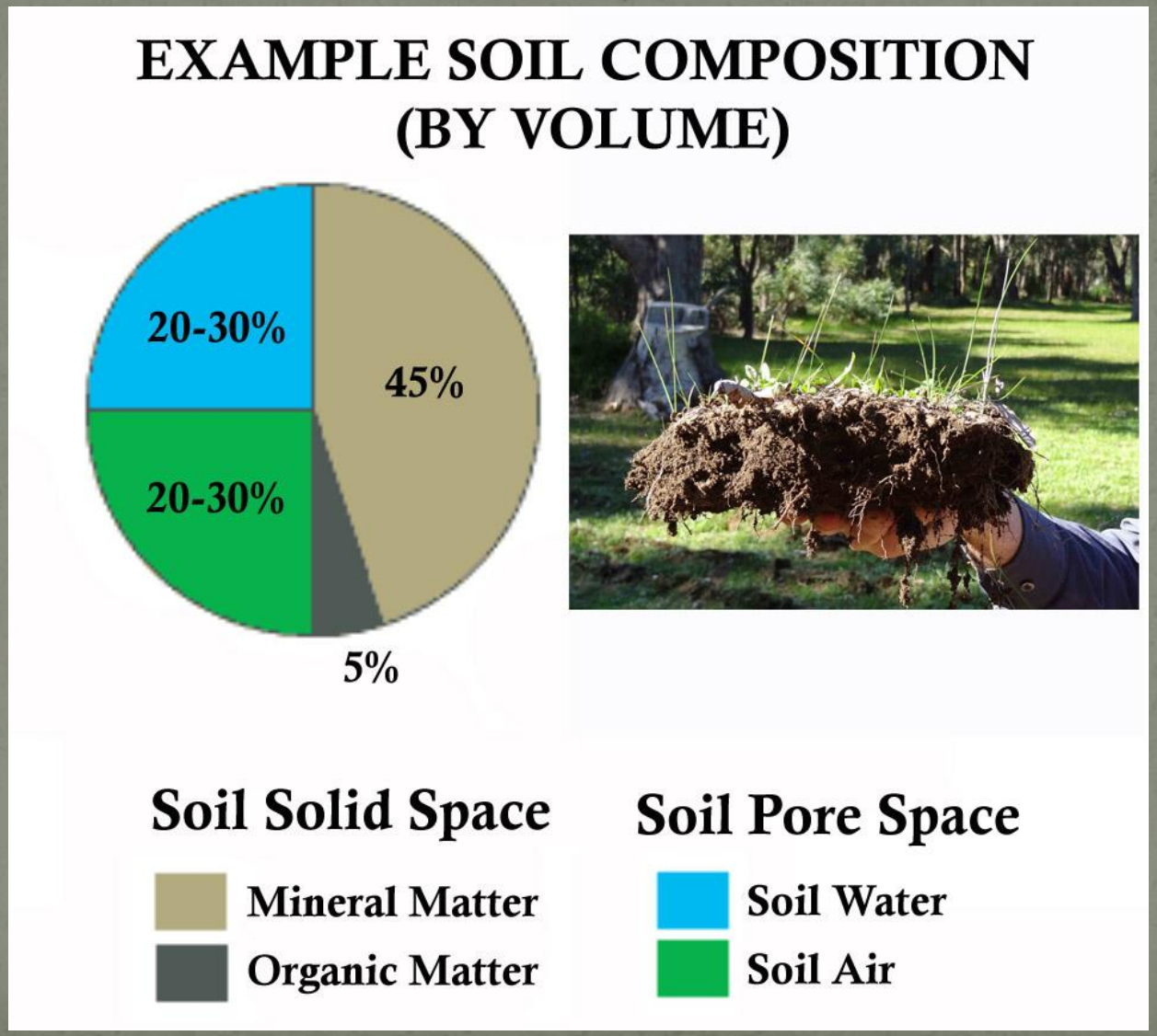
- Needs (similar to the human body) -
    - water, air, nutrition source
    - building blocks / structure to house it in
    - a stable balance of smaller creatures to fight disease, to aid nutrient digestion and to perform many other processes to maintain overall health.

- To resuscitate the soil so it can help kick start a long term, productive and self sustaining garden, it takes an understanding of all these needs and an appreciation of how the individual parts of the soil work together as a whole.

- What we'll run through:
    - Soil Composition – what makes up 'soil'
    - Soil Properties – how it behaves
    - Brief look at Katanning Specific Soil and Resources
    - Soil Resuscitation – what can we do
    - The Plan from Here – let's get practical.

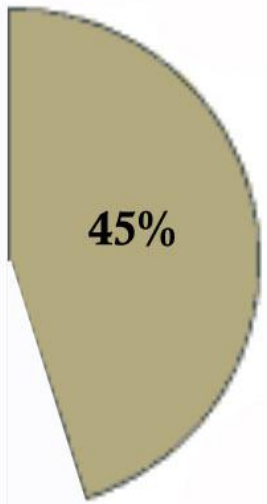
Soil Composition
- What makes up ‘soil’? -

Soil Composition - Overview



Soil Composition – Minerals/Nutrients

MINERAL MATTER



Soil Solid Space

Mineral Matter

Macro Nutrients - required by plants in large amounts.

Nitrogen (N) - for proteins, hormones, chlorophyll, vitamins and enzymes.
Too little - yellowing of the leaves, less yield and stunted growth.

Phosphorus (P) - for seed germination, photosynthesis, protein formation and growth/metabolism in plants.
Too little - purple stems and leaves; less yield and stunted growth.

Potassium (K) - for formation of sugars, starches, carbohydrates, protein synthesis and cell division throughout the plant.
Too little - mottled, spotted, curled, scorched or burned look to leaves.

Sulphur (S) - for amino acids, proteins, vitamins, enzymes and chlorophyl production. It imparts flavour to many vegetables.
Too little - light green leaves.

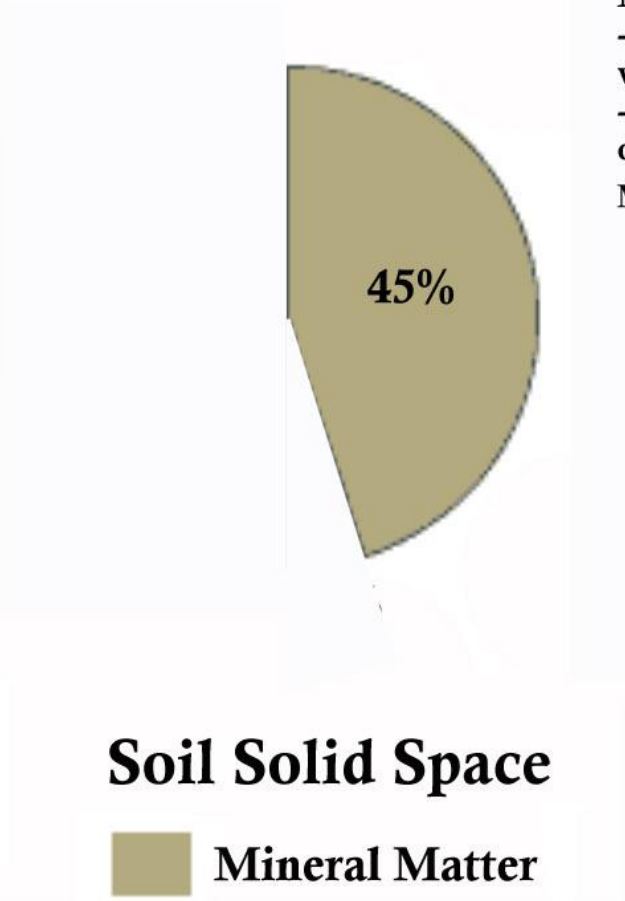
Magnesium (Mg) - for chlorophyll molecule structure, plus carbohydrates, sugars and fat production. Is essential for germination of seeds.
Too little - chlorotic, yellowing between veins of older leaves; drooping.

Calcium (Ca) - activation of enzymes, cell walls structure, water movement and cell growth and division. Some plants need Ca to take up N and other minerals.
Too little - stunting/distortion of new growth; black spots on leaves and fruit. Yellow leaf margins may also appear.

(Reference: : Life Sciences Vol I, Ahuja, M, 2006; http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mt/water/?cid=nrcs144p2_057473 http://soils.missouri.edu/tutorial/page1.asp)

Soil Composition – Minerals/Nutrients

MINERAL MATTER



Micro Nutrients (or trace elements)

- Essential (Ess) micronutrients are where the plant is unable to complete its lifecycle without it.
- Beneficial (Ben) micronutrients can compensate for the toxic effects of other elements or can replace a mineral nutrient in function not directly related to plant metabolism.

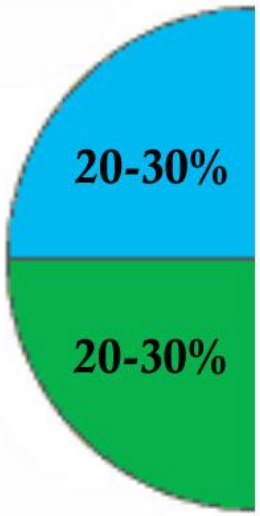
Missing the beneficial elements for a plant will just result in poor performance.

Iron (Fe, Ess) - pale leaf colour initially then yellow leaves and large veins.
Manganese (Mn, Ess) - leaves have green veins & rest lightens to white before leaves are shed.
Boron (B, Ess) - kills terminal buds. Leaves are thick, curled and brittle. Fruits, tubers and roots are discoloured, cracked and flecked with brown spots.
Zinc (Zn, Ess) - irregular leaf colouring. (Zinc deficiency leads to iron deficiency)
Copper (Cu, Ess) - die back of the shoot tips, and terminal leaves develop brown spots.
Molybdenum (Mo, Ess) - plant growth ceases. Seeds may not form completely. pale green leaves with rolled or cupped margins.
Chlorine (Cl, Ess) - wilting, stubby roots, chlorosis (yellowing) and bronzing.
Nickel (Ni, Ess) - may fail to produce viable seeds.
Sodium (Na, Ess) - osmotis (water movementement) and ionic balance in plants.
Cobalt (Co, Ben) - nitrogen deficiency symptoms.
Silicon (Si, Ben) - more vulnerable to insect/disease/fungus attack. Poor heat and drought tolerance. Helps protect against Fe and Mn toxicity.

(Reference: : Life Sciences Vol I, Ahuja, M, 2006; http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mt/water/?cid=nrcs144p2_057473 http://soils.missouri.edu/tutorial/page1.asp)

Soil Composition – Pore Spaces

PORE SPACES



Pore spaces are the gaps between all mineral and organic materials. These pores contain the critical elements for all life within the soil:

Carbon (C), Hydrogen (H), Oxygen (O) - In combination as Air and Water.

These spaces represent the pathways of water drainage and air flow, which in turn represents the major flow of soluable nutrients, and migration of bacteria, fungi, etc.

The spaces themselves are influenced by the larger life within the soil (worms, ants, nematodes etc) as well as activity on top of the soil which leads to compaction or decompaction via tilling.

It is the edges of the particles or roots that border these gaps where the fauna colonies thrive.

Soil Pore Space

- Soil Water
- Soil Air

(Reference: : http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mt/water/?cid=nrcs144p2_057473)

Soil Composition – Organic Content

ORGANIC MATTER

It is said that "Soils are home to over one fourth of all living species on earth, and one teaspoon of garden soil may contain thousands of species, millions of individuals, and a hundred metres of fungal networks." However experience has shown that, with extensive human effort and some chemical based farming practices, it can also contain none at all!

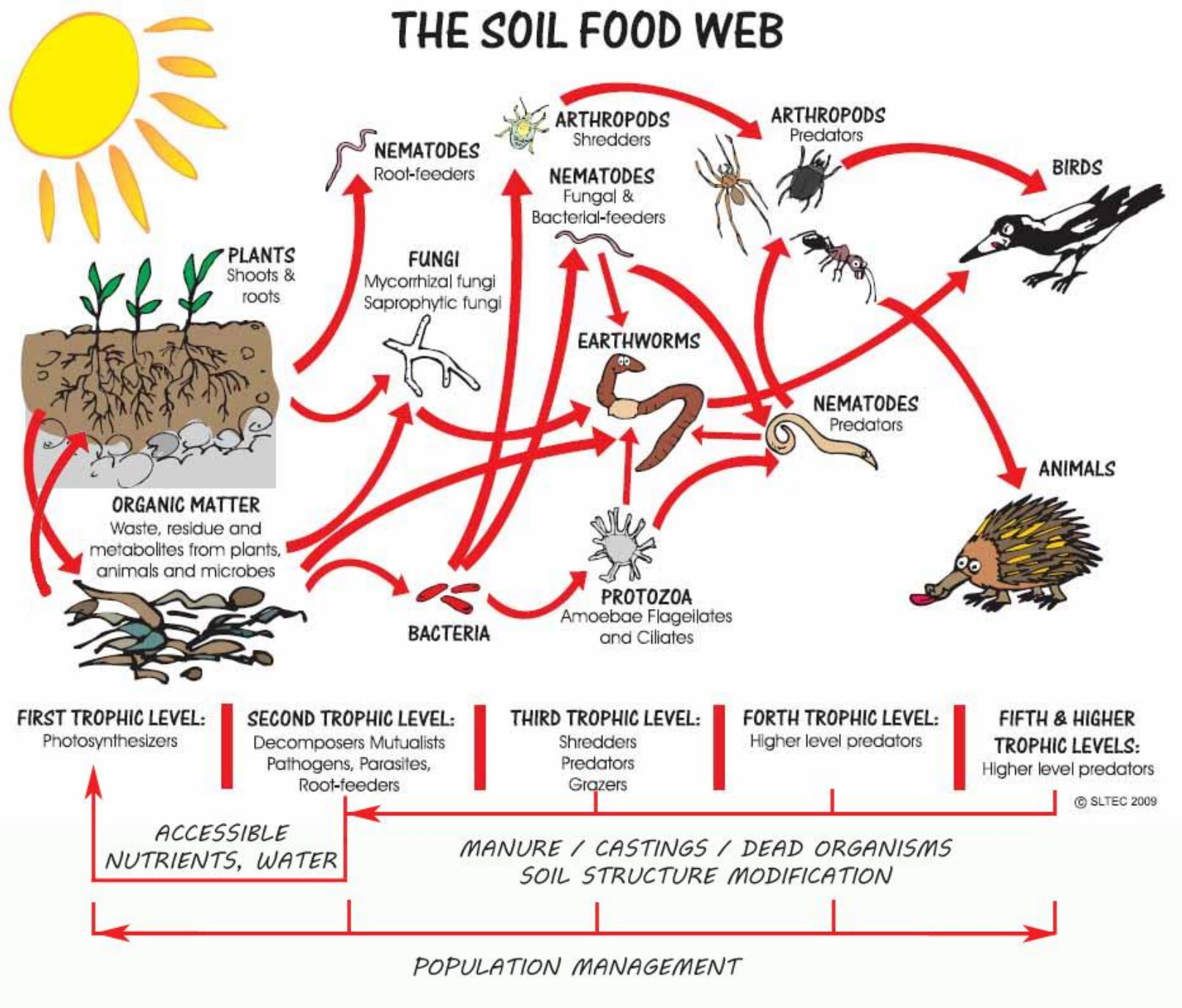
Plants, due to their ability to make their own energy (Autotrophs), kick off the **Soil Food Web** and provide those who cannot (Heterotrophs) with food to survive.

5%

Soil Solid Space

Organic Matter

(Reference: : ec.europa.eu/environment/archives/soil/pdf/biodiversity_report.pdf; http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mt/water/?cid=nrcs144p2_057473 http://soils.missouri.edu/tutorial/page1.asp)



(Reference: http://sltec.com.au/sustain-gro/, Soil Hugger's adaptation)

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Plants, due to their ability to make their own energy (Autotrophs), kick off the **Soil Food Web** and provide those who cannot (Heterotrophs) with food to survive.

(a) Chemical Engineers - (e.g. the bacteria, fungi and protozoans) - decomposes organic matter (mainly plantae and animalia, but also microorganisms) into nutrients in a suitable form for plants and animals to utilise them.

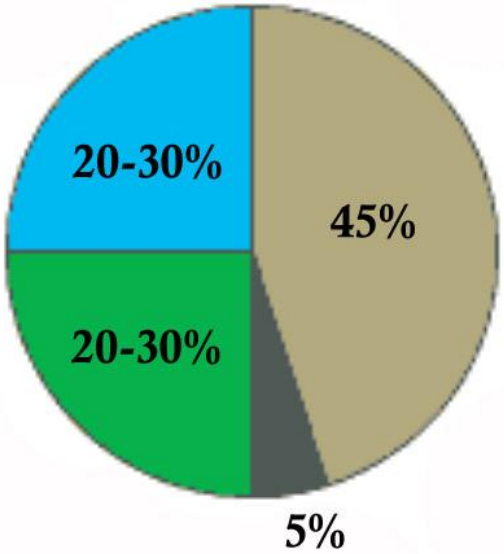
(b) Biological Regulators - (defined as the small invertebrates - e.g. nematodes, mites etc) These guys act as predators/eating machines, which devour their way through: living plant material (roots); bacteria and fungi (to mineralise nutrients contained in the microbe bodies as per (a)); protozoa, algae and other invertebrates or organisms (grubs, weevils, wasps, even slugs); and other nematodes, mites etc. The population controllers.

(c) Ecosystem Engineers - (e.g. Earthworms, ants, and other "Animalia" kingdom life) modify or create habitats in the soil by changing its structure - clumping and compaction versus creating holes/pores. These different environments present ideal conditions for very different types of microbial activity as well as delivering additional resources (manure/castings/dead bodies) to locations within the soil - when typically us humans can only add to the top layer. Increased holes leads to a greater air holding capacity which supports the organisms suited to those conditions, but also greater water holding potential.

(Reference: : ec.europa.eu/environment/archives/soil/pdf/biodiversity_report.pdf; http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mt/water/?cid=nrcs144p2_057473 http://soils.missouri.edu/tutorial/page1.asp; Teaming with Microbes - The Organic Gardener's Guide to the SOil Food Web, Lowenfels, J and Lewis, W, 2011))

Soil Composition - Recap

EXAMPLE SOIL COMPOSITION (BY VOLUME)



Soil Solid Space

- Mineral Matter
- Organic Matter

Soil Pore Space

- Soil Water
- Soil Air

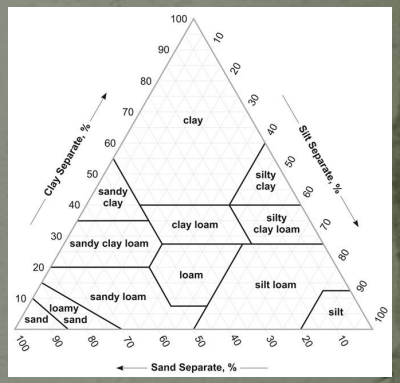
Soil Properties
- How ‘soil’ behaves -

Soil Properties

- Texture –
- Structure
- Density
- Porosity
- pH
- Consistency
- Temperature
- Colour
- Resistivity

Relative volume % of each MINERAL particle size:

- larger rock fragments - granules, pebbles, cobbles/stones, etc - >2mm
- Sand - 0.05mm to 2mm
- Silt - 0.002 to 0.05mm
- Clay - <0.002mm



Balancing Surface Area with Pore Space (Microbial Living Space with Water holding)

Rock Melon
Peas
Poppy Seeds

Soil Properties

- Texture –
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But what happens on those surfaces that is so important……

- Water adheres to these surfaces (surface tension, capillary action, adhesive forces, particulate charges etc all causing attraction) – i.e. the soil holds more water.

- Gases and dissolved chemicals within or passing through the pore spaces are "attracted to and absorbed by mineral particle surfaces" – i.e. the soil can retain more nutrients

- Weathering occurs on the surfaces releasing elements into the soil – the particles themselves deliver more minerals etc

- Soil life tends to colonise and thrive on the surfaces – i.e. more soil life.

- (Elements of the Nature and Properties of Soils, Brady, N.C. and Weil, R.R., 2004)

Soil Properties

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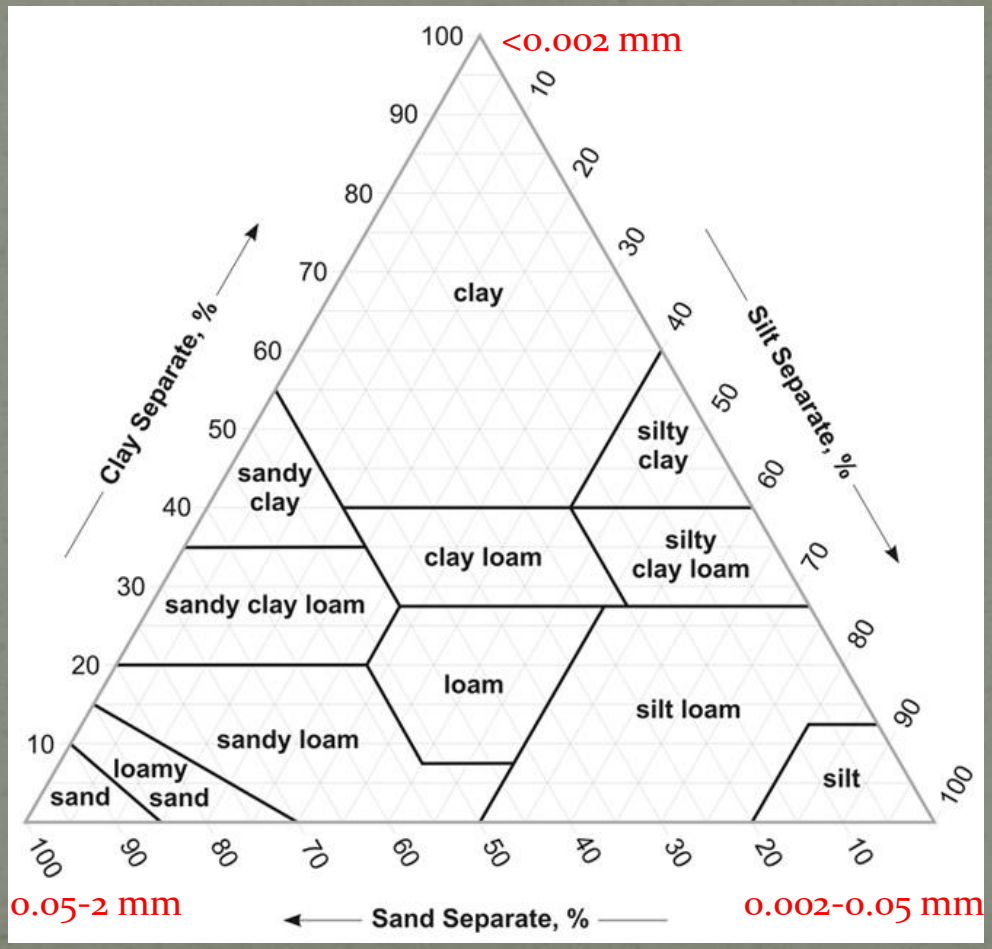
Relative volume % of each MINERAL particle size:



- http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/kthru6/?cid=nrcs142p2_054311

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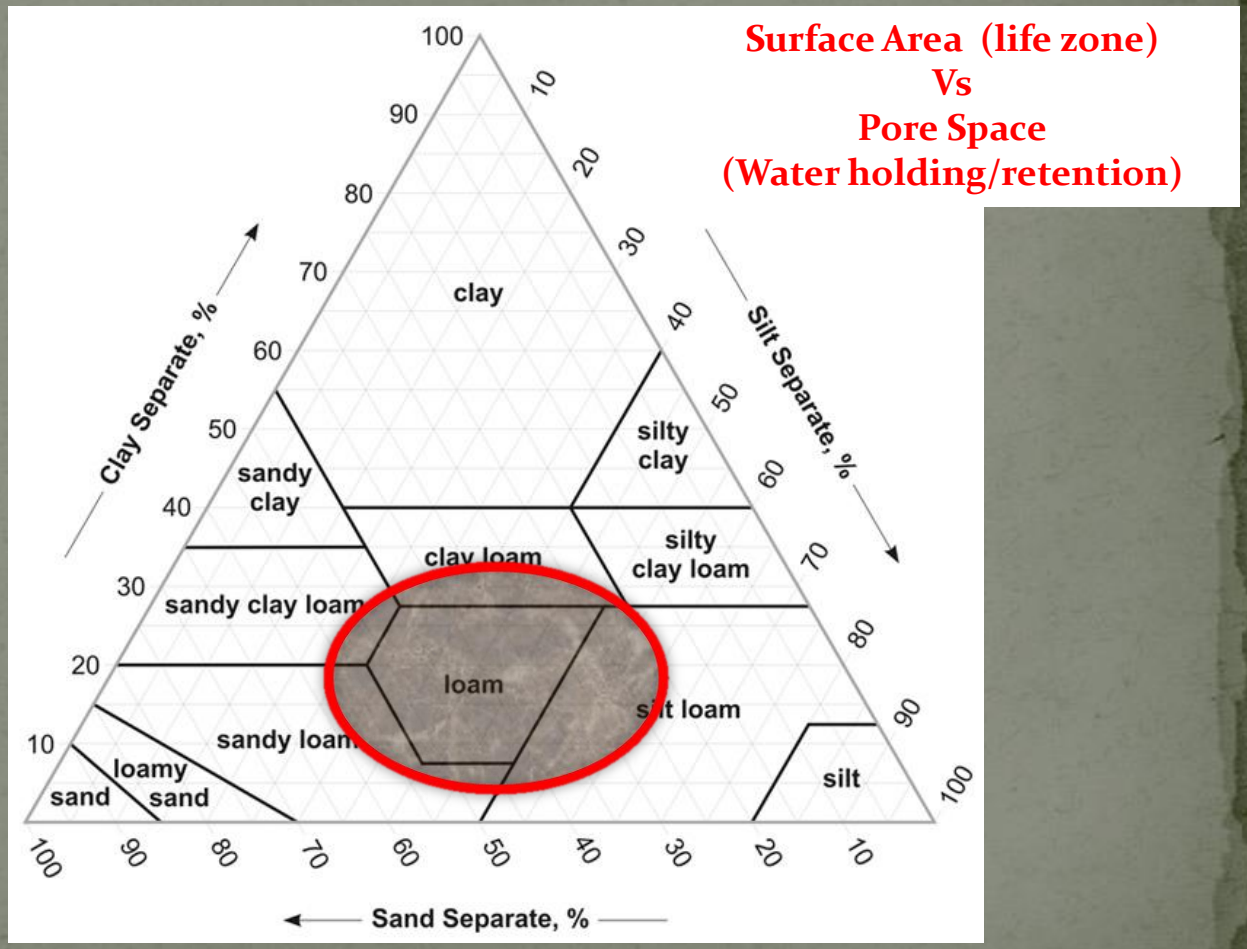

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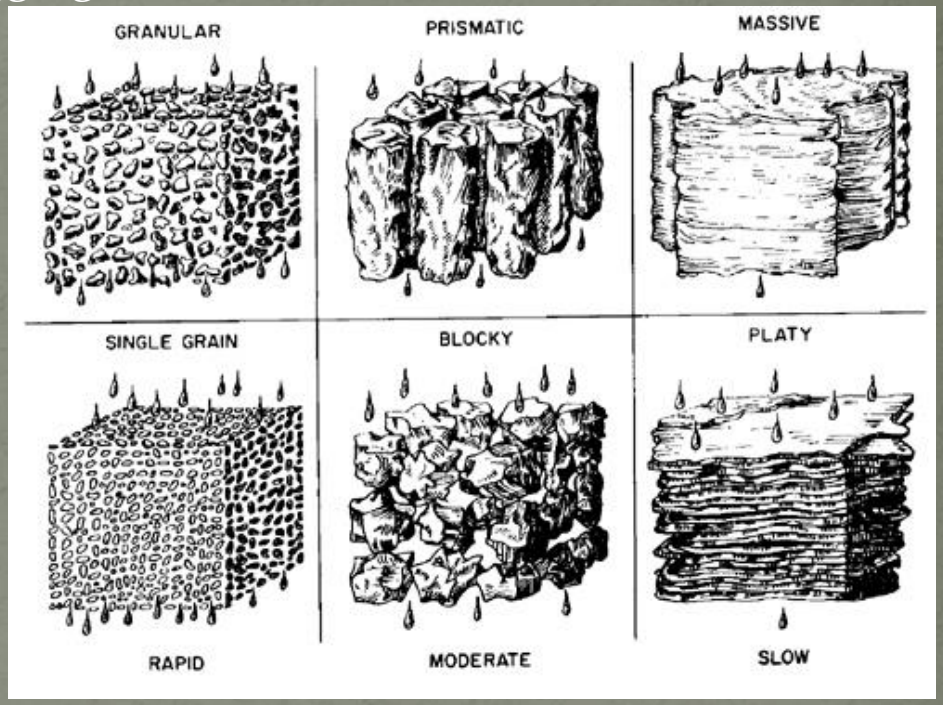
Soil Properties

- Texture
- Structure -
- Density
- Porosity
- pH
- Consistency
- Temperature
- Colour
- Resistivity

Looking at the shapes the particles form when clumped together as aggregates.
Structures:



- (Elements of the Nature and Properties of Soils, Brady, N.C. and Weil, R.R., 2004)

Soil Properties

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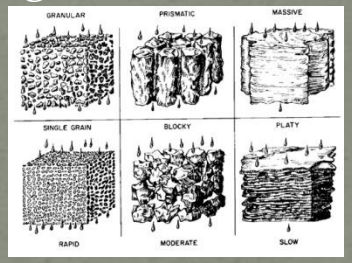

How aggregates form:

- Soil microorganisms excretions – binding soil particles together.
- Fungi filaments (called hyphae) – tying particles together.
- Roots excrete sugars – help bind minerals.
- Electrostatic attraction between soil particles.

- (Elements of the Nature and Properties of Soils, Brady, N.C. and Weil, R.R., 2004; http://www.ext.colostate.edu/mg/gardennotes/213.html)

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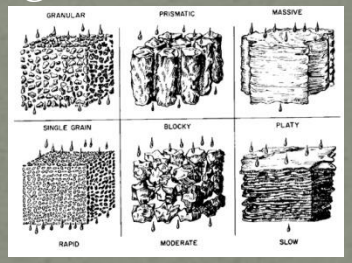

Structure can influence:

•**Infiltration** - ability to accept rainfall, moisture availability.

•**Water Retention** - ability to hold moisture, time exposure of roots.

•**Aeration** - plants need air to grow. Compacted or waterlogged plants fail to thrive.

•**Friability**– the ability of the soil to be broken into finer particles with little force… i.e. good seed/soil contact when planted, but allows the seedling stem and root to easily pass through the soil.

•**Soil Strength** – the dry dense surface crust that can form or other impediment which can restrict plant emergence and root growth.

- (Elements of the Nature and Properties of Soils, Brady, N.C. and Weil, R.R., 2004)

Soil Properties

- Texture
- Structure
- Density -
- Porosity -
- pH
- Consistency
- Temperature
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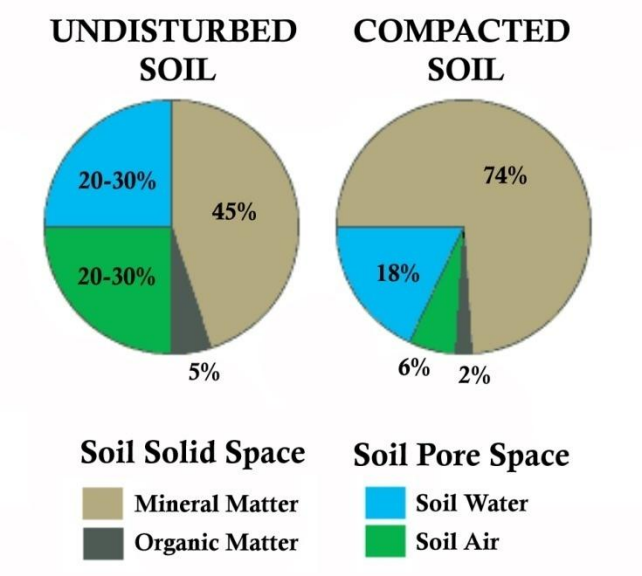
Compaction (high bulk density) Vs Tilling



High bulk densities restrict root growth by limiting the Pore Space (water and air), available surface area (the living space for soil fauna) and the act of compaction damages roots and fauna.

- (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mt/water/?cid=nrcs144p2_057473)

Soil Properties

- Texture
- Structure
- Density -
- Porosity -
- pH
- Consistency
- Temperature
- Colour
- Resistivity

Tilling in urban yards:

- Breaks the Fungi filaments (called hyphae) which:
  - would otherwise hold the soil particles together in aggregates, which has the benefit of:
    - allowing water to be held longer adjacent to roots.
    - reducing the removal of nutrients as the bulk water drains through.
    - reducing or eliminating erosion.
  - deliver more distantly available nutrients to the plant roots in exchange for root exudates which it consumes as food.

- (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mt/water/?cid=nrcs144p2_057473)

Soil Properties

- Texture
- Structure
- Density -
- Porosity -
- pH
- Consistency
- Temperature
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Tilling in urban yards:

- Breaks the Fungi filaments
- Inverts the soil layers and hence changes the air ratio available deeper in the soil which:
    - increases the short term microbial activity increasing the rate of carbon breakdown and release it to the atmosphere. This carbon will take time to replace especially deep in the soil.
    - effects the balance of fauna in the soil (microbes and hence higher forms of life are no longer at a steady state), reducing the soil's ability to resist pests and disease.
    - can cause exposure of deeper soil life to predators and unfavorable conditions (e.g. earth worms)

- (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mt/water/?cid=nrcs144p2_057473)

Soil Properties

- Texture
- Structure
- Density -
- Porosity -
- pH
- Consistency
- Temperature
- Colour
- Resistivity

Tilling in urban yards:

- Breaks the Fungi filaments
- Inverts the soil layers

- The gardener has one less job!

- Leaving the roots of annual or aged perennial crops leaves carbon (food) deep in the soil to keep the fauna happy while the next plant grows.

- Tilling changes the pore spaces (some areas end up more compacted, other less) - pore spaces <30 µm, the water / particle attraction forces are greater than the gravitational force acting to drain the water.

- (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mt/water/?cid=nrcs144p2_057473)

Soil Properties

- Texture
- Structure
- Density
- Porosity
- pH -
- Consistency
- Temperature
- Colour
- Resistivity

Soil pH refers to the acidity (<7) or alkalinity (>7) of the soil. It represents the relative amount of H^+ ions. Hydrogen ions are made present due to the dissociation of water, the activity of plant roots, and chemical weathering reactions. i.e. both within the organic mater and in the mineral "pieces of soil pie".

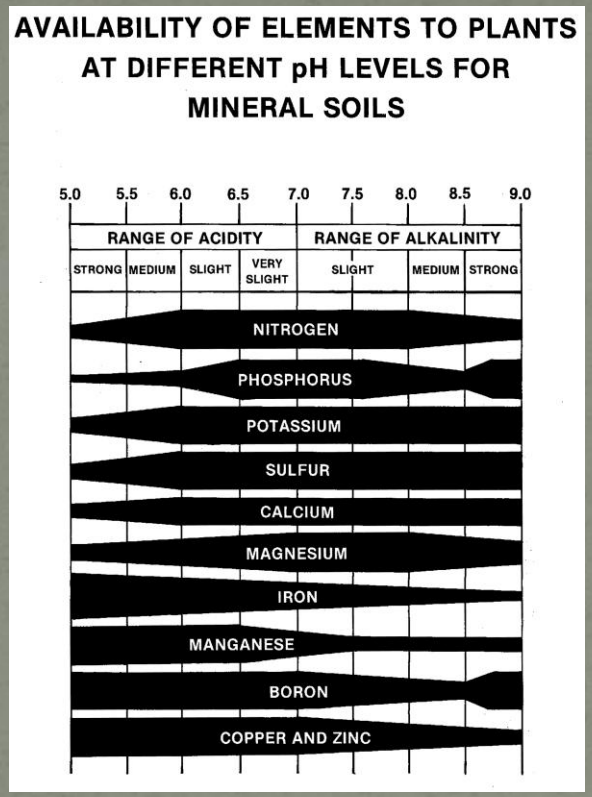
The addition of chemical addition tends to cause more significant short term fluctuations in pH whilst the application of organic matter migrates pH gradually and is regulated by the bacteria who thrive within a limited pH range.

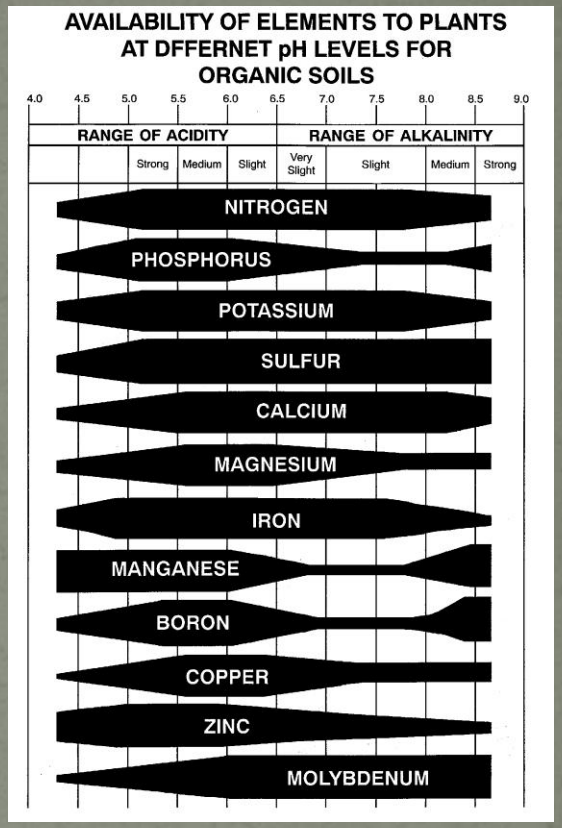
Optimum soil fertility is typically pH neutral (6.0-7.2).

- (Reference:)

Soil Properties

- Texture
- Structure
- Density
- Porosity
- pH - minerals
- Consistency
- Temperature
- Colour
- Resistivity





The wider the band the more available the nutrient is to the plant. I.e. you can add all the nutrients you like to the soil, but with an extreme pH the plants might not be able to access it.

- (Reference: http://www.spectrumanalytic.com/doc/library/articles/soil_buffer_ph)

Soil Properties

- Texture
- Structure
- Density
- Porosity
- pH - life
- Consistency
- Temperature
- Colour
- Resistivity

In very general terms:

- Bacteria like a neutral/7 pH and are depleted <5 or >9.

- Fungi prefer acidic/5 pH, but can exist between 2-7.

- Organic matter mineralization is accelerated as neutral pH is approached due to better microbial activity linked to happy bacteria.

- Nitrification and nitrogen fixation are also inhibited by low pH.

- (Reference: http://www.spectrumanalytic.com/doc/library/articles/soil_buffer_ph)

Soil Properties

- Texture
- Structure
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- pH - life
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"Typically, Western Australian soils have a pH range between 4 and 8.5. In the metropolitan area, soils are more alkaline near the limestone-based coastal sands. Soils further inland and in most agricultural areas are naturally acidic."

However – we'll go through the pH testing later.

- (Reference: http://www.spectrumanalytic.com/doc/library/articles/soil_buffer_ph)

Soil Properties

- Texture
- Structure
- Density
- Porosity
- pH
- Consistency
- Temperature
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- Resistivity

Consistency – Is a measure of how the soil behaves wet, moist and dry conditions – the sausage or ball test – which more relates to use in dams or road bases.

Temperature - Extremes of temperature impact soil life. (Whilst we can't control the air temperature, protecting exposed earth from the sun's heat of the winter frost is critical in protecting the life within.

-More organic matter means more heat holding, darker colour and more decomposition – increasing temperature.

-Cover the soil across all seasons with living protection (ground covers, bushes, trees etc) in the long term or mulch in the short term.

-More moisture leads to evaporative cooling in heat of the day.

-Tilled soil is more prone to extremes - cold air able to infiltrate and greater exposure to solar radiation.

Soil Properties

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Colour – Is a science in itself.
- The easy end of the spectrum is that more organic content and/or the more moisture, the darker the soil looks. However other colours can be linked to mineral presence.

Soil Properties

- Texture
- Structure
- Density
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Mineral	Formula	Size	Munsell	Color
goethite	FeOOH	(1-2 m m)	10YR 8/6	yellow
goethite	FeOOH	(~0.2 m m)	7.5YR 5/6	strong brown
hematite	Fe_2O_3	(~0.4 m m)	5R 3/6	red
hematite	Fe_2O_3	(~0.1 m m)	10R 4/8	red
lepidocrocite	FeOOH	(~0.5 m m)	5YR 6/8	reddish-yellow
lepidocrocite	FeOOH	(~0.1 m m)	2.5YR 4/6	red
ferrihydrite	$Fe\ (OH)_3$		2.5YR 3/6	dark red
glauconite	$K(Si_xAl_{4-x})(Al,Fe,Mg)O_{10}(OH)_2$		5Y 5/1	dark gray
iron sulfide	FeS		10YR 2/1	black
pyrite	FeS_2		10YR 2/1	black (metallic)
jarosite	$K\ Fe_3\ (OH)_6\ (SO_4)_2$		5Y 6/4	pale yellow
todorokite	MnO_4		10YR 2/1	black
humus			10YR 2/1	black
calcite	$CaCO_3$		10YR 8/2	white
dolomite	$CaMg\ (CO_3)_2$		10YR 8/2	white
gypsum	$CaSO_{4\times}\ 2H_2O$		10YR 8/3	very pale brown
quartz	SiO_2		10YR 6/1	light gray

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Resistivity - how poorly the soil conducts electrical currents which is dependent on moisture, temperature and salt content. Without the science behind the influence of each factor and an ohm meter on hand, this property provides very little insight for us.

Soil Objective Summary

- To cut a long story short, most of the physical properties measure (or are worked upon to determine) the aeration of the soil; the ability of water to infiltrate and to be held in the soil; and the nutrient availability within the root zone of the plants we wish to nurture.

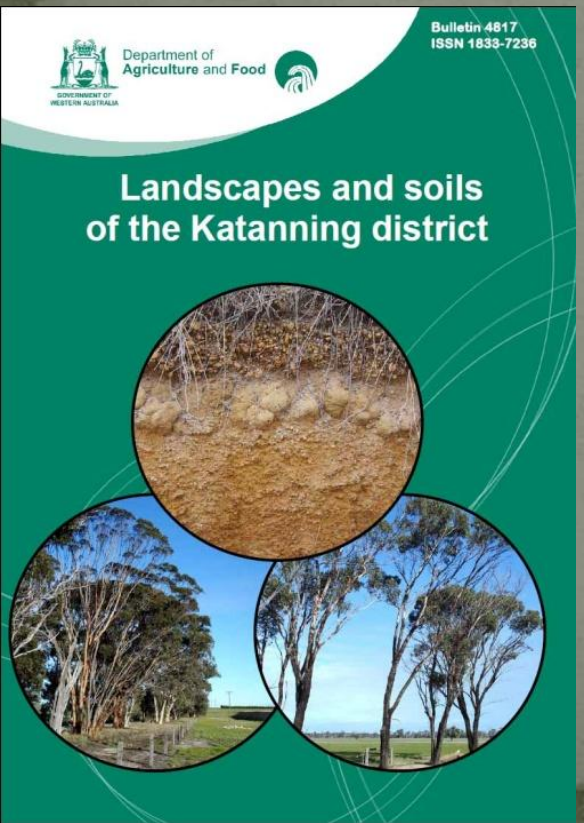
- Our goal should be as close as is practical to:
  - Loamy soil; with lots of nutrients and a high organic content to make those nutrients available; with medium density (not compacted), and covered to protect it from damaging forces (solar radiation, frost, larger order predators, compaction mechanisms…)
  - Once established the system should require limited input of energy and mineral sources.

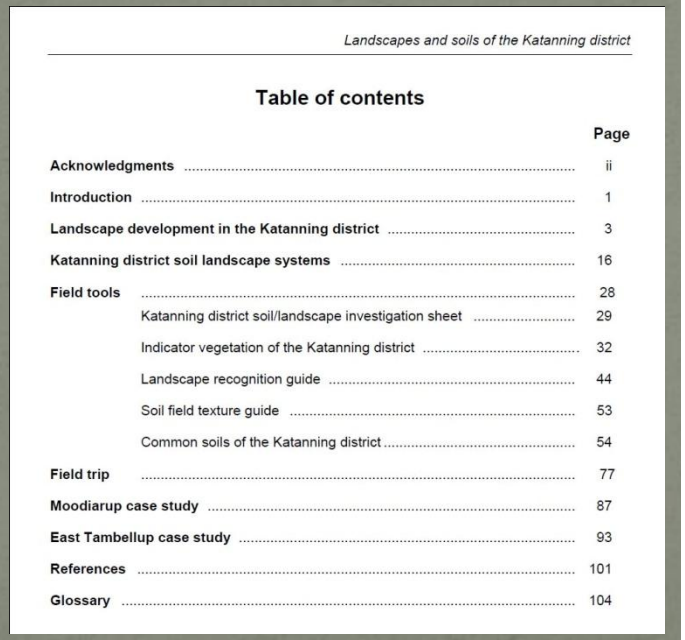
Katanning Specific Soil and Resources

Katanning Specific Soil and Resources

KEY FREE RESOURCES AVAILABLE ON LINE:

http://archive.agric.wa.gov.au/objtwr/imported_assets/content/lwe/land/ka_booklet_web_part1.pdf (2007) (or just google: katanning native soil)





Landscapes and soils of the Katanning district

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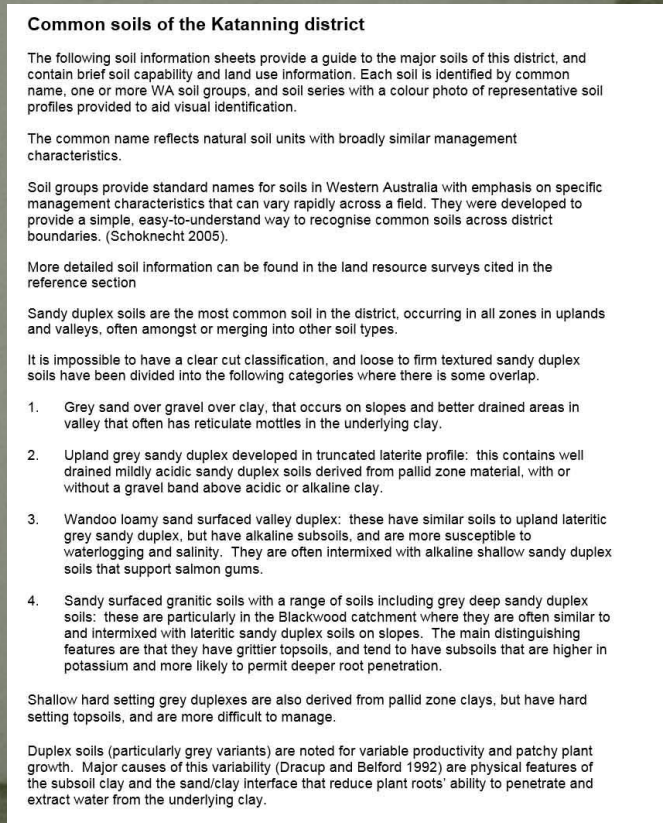


Common soils of the Katanning district

The following soil information sheets provide a guide to the major soils of this district, and contain brief soil capability and land use information. Each soil is identified by common name, one or more WA soil groups, and soil series with a colour photo of representative soil profiles provided to aid visual identification.

The common name reflects natural soil units with broadly similar management characteristics.

Soil groups provide standard names for soils in Western Australia with emphasis on specific management characteristics that can vary rapidly across a field. They were developed to provide a simple, easy-to-understand way to recognise common soils across district boundaries. (Schoknecht 2005).

More detailed soil information can be found in the land resource surveys cited in the reference section

Sandy duplex soils are the most common soil in the district, occurring in all zones in uplands and valleys, often amongst or merging into other soil types.

It is impossible to have a clear cut classification, and loose to firm textured sandy duplex soils have been divided into the following categories where there is some overlap.

1. Grey sand over gravel over clay, that occurs on slopes and better drained areas in valley that often has reticulate mottles in the underlying clay.
2. Upland grey sandy duplex developed in truncated laterite profile: this contains well drained mildly acidic sandy duplex soils derived from pallid zone material, with or without a gravel band above acidic or alkaline clay.
3. Wandoo loamy sand surfaced valley duplex: these have similar soils to upland lateritic grey sandy duplex, but have alkaline subsoils, and are more susceptible to waterlogging and salinity. They are often intermixed with alkaline shallow sandy duplex soils that support salmon gums.
4. Sandy surfaced granitic soils with a range of soils including grey deep sandy duplex soils: these are particularly in the Blackwood catchment where they are often similar to and intermixed with lateritic sandy duplex soils on slopes. The main distinguishing features are that they have grittier topsoils, and tend to have subsoils that are higher in potassium and more likely to permit deeper root penetration.

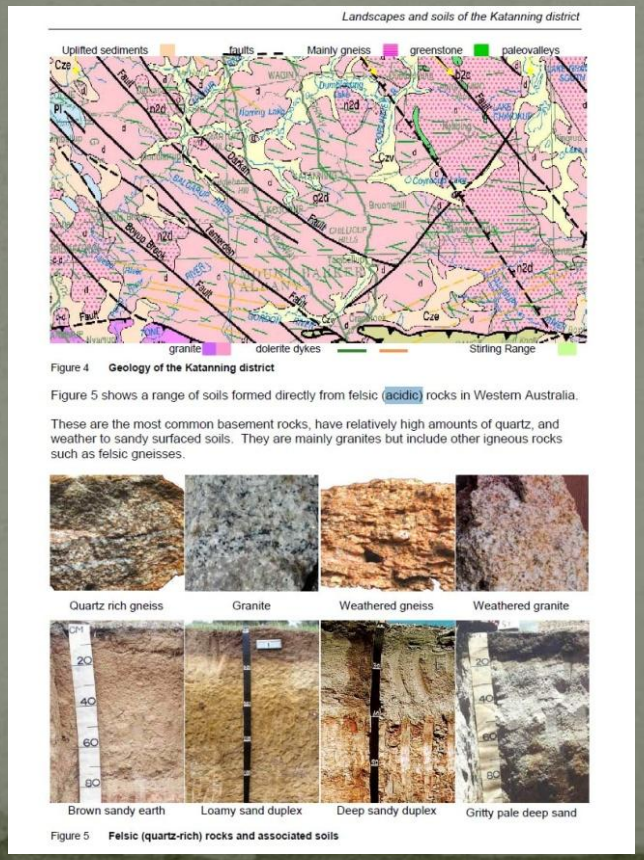
Shallow hard setting grey duplexes are also derived from pallid zone clays, but have hard setting topsoils, and are more difficult to manage.

Duplex soils (particularly grey variants) are noted for variable productivity and patchy plant growth. Major causes of this variability (Dracup and Belford 1992) are physical features of the subsoil clay and the sand/clay interface that reduce plant roots' ability to penetrate and extract water from the underlying clay.

Katanning Specific Soil and Resources

KEY FREE RESOURCES AVAILABLE ON LINE:

http://archive.agric.wa.gov.au/objtwr/imported_assets/content/lwe/land/ka_booklet_web_part1.pdf (2007) (or just google: katanning native soil)



Landscapes and soils of the Katanning district

Uplifted sediments faults Mainly gneiss greenstone paleovalleys

granite dolerite dykes Stirling Range

Figure 4 **Geology of the Katanning district**

Figure 5 shows a range of soils formed directly from felsic (acidic) rocks in Western Australia.

These are the most common basement rocks, have relatively high amounts of quartz, and weather to sandy surfaced soils. They are mainly granites but include other igneous rocks such as felsic gneisses.

Quartz rich gneiss Granite Weathered gneiss Weathered granite

Brown sandy earth Loamy sand duplex Deep sandy duplex Gritty pale deep sand

Figure 5 **Felsic (quartz-rich) rocks and associated soils**

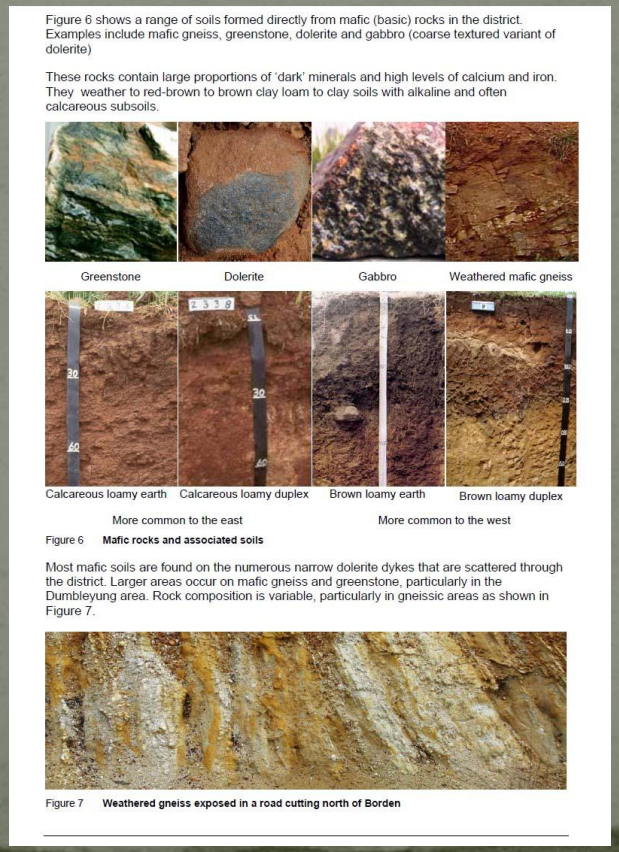


Figure 6 shows a range of soils formed directly from mafic (basic) rocks in the district. Examples include mafic gneiss, greenstone, dolerite and gabbro (coarse textured variant of dolerite)

These rocks contain large proportions of 'dark' minerals and high levels of calcium and iron. They weather to red-brown to brown clay loam to clay soils with alkaline and often calcareous subsoils.

Greenstone Dolerite Gabbro Weathered mafic gneiss

Calcareous loamy earth Calcareous loamy duplex Brown loamy earth Brown loamy duplex

More common to the east More common to the west

Figure 6 **Mafic rocks and associated soils**

Most mafic soils are found on the numerous narrow dolerite dykes that are scattered through the district. Larger areas occur on mafic gneiss and greenstone, particularly in the Dumbleyung area. Rock composition is variable, particularly in gneissic areas as shown in Figure 7.

Figure 7 **Weathered gneiss exposed in a road cutting north of Borden**

Katanning Specific Soil and Resources

KEY FREE RESOURCES AVAILABLE ON LINE:

http://archive.agric.wa.gov.au/objtwr/imported_assets/content/lwe/land/ka_booklet_web_part1.pdf (2007) (or just google: katanning native soil)

http://archive.agric.wa.gov.au/objtwr/imported_assets/content/lwe/rpm/landcap/soilguide_introduction.pdf (more technical and agricultural land focused)

http://archive.agric.wa.gov.au/objtwr/imported_assets/content/lwe/regions/sar/tr232.pdf (2001) (more technical and salinity focused, but interesting look at climate, aquifers, soil profiles across the region)

Katanning Urban Block Soil

Typically for urban block it's sandy on the surface due to the building sand brought in for block leveling and house building. If no work has been done to improve the "soil" it's likely that sand will be the dominant texture present. This may or may not be the case for you.

Several of the Katanning Native soils are described as loam and comments have been made that you have sand over clay at varying depths, so you may be in a much better starting place than the folks in the Perth area.

Different areas of your garden may also reveal different characteristics, so testing it simply and cheaply, in multiple spots can help you determine where you are starting and what might help you reach a more balanced soil texture.

We'll go through the jar shake test later as one option of testing in our practical session.

Soil Resuscitation
- What can we do? -

Soil Resucitation – Talk the Tork

- T Texture – develop texture aspiring to loam
- O Organics – Fine (compost) and Coarse (Mulch)
- R Rock Dust – Longterm Macro- & Micro-Nutrients
- K Kelp – Introduce Sea Minerals

- Chose locally available, ethical, economical substitutes to fulfill same function.

Soil Resucitation – Talk the Tork

- R Rock Dust – Longterm Macro- & Micro-Nutrients
- It is usually a mixture of granite and basalt rocks.
- Is applied at 1-2 handfuls per square metre
- Contains: Nitrogen, Phosphorous, Potassium, Calcium, Carbon, Magnesium, Sulphur, Silicon, Iron, Copper, Zinc, Manganese, Boron, Cobalt, Molybdenum and Selenium in a balanced, slow release form. (The Green Life Soil Company)
- Some producers bond it with beneficial microbes (bacteria & fungi -VA Mycorrhizae) to innoculate the soil and help establish healthy microbial populations.
- Supply Options - The Green Life Soil Company (we use), but other more local sources may be found - e.g. No Frills Fertilisers (multiple south west stockists), or local seller / granite quarry (brick factory?)….

Soil Resucitation – Talk the Tork

- K Kelp – Introduce Sea Minerals

- enhances plant productivity and quality – root and foliage growth, flowering, fruiting (evenness of fruit set, sugar content, etc).
- improves tolerance to heat, drought and frost conditions.
- assists a plants natural resistance to insect and fungal attack.
- optimises balanced plant nutrition with a broad range of trace elements and minerals.
- Supply options – Eco-seaweed, Seasol, etc

CHEMICAL ANALYSIS OF SEASOL LIQUID SEAWEED

The analysis below has been compiled from several sources including analyses carried out by the Department of Agriculture, Mt. Pleasant Laboratories, Launceston, The Government Analyst in Hobart, Tasmania and the Research School of Chemistry, Australian National University, Canberra.

Tri Indole Acetic Acid (IAA)	154 micrograms per lt	Magnesium (Mg)	0.04% w/w
Trans-Zeatin-Riboside (Zr)	7.0 micrograms per lt	Sulphur (S)	0.2% w/w
Isopentenyl Adenosine (IPA)	2.0 micrograms per lt	Cobalt (Co)	0.40 p.p.m
Trans-Zeatin (Z)	0.7 micrograms per lt	Boron (B)	13 p.p.m
Isopentenyl Adenine (IP)	16.0 micrograms per lt	Iron (Fe)	300 p.p.m
Bacterial Activity	8 x 107 cells/g	Flouride	24 p.p.m
Ash (Mineral Content)	10.2% w/w	Manganese (Mn)	5.4 p.p.m
Organic matter (Solids minus Ash)	10% w/w	Zinc (Zn)	32 p.p.m
Water Content	76.8 %w/v	Copper (Cu)	0.64 p.p.m
Total Nitrogen	0.22% w/w	Nickel (Ni)	2.0 p.p.m
Ammonia Nitrogen	156 mgm/kg	Molybdenum (Mo)	3 p.p.m
Nitrate Nitrogen	46 p.p.m	Aluminium (Al)	30 p.p.m
pH Value	9.5 – 10.5	Selenium (Se)	0.02 p.p.m
Specific Gravity 20℃	1.08	Silver (Ag)	0.02 p.p.m
Free Alkalinity (as KOH)	0.06% w/w	Vanadium (Vd)	0.08 p.p.m
Phosphorus	0.58% w/w	Iodine (I)	120 p.p.m
Potassium (K)	4.3% w/w	Mercury (Hg)	0.008 mgm/kg
Sodium (Na)	0.9% w/w	Polychlorinated Biphenyls	<0.001 mgm/kg
Chloride (Cl)	0.33% w/w		
Calcium (Ca)	0.098% w/w		

The Plan From Here
- Let’s get practical! -

Soil Practical

- Jar shake test
- pH assessment
- Garden Bed Assessment
- Compost discussion
- Garden Bed Amendment

REFERENCES:

- All the information within this slide pack has been extracted from the SOIL HUGGER'S JOURNEY, which also contains the active links, references and acknowledgements of the supplied information:

- Soil Structure: Mineral Particles and Pore Spaces http://thesoilhuggersjourney.wordpress.com/2014/08/27/soil-series-high-level-components-of-soil-episode-2-1-mineral-particles-and-pore-spaces/

- Soil Structure: Organic http://thesoilhuggersjourney.wordpress.com/2014/09/04/soil-series-high-level-components-of-soil-episode-2-2-organic-matter/

- Soil Properties: http://thesoilhuggersjourney.wordpress.com/2014/09/10/soil-series-high-level-components-of-soil-episode-2-3-resultant-soil-properties/

- All products mentioned are intended to be generic representatives and are not necessarily endorsed by Terra Perma Design.