Landcare RASH Manual

A landholders guide to the

***R*apid *A*ssessment of *S*oil *H*ealth**

General Edition v1

CARING FOR OUR COUNTRY

soil land food

Little River Big Picture
Little River Landcare Group Inc.

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How to use this Manual

The Landcare RASH Kit is a tool to help you assess your soil's health and some of its key properties. Soil is the most valuable natural asset on your property. Without a well functioning soil farm productivity will not be optimal. Use this Manual to help you objectively assess the condition of the soil on your property.

Monitoring the condition of your soil can help you can make decisions for better soil fertility and paddock management. It can help you identify any major soil constraints. Accurate monitoring of soil health can also help you track whether your management practices are maintaining your soil, improving it or degrading it. Use the Landcare RASH, along with an agronomic soil test, and allocate 1 or 2 days a year to assess and monitor the condition of one of your most important farm assets – your soil.

5 Steps to Soil Health Assessment

1. Check your equipment: Make sure you have all the equipment you need and it is all in working order. The Equipment List is on Page 5.

2. Prepare your soil sampling approach: You should have a well thought out sampling site and need to decide when and how often you will do a soil health assessment. A Guide to Sampling is on Page 6.

3. Assess each Soil Health Indicator using the guidelines in this Manual: Follow the steps in this manual to complete a soil health assessment. The assessments start on Page 8.

4. Fill in a RASH Score Card as you go: Score Card Sheets are provided in the Kit and you can make photocopies if required. As you assess each indicator just fill in the Score Card. Instructions on using the Score Card are found at the end of this manual on Page 28.

5. Tally your score and review the results: Once you have scored your soil's health and key properties you can evaluate it against benchmarks and identify areas where you may need to take management action. See the Troubleshooting Guide on Page 29.

The RASH Indicators

Soils have three key aspects to their fertility and condition: Physical, Chemical & Biological. All are important and all influence each other. A healthy soil is one that is in good condition across all three areas. This will result in a well performing soil ecosystem.

The RASH approach assesses key indicators in all three areas. It uses practical indicators that can be monitored in the field or in the farm office at little cost. These indicators can be measured fairly easily and are known to be key properties that strongly influence soil function and fertility. There are 10 main indicators used as part of the RASH approach. These are the Base Indicators.

There are other soil health indicators that you may want to add to your monitoring. These can be used to get a more detailed picture of your soil's condition. They take a bit more time and effort but can be well worth it. These include monitoring earthworm numbers, assessing dung beetles, measuring bulk density and assessing root characteristics.

Base Indicators

Physical:

Soil Texture..... page 8
Groundcover..... page 10
Soil Infiltration..... page 12
Aggregate Stability..... page 14

Chemical:

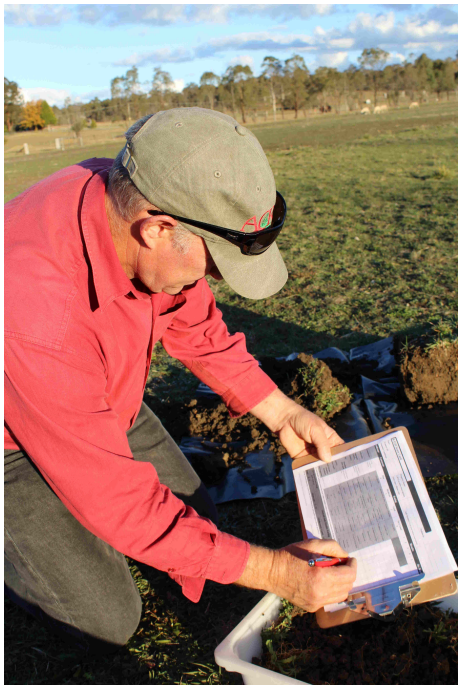
pH..... page 16
Salinity..... page 18
Sodicity..... page 20

Biological:

Root Depth..... page 22
Root Volume..... page 24
Soil Organisms..... page 26

RASH Score Card

Score Card..... page 28
Troubleshooting Guide..... page 29



Equipment

The RASH Kit that accompanies this manual contains most of the equipment you need to carry out assessments of your soil health. There are a few additional items you will need to get from your farm shed or the hardware store. These are also listed below. Before doing a RASH it is a good idea to check that all your equipment is in working order. This includes the batteries in the pH/EC meter if you are using one. Make sure that you clean all the items and pack them away into the kit after you finish. If you do not have access to a RASH kit and want to make your own then just use this list to develop your own.

RASH Kit Equipment

Mortar & Pestle - 1	**Mallet - 1**
Water Bottle Plastic - 1	**Tweezers - 2**
Paper Hand-towel	**Plastic dish/petri dish - 5**
Soap	**Plastic Tray white - 2**
Liquid Paper	**pH/EC Hand-held Meter – 1** (or pH kit)
Groundcover Worksheets	**Calibration fluids & Instructions for Meter**
Calculator - 1	**pH Colour Test Kit – 1** (or pH/EC Meter)
Pens - 5	**Screwtop Plastic Container 20 ml marks - 2**
PVC Tube with bevelled edge - 1	**Steel Ruler - 1**
Jug – 500ml plastic - 1	**Magnifying Glass/Hand Lens - 1**
Scissors - 1	**Soil Organism ID Guide**
Stopwatch - 1	**Cling-wrap**
Plastic Sheet - Heavy duty - 1	**Wooden Block – 1**
RASH Quick Guide Sheets	**RASH Score Card**

Additional Equipment

You will need to gather this additional equipment from the farm shed, the hardware store or the supermarket.

Spade	**Camera**
Mattock	**GPS**
Plastic Buckets - 10L	**Distilled Water (Rainwater is next best) - 10L**
Extra Water - 20L	**Wooden Board approx. 0.5m by 0.5m** (or larger)

Sampling the paddock for soil health

It is important to take a consistent approach to your sampling when assessing soil health. It is recommended that your soil health monitoring sites be chosen based on soil type and land management units. Soil type influences the key properties of a soil greatly. Therefore it is better not to mix up soil types when scoring soil health. It also important to separate out different areas of management as tillage, fertiliser use, farm traffic and other practices will modify soils greatly even if they are the same soil type.

Obviously farmers are mainly interested in the soil health of the actively farmed areas of the property. So this is where to set up a monitoring site. However it can be very helpful to also set up a monitoring site in a non-farmed area like natural bush or a unused area of grass as a comparison.

4 Key Steps to good Soil Health sampling

1. Locate your Monitoring Sites: You need to decide where you will set up your Monitoring Sites. Use a farm map to set up one or more Monitoring Sites in your management areas. Stay within the same soil type for each Monitoring site. Also stay within the same Land Management Unit for each site. Write the Location on the RASH Score Card.

2. Set out your sampling transect: The RASH method requires you sample at least 5 points along a transect or straight line. This needs to start from an identifiable point in the paddock/orchard or from a GPS point. You can then decide how far to space each of your 5 sample points apart. A minimum of 5 meters is recommended. In large paddocks you may have 20m between points.

3. Decide on when you will sample: At least once a year is recommended, although ideally 2 or 4 times a year is better. It is important to sample around the same time each year. In areas with seasonal rainfall it is important to pick a time of the year when the soil is not dry but is not too wet. In tropical areas it is best to sample in a drier month when the soil is not waterlogged if possible. The soil needs to be moist when sampling. A few days after good rain is ideal.

4. Take a soil sample at each sample point: At each of the 5 sample points you need to take a sample of soil to do the assessments. This involves using a spade to dig out two cubes of soil that are approximately 20cm by 20cm by 20cm following the instructions on the next page.

Sampling the paddock for soil health

Setting out your sampling transect

In this paddock of broccoli you could set your transect up along the contour to ensure similar moisture conditions.

In this pasture paddock you could lay your transect out across the slope. If it is all one soil type then you could space the 5 sample points out to 20m intervals.

In orchards and vineyards you can do 2 transects. Sample in row as well as in the inter row. In tree crops sample just under the drip line.

The key things when setting out your transect are: stay on the same soil type, stay in the same management unit, stay in the same part of the landscape, sample when the soil is moist at a similar time each year & use the same area for the transect each time.

Sampling at each sampling point

At each sample point dig out two 20cm cubes with a spade.

Carefully lift them out of the ground.

Place them on the plastic sheet or a wooden board or similar.

Use one cube to measure root depth, root volume and then soil organisms

The other can be broken up carefully to measure the other indicators.

It can be difficult to get an intact soil cube from a sandy soil. You may need to carefully lay the soil out on the sheet noting which is top and which is bottom.

Soil Texture

What is it:
The texture of a soil is an estimate of the proportion of sand, slit and clay that it contains. It gives either a gritty, silky or smooth feel to a soil depending upon how much of these three fractions are in any soil type.

Why it is important:
Texture strongly influences a number of other soil properties including structure, water infiltration, water holding capacity and ease of tillage. Texture does not readily change as it is an inherited property. The soil texture depends mainly upon the type of rock that a soil is formed from. Therefore it is important to determine texture as a first step in assessing Soil Health.

How to assess it:
Soil texture is assessed by the way soil behaves when a small handful of it is moistened and rolled into a ball or bolus in your hand. This ball is then pressed out between your thumb and forefinger to form a ribbon. The strength and feel of the bolus and the length of the ribbon formed are then rated against a chart to see what texture the soil has. There is no good or bad value with soil texture. All soil textures, sandy, silty and clayey, have advantages and disadvantages. Then write your texture on your RASH Score Card.

Equipment List

From the Kit:

Water Bottle, Hand towels, Mortar & Pestle, Soap, Pen, Scorecard

Additional:

Distilled Water, Spade,

Assessing Soil Texture

1 – Get a sample of soil in your hand. Remove any roots and gravel.

2 – Moisten the sample

3 – Shape the moist sample into a ball/bolus. Assess how well the bolus stays together. Its coherence.

4 – Shape the sample into a ribbon and press it out between thumb and forefinger. Measure the length of the ribbon that forms.

Be sure not to add too much water to the sample as you work it in your hand. As you handle it note whether it feels sandy, smooth and silky or handles like plasticine. Finally press out and measure 4 or 5 ribbons from the sample to get an average ribbon length.

Assessing your Soil's Texture

Evaluate your sample against this table for **Bolus Coherence**, **Feel** & **Ribbon length.** Then work out your texture type.

Bolus Coherence	Feel	Approx. Ribbon length	Soil Texture Type	Comments	Approx. % Clay content
Nil to slight	Sandy & gritty	Less than 15mm	**Sand**	Unable to form a ball, single grains stick to fingers	Up to 10%
Slight to just firm	Sandy	15-25mm	**Sandy Loam**	Sand grains can be seen or felt	10-25%
Firm	Smooth, spongy & may be greasy	Approx. 25mm	**Loams**	Can feel spongy or silky, no sand can be felt	20-30%
Firm to Strong	Sandy	25 -40mm	**Sandy Clay Loam**	Sandy to touch with grains visible in finer matrix	20-30%
Firm to Strong	Smooth	40-50mm	**Clay Loam**	Smooth to touch	30-35%
Strong plastic bolus	Plastic	50-85mm	**Light Clay**	Smooth like soft plasticine	35-45%
Strong plastic bolus	Plastic	Greater than 85mm	**Medium – Heavy Clays**	Smooth and handles like plasticine	Over 45%

Source: NSW DPI 2007

Write your soil's texture at the top of your RASH Score Card

Groundcover

What is it:
Groundcover is any material that covers bare soil and protects it from exposure and degradation and erosion. It can include living plants (pastures, crops and weeds) dead plant litter, mulches as well as stones and in grazing systems can also include manure.

Why it is important:
Exposed soil can be degraded in a number of ways including by wind and water erosion as bare soil is stripped away. Raindrops impacting on bare soil can also damage the structure of soil at the surface. This leads to less water infiltrating the soil and more running off. Having adequate Groundcover is the most effective way of increasing water infiltration into the soil. Having plenty of plant material, including living plants, on the soil surface also helps to maintain organic matter levels in the soil and can help increase the number of soil organisms in the soil as they use Groundcover materials as food and habitat.

How to assess it:
There are 2 quick ways to assess Groundcover in the paddock. Using the *Step Point* method you walk along your sample transect and every step you stop and look down at what is at the toe of your boot: bare soil, plant litter, plants etc. Then you mark this down. You do this 20 times along the transect. You can then tally the results up and work out a ground cover figure. The other way is to do a *Visual Estimation* method where you use a wire square quadrant and estimate visually how much cover is inside the quadrant when you place it on the ground along the transect. The end result of either method is a *Groundcover % figure* for your sample area. This can now go on your RASH Score Card.

Equipment List

From the Kit:

Liquid paper, Groundcover Worksheet, Calculator, Pen, Scorecard

Assessing Groundcover

Step Point Method

1 - Identify your transect & get the Groundcover Worksheet

2 - Mark the toe of your boots with Liquid Paper

3 - Step out along the transect

4 - At each step look down and note what you see

5 - Record each observation on the Worksheet

6 - Tally up the observations & calculate % Groundcover

Scoring Groundcover

Once you have calculated your % Groundcover for your transect on the Groundcover Worksheet, now score your Groundcover levels using the table below:

Rating	Poor	Moderate	Good	Very Good
Description	Less than 50%	Between 50% & 70%	Between 70% & 90%	Over 90%
Score	0	1	2	3

Now write the score for your Groundcover assessment on your RASH Score Card.

Soil Infiltration

What is it:
Infiltration measures how readily water will enter the soil through the soil surface. It shows how well rainfall will enter into a soil and not run-off.

Why it is important:
The more rainfall that enters the soil profile the more will be available for plant growth. So it is important that as much water enters the soil during each rainfall event. Otherwise water will run-off and can cause erosion. The infiltration capacity of a soil is also related to its structure. So the better the infiltration, the better the structure. This means the soil will have better soil air properties and plant roots will grow more easily into the soil.

How to assess it:
Infiltration is measured by pouring a known volume of water into a piece of PVC pipe that is hammered into the ground. Using a stopwatch you can time how quickly the water disappears into the ground. From this you can estimate the infiltration rate per hour of water in mm. Then score your sample using the RASH Score Card.

Equipment List

From the Kit:

PVC Tube, 500ml Plastic jug, Scissors, Stopwatch, Cling-wrap, Wood Block, Mallet, Pen, Scorecard

Additional:

Fresh water & bucket

Assessing Soil Infiltration

1 - Get all your equipment

2 - Use scissors to clear excess vegetation if required

3- Hammer in the PVC tube using a block. Make sure it is level and firmly in the ground.

4 - Lay Cling-wrap inside the tube – optional.

5 - Pour 500ml of water into the tube

6 - Carefully pull out the cling-wrap

7 - Time how long it takes the water to infiltrate

8 - Record your results on the Scorecard

Scoring Infiltration

Now you have assessed the infiltration rate you can score the soil on its infiltration.

Rating	Poor	Moderate	Good	Very Good
Description	More than 10 mins	3 to 10 mins	Less than 3 mins but more than 1 min	Less than 1 min
Score	0	1	2	3

Source: SoilCare 2007

Write the score for each assessment onto your RASH Score Card

Aggregate Stability - Slaking

What is it:
Aggregate stability refers to the ability of soil aggregates or crumbs to keep their structure when put under stress. Soil aggregates that hold together indicate that the soil structure will be stable and the soil will be in better condition. Unstable soil aggregates can either *slake*, where they fall apart into smaller crumbs; or *disperse*, where aggregates dissolve into individual soil clay particles. Clay levels and organic matter are what gives a soil good structure and reduces slaking. Dispersion, another aspect of aggregate stability, is an indicator of soil sodicity, whereby there is excessive exchangeable sodium in the clay minerals of a soil. This is measured later in the RASH approach.

Why it is important:
Good structure is important for all soil functions. It ensures better plant root growth, better soil air and water cycles and it improves the habitat for soil organisms. It also means the soil can cope better with agricultural activities like tillage and traffic without soil condition declining too much.

How to assess it:
Aggregate stability – Slaking, can be measured using the Aggregate Stability in Water Test (*ASWAT*). A small air dried aggregate of soil (3-5mm) is placed into a shallow dish of distilled water and then it is observed over a period of 10mins. It is observed for slaking over this time and then an *ASWAT score* for slaking can be given. Then score your sample using the RASH Score Card. Dispersion which measures potential sodicity in a soil can be measured at the same time. See page 20. For this test it is a good idea to air dry the soil for 24-48 hrs before hand.

Equipment List

From the Kit:

Tweezers, Plastic/Petri Dishes, Stopwatch, Wooden Board, Pen, Scorecard

Additional:

Distilled Water

Assessing Aggregate Stability - Slaking

This test and the test for Soil Sodicity (page 20) both use a similar method. They can therefore be done at the same time using the same sample. Take your soil from 10cm depth. It is better to air dry the soil for 24-48 hrs before doing this test.

1: Pour distilled water into your petri dish or plastic bowl.

2: Get a small 3 – 5 mm aggregate from 10cm depth that has been air dried for 24-48 hrs.

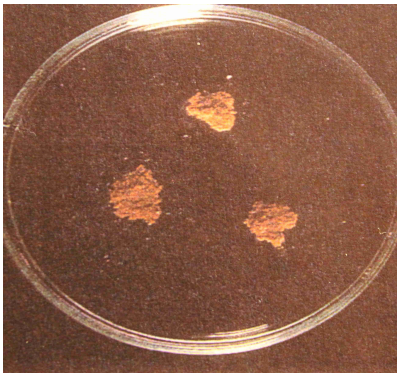
3: Carefully place it into a dish. Use tweezers if you need to.

4: Using a timer leave the sample for 10 mins. Then observe how much the slaking has occurred at the 10 min mark.

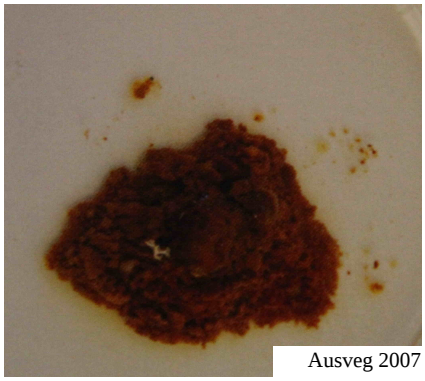
At the 10 minute mark you can assess the level of slaking you observe. Either:

Nil Slaking ***Slight Slaking*** ***Strong: Up to 70% Slaking*** ***Complete Slaking***

Then Score your sample:



Nil Slaking



Ausveg 2007

Strong Slaking

Scoring Aggregate Stability

Now you have assessed the sample for slaking you can score this soil for aggregate stability using the table below:

Rating	Poor	Moderate	Good	Very Good
Description	Complete Collapse at 10 mins	Strong: Up to 70% collapse at 10mins	Slight: Edges collapse only at 10 mins	No slaking at all at 10 mins
Score	0	1	2	3

Now write the score for each assessment onto your RASH Score Card

Soil pH

What is it:
pH is a measure of how acidic or how alkaline overall soil conditions are. It really measures the amount of free Hydrogen (H) and hydroxyl (OH) ions that are in a soil. The biochemical processes that occur daily in soils always result in a balance of acidity and alkalinity and give a soil its pH. However some natural processes as well as many agricultural practices can increase the acidity of a soil and make conditions less suitable for many agricultural crops.

Why it is important:
The pH of a soil strongly influences a number of soil processes including nutrient availability and soil biological processes. Under highly acidic and highly alkaline conditions a number of nutrients may tie up or become unavailable. Under acidic conditions some toxic elements like aluminium and manganese may become available and create toxic conditions for plant growth.

How to assess it:
pH in the field can be assessed by either using a hand-held pH meter or using a pH powder indicator kit. The hand-held meter is inserted into a beaker with a 1 to 5 soil:water solution in it. A reading is then taken off the meter. Using the powder indicator kit a sample of soil is mixed with a solution and then dusted with a reagent powder. The sample then changes colour and the colour can be assessed against a colour chart to determine the sample's pH.

Equipment List

From the Kit:

pH Test Kit or pH Hand-held Meter & Calibration Fluid, Screw Top Jar, Paper-towel, Pen, Scorecard

Additional:

Distilled water

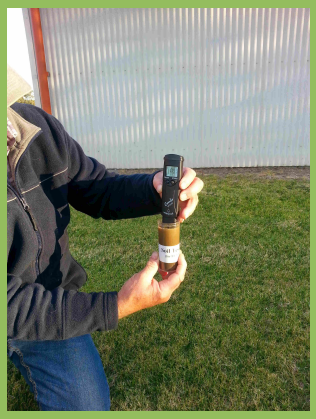
Assessing Soil pH

Using the Hand-held Meter – make sure your meter is set to measure pH

1: Calibrate your meter following the instructions in the Kit.

2: Fill the screw top jar to the 20ml mark with crushed soil from either 10 or 20cm depth with no stones and roots in it.

3: Add 100ml of distilled water. This should now be a 1:5 Soil solution. Screw on lid and shake well for at least 3 mins.



4: Let the jar settle for about 5 mins. Then insert the meter and measure the pH after the reading has stabilised.

Using the pH Colour Test Kit

1: Get a sample of soil and place on card.

2: Squirt on the indicator solution.

3: Mix in well to a thick paste.

4: Add the reagent powder onto the sample

Which ever method you use, hand-held meter or the test kit, you are aiming to measure pH at both 10cm and 20 cm depths. So take soil from both depths. When you are finished remember to record your results! Rinse and clean the equipment after use.

5: Wait 1 min and then compare the soil's colour to the chart.

Scoring pH

Now you have assessed the pH of your sample score it using the table below. Do it for both depths 10cm and 20cm:

Rating	Poor	Moderate	Good	Very Good
Description	Less than 5 or more than 8	From 5 to 5.5 or 7.5 to 8	From 5.5 to 6 or 7 to 7.5	Between 6 & 7
Score	0	1	2	3

Now write the score for each assessment onto your RASH Score Card

Soil Salinity

What is it:
Soil Salinity is a measure of how many salts are in the soil's soluble fraction. Salts in a soil can occur naturally coming from the parent materials, they can move to a site through the water cycles in a catchment or they can be added through heavy salt-based fertiliser use. When salts rise to the surface on the soil they increase the salinity of the soil. A low level of salts in a soil is normal as these are forms of soluble nutrients. Excessive salts in the soil cause problems. There are a number of types of salts including sodium, magnesium and calcium-based salts.

Why it is important:
Excessive soluble salts in a soil can adversely affect plant growth. The main effects of different salts in the soil include preventing plants from taking in water due to osmotic changes and causing toxic conditions. Some types of salts can also adversely affect soil structure.

How to assess it:
Soil salinity is assessed by measuring the soil's Electrical Conductivity (EC). In the field this can be assessed by using a hand-held EC meter. The hand-held meter is inserted into a beaker with a 1 to 5 soil:water solution in it. A reading is then taken off the meter. This gives you an $EC_{1:5}$ result. This then needs to be multiplied by a conversion factor depending on your soil's texture to give you an estimate of soil salinity as EC_e. Then you can score your sample's EC_e using the RASH Score Card.

Equipment List

From the Kit:

EC Hand-held Meter, Calibration Fluid, Screw Top Jar, Paper-towel, Pen, Scorecard

Additional:

Distilled water

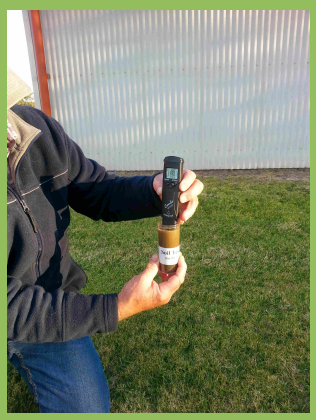
Assessing Soil Salinity

Using the Hand-held Meter – make sure your Meter is set to measure EC (Salinity). Take your soil from 10cm depth. It is better to air dry the soil for 24-48 hrs before doing this test.

1: Calibrate your meter for EC following the instructions in the Kit.

2: Fill the screw top jar to the 20ml mark with crushed soil with no stones and roots in it.

3: Add 100ml of distilled water. This should now be a 1:5 soil solution. Screw on lid and shake well for at least 3 mins.



4: Let the jar settle for about 5 mins. Then insert the meter and measure the $EC_{1:5}$ after the reading has stabilised.

If you have a Combo Meter that can measure both pH and EC in the one unit then you can use the same 1:5 soil solution to do both readings one after each other. This means that you can skip steps 2 & 3 above. You still need to rinse the equipment and calibrate for EC before taking an EC reading. It uses a different sensor on the meter.

5: Convert $EC_{1:5}$ to EC_e. Now you have to convert the 1:5 salinity result to get a Soil Salinity measurement (EC_e). Use the Conversion Table to the right.

Converting $EC_{1:5}$ to Soil Salinity EC_e

To convert your salinity measurement to a soil salinity level you need to multiply your $EC_{1:5}$ by a conversion factor depending upon your soil's texture. See the Table below.

Soil Texture	Conversion Factor
Sand	17
Sandy Loam	14
Loam	9.5
Clay Loam/ Light Clay	8.6
Medium & Heavy Clay	6.7

Example with Light Clay and $EC_{1:5}$ of 0.15 dS/m:

0.15 dS/m X 8.6 = 1. 29 ECe

Source: NSW DPI 2007

Scoring Soil Salinity

Now you have determined the Soil Salinity (**EC_e**) of your sample score it using the table below:

Rating	**Poor**	**Moderate**	**Good**	**Very Good**
Description	More than 6	Between 2 & 6	Between 1.5 & 2	Less than 1.5
Score	**0**	**1**	**2**	**3**

Now write the score for each assessment onto your RASH Score Card

Soil Sodicity - Dispersion

What is it:
Soil Sodicity is a measure of how many sodium ions are in a soil relative to the calcium, potassium, magnesium, aluminium and hydrogen ions. This sodium is in the exchangeable clay fraction of the soil. When there is excessive sodium ions in the clay fraction of the soil the soil is considered sodic. The sodium usually comes from the parent materials or rocks from which the soil forms.

Why it is important:
Excessive sodium in the soil's exchangeable clay fraction leads to the soil's structure collapsing and the clays dispersing. This can result in hard layers in the soil, crusting and hard setting surfaces on the soil. Water infiltration is reduced and less air can get into the soil. The end result is less than ideal conditions for plant root growth and soil organism activity. Sodic soils are extremely sensitive to cultivation.

How to assess it:
Soil Sodicity can initially be measured using the *Aggregate Stability in Water Test* (*ASWAT*) as used for the Aggregate Stability Slaking Test previously. A small air dried aggregate of soil (approximately 3-5mm) is placed into a shallow dish of distilled water and then it is observed at the 10 minute mark and then again at the 2 hour mark. It is observed for dispersion over this time and then an *ASWAT score* can be given for dispersion. If this test indicates that dispersion is an issue then a laboratory test is recommended to assess more accurately if the soil is sodic and will have management issues before taking further action.

Equipment List

From the Kit:

Tweezers, Plastic/Petri Dishes, Stopwatch, Wooden Board, Pen, Scorecard

Additional:

Distilled water

Assessing Soil Sodicity - Dispersion

This test and the test for Aggregate Stability (page 14) both a similar method. They can therefore be done at the same time using the same sample. Take your soil sample from 10cm depth. It is better to air dry the soil for 24-48 hrs before doing this test.

1: Pour distilled water into your petri dish or plastic bowl.

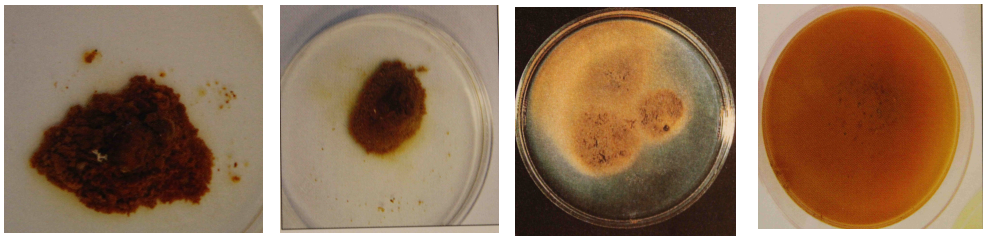
2: Get a small 3-5mm aggregate from 10cm depth that has been air dried for 24-48 hrs.

3: Carefully place it into a dish on a flat surface. Use tweezers if you need to.

4: Using a timer leave the sample for 10 mins. Then observe how much the dispersion has occurred at the 10 min mark.

At the 10 minute mark note the level of Dispersion you observe. Then leave until the two hour mark and observe again. Then score the dispersion of the sample.

5: Then observe how much the dispersion has occurred again at the 2 hr mark.



Nil **Slight** **Strong** **Complete**

Dispersion Patterns

Source Photos 1,2 & 4 above: Ausveg 2007

Scoring Soil Sodicity

Now you have assessed the dispersion of your sample score it using the table below:

Rating	Poor	Moderate	Good	Very Good
Description	Strong dispersion at 10 mins or complete dispersion at 2 hrs	Slight dispersion at 10 mins or strong at 2hrs	Slight dispersion at 2hrs	No dispersion at 2hrs
Score	0	1	2	3

Now write the score for each assessment onto your RASH Score Card

Root Depth

What is it:
Root depth is the depth in the topsoil that the majority of roots of growing plants are going to. This is the active area of soil where nutrients, water and carbon are exchanging and soil life is at its greatest. Generally the deeper the roots are growing the better.

Why it is important:
The living and dead roots of plants are important to soil health in a number of ways. They supply carbon to the soil and have a positive influence on soil processes, nutrient cycling & soil structure. The deeper that plant roots go the greater the development of topsoil and the more water and nutrients are available to plants for growth.

How to assess it:
Root depth is assessed by carefully turning your sample 20cm soil cube upside down and counting if 15 easily visible roots are reaching through to the 20cm depth. If not then trim 5cm off the bottom of the cube using a spade and a ruler. Then assess again. Do it again at 10cm if needed. Root depth is the depth where 15 easily visible roots are reaching to in the sample cube.

Equipment List

From the Kit:

Steel Ruler, Pen, Scorecard, Plastic Sheet

Additional:

Spade, Wooden Board

Assessing Root Depth

Step 1: Get a cube of soil approximately 20cm each side

Step 2: Place the cube on its side on a sheet and carefully count the roots at 20cm.

Step 3: If there are less than 15 roots at 20cm then shave off 5cm of soil with a spade. Then recount. Repeat again at 10cm if needed.

You are aiming to measure the depth at which 15 roots are clearly reaching.

In a permanent pasture you should be able to assess the Root Depth at any time during the year. Although pastures may not be growing during winter, roots from autumn growth should be present. In a cropped paddock assess growth from mid to late stages of crop growth. In an orchard assess root depth just under the drip line of the trees.

In sandy soils keeping your cube intact can be difficult! Handle it carefully.

When you are finished remember to record your results!

Source: Hardwick 2014

Scoring Root Depth

Now you have assessed the Root Depth of your sample score it using the table below:

Rating	Poor	Moderate	Good	Very Good
Description	Less than 15 roots at 10cm depth	15 roots at 10cm depth	15 roots at 15cm depth	15 roots at 20cm depth
Score	0	1	2	3

Now write the score for each assessment onto your RASH Score Card

Root Volume

What is it:
Root volume is a measure of how much of a soil's space contains roots. In a healthy soil plant roots should be able to fill much of the soil with roots as they grow. This indicates that a large portion of a soil is actively exchanging nutrients, water and carbon. Generally the more root volume the better.

Why it is important:
The living and dead roots of plants are important to soil health in a number of ways. They supply carbon to the soil and have a positive influence on soil processes, nutrient cycling & soil structure. The more soil space that plant roots fill the greater the development of topsoil and the more water and nutrients are available to plants for growth.

How to assess it:
Root volume is assessed by carefully taking 10 small aggregates (3-7mm) from your sample 20cm soil cube at 2 depths: 10cm and at 20cm. Lay each set of ten aggregates out on a plastic sheet or board. Then carefully break each aggregate open between your fingers. Observe if you can see any roots inside each aggregate as you break it. Score a point each time a root is found. Tally up how many aggregates had a root fragment inside them. Then score both the 10cm and 20cm depth out of 10.

Equipment List

From the Kit:

Plastic Tray/Wooden Board or Plastic Sheet, Pen, Scorecard

Additional:

Spade

Assessing Root Volume

Step 1: Get a cube of soil approximately 20cm each side

Step 2: Get 10 small aggregates (approx. 5cm size) from the 10cm depth and lay them out.

Step 3: Break each aggregate open and observe if roots are visible or not.

You are aiming to measure root volume at both 10 and 20 cm depth. In very heavy clay soils you may need to drop a clump of soil from a height onto a flat board to get a number of aggregates that you can use for this assessment. Use a spade to help you break open the cube if needed.

Source: Hardwick 2014

Step 4: Repeat with 10 aggregates at 20cm depth.

Scoring Root Volume

Now you have assessed the Root Volume of your sample score it using the table below. Don't forget to assess root volume at 2 depths; 10cm and 20cm:

10cm depth

Rating	Poor	Moderate	Good	Very Good
Description	0-3 out of 10	4-6 out of 10	7-9 out of ten	10 out of 10
Score	0	1	2	3

20cm depth

Rating	Poor	Moderate	Good	Very Good
Description	Nil	1-3 out of 10	4-8 out of 10	More than 8
Score	0	1	2	3

Now write the scores for each assessment onto your RASH Score Card

Soil Organisms

What is it:
As well as micro-organisms such as fungi, bacteria and protozoa, a healthy topsoil should contain a diverse range of larger organisms such as earthworms, spring-tails, ants, nematodes, mites, pot-worms, millipedes, dung beetles and a range of other insects. Many of these are visible to the naked eye. These larger organisms are called soil organisms.

Why they are important:
Soil organisms are important to soil health in a number of ways. Many of them are important in helping breakdown organic matter and the cycling of nutrients through the process called mineralisation. Others such as earthworms and dung beetles also have a positive influence on soil structure and water infiltration. Although some soil organisms feed on living plant roots and are pathogens, most do not. In fact many soil organisms are predators of pathogens and can keep their populations under control.

How to assess it:
Soil organism diversity can be assessed by visually counting the number of different types (the diversity) of organisms seen in a soil sample over a period of time. Taking an intact soil cube slice off the top 5cm, break this sample in half and spread one half out on a flat board or plastic tray so it is evenly spread out. Then observe the sample for 5mins using a stopwatch or timer. Make a note of each different type of organism seen.

Equipment List

From the Kit:

Magnifying Glass or Hand Lens, Plastic Trays, Stopwatch, Soil Organism ID Sheet, Pen, Scorecard

Additional:

Fresh water

Assessing Soil Organisms

Step 1: Place a cube on a sheet.

Step 2: Carefully slice the top 5cm of the cube off. Then cut this in half.

Step 3: Now place this sample onto a tray & spread it out.

Step 4: Allow your eyes to adjust for 1 minute and then start looking for organisms. Count the number of different types of organisms you see. Use the *Soil Organism Id Guide* in the Kit to help you.

Time yourself and spend 5 minutes looking for soil organisms such as worms, larvae, ants, mites, spiders, centipedes and beetles in the sample. These have been attracted by the roots, microbes and organic matter. Also look for pores in the soil that have been created by either roots or soil organisms. A hand lens or magnifying glass is handy for this exercise.

Use the *RASH Soil Organism ID Guide* to help you.

Not only are numbers of organisms important but so is having a diversity of organisms present. Record the number of different types of organisms you see.

Don't forget to record your observation on your score card.

Scoring Soil Organisms

Now you have assessed the Soil Organism diversity of your sample score it using the table below:

Rating	Poor	Moderate	Good	Very Good
Description	Nil seen	1 type only	2-5 types seen	More than 5 types seen
Score	0	1	2	3

Write the score for each assessment on your RASH Score Card

RASH Score Card

To complete a RASH you need to record your assessments so you can evaluate them against a benchmark and see if your soil is reasonably healthy or you need to take management action to improve it. Use the RASH Score Card to do this. Copies of these can be found in the RASH Kit or are available from Little River Landcare Inc. or Soil Land Food.

Completing the RASH Score Card

Step 1

The top of the Score Card has a section where you can fill the general details on the monitoring including date, seasonal conditions, your property, paddock names along with an ID for your monitoring point.

Date:		**Property Name:**		**Paddock:**	
Transect Id:		**GPS/Location Description**			
Seasonal Conditions		**Days since 20mm rain**		**Soil Texture** *From your texture assessment:*	

Step 2

After you have done your Texture test then fill in the soil texture box on the top of the Score Card.

Step 3

As you complete each of the Soil Health assessments you can Score the results.

Indicator	Comments	Rating				Results					Av. Score
		Poor 0	Moderate 1	Good 2	Very Good 3	1	2	3	4	5	
Groundcover	Use the Groundcover Worksheet	Less than 50%	Between 50% & 70%	Between 70% & 90%	Over 90%						
Infiltration		More than 10 mins	3 to 10 mins	Less than 3 mins but more than 1 min	Less than 1 min						

Step 4

Now fill the in score for each sample site

Step 5

Add up and average your 5 sample scores If scores are less than 2 then use the Troubleshooting Guide to look at options for improvement.

Troubleshooting Guide

If you Score Poor or Moderate on any of the Soil Health Indicators then there is an opportunity to improve your soil by implementing management practices that can improve Soil Health. Use the Table below to identify possible management practices for addressing any low soil health conditions with your soil.

Indicator	Situation	Possible Causes	Management Options
Groundcover	Low levels of surface litter or plants	Overgrazing, poor plant growth, herbicides, soil compaction, erosion, shading, excessive tillage	Strategic grazing, ripping, fertilisers or amendments, use shade tolerant plants, stubble retention, conservation tillage
Infiltration	Poor infiltration due to poor surface structure	Soil sealing, low ground cover levels, crusting, compaction, poor structure	Ripping, reduced tillage methods, cover crops, green manures, controlled traffic, pasture phase, strategic grazing
Aggregate Stability	Aggregates collapse	Low soil organic matter, sandy texture,	Use reduced tillage, cover crops, green manures, use of pasture phase, organic amendments like manure/compost, strategic grazing
Sodicity	Aggregates disperse	High levels of exchangeable sodium	Apply Gypsum, increase organic matter levels by cover crops, green manures, use of pasture phase, organic amendments like stubble, manure/compost, mulches
pH	Acidic soil	Inherent soil factors, excessive nitrogen fertilisers, low soil organic matter	Add lime or dolomite, change nitrogen fertiliser use, increase organic matter as above
pH	Alkaline soil	Inherent soil factors, low soil organic matter	Add sulphur products, increase organic matter as above
Salinity	High levels of soil salinity	Rising water table, saline irrigation water, high salt-based fertiliser use	Use pasture phase to lower water table, use salt tolerant species, change fertiliser use, shandy irrigation water, match crop to land potential
Root Depth	Shallow rooting depth	Compaction, poor pH or salinity, chemical toxicity, soil borne diseases, low fertility	Ripping, address chemical constraints as above, diverse crop rotations, add more organic matter as above
Root Volume	Low volume of roots in topsoil	Compaction, poor pH or salinity, chemical toxicity, soil borne diseases, low fertility	Ripping, address chemical constraints as above, diverse crop rotations, add more organic matter as above
Soil Organisms	Low diversity of organisms	Lack of habitat/structure, low soil organic matter, low Groundcover levels	Use strategic grazing, increase organic matter levels by cover crops, green manures, use of a pasture phase, organic amendments like stubble & manure/compost, reduce tillage, minimise chemical use, strategic grazing

Source: SoilCare 2007, Ausveg 2007, NSW DPI 2007, Pattison, Moody & Bagshaw 2010, BRG CMA 2011.

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