



FACT SHEET

Outdoor Piggery Fact Sheet Series
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SOIL MONITORING FOR ROTATIONAL OUTDOOR PIGGERIES

Soil testing is integral to operating an environmentally sustainable rotational outdoor piggery. Depending on management, soil nutrients can reach very high levels within a year or two of pigs being put onto a paddock. When nutrients are concentrated in the topsoil, these are more likely to dissolve in runoff and more will be attached to eroded soil, posing a risk to surface water quality. Elevated subsoil levels may pose a leaching risk to groundwater. Regular soil testing provides for better understanding and mitigation of environmental risks.

Nutrients accumulate in the soils of all rotational outdoor piggeries because the mass of nutrients brought in as feed exceeds the mass removed in pig liveweight gain. Australian Pork Ltd has produced a Nutrient Balance Calculator for Rotational Outdoor Piggeries that can be used to estimate nutrient additions during the pig phase and nutrient removals during the crop / forage / pasture phase. Depending on stocking density and herd composition, nutrients can quickly accumulate in the soil to high levels. The calculator provides a guide as to how quickly nutrients might build-up to levels that warrant management and is a useful tool for planning a suitable stocking density, length of pig phase and cropping rotation. However, it needs to be supported by regular soil monitoring.

Another aspect of nutrient management relates to the distribution of nutrients in the pig paddocks.

Unless the site is actively managed to promote even dunging over the whole paddock, nutrient-rich hot-spots will be present. Although these may cover a relatively small land area, there is an increased likelihood of nitrate-nitrogen leaching and soil structure decline from these during both the pig phase and the cropping phase that follows. There is also a risk of nutrient removal in runoff or as eroded soil.

To better understand changes in soil nutrient levels, soil testing should occur before a pig phase commences. This can help to confirm that the soil has suitable properties for use by pigs (refer to chapter 15 of the National Environmental Guidelines for Rotational Outdoor Piggeries (2013 Revised) revised). It also provides benchmark data for comparison with future analysis results.

Soil sampling and analysis should also occur at the end of any two-year period that includes a pig phase. For more heavily stocked paddocks, annual soil monitoring is recommended. Collecting samples from areas that are expected to be nutrient-rich (i.e. the land between where shelters and feeders have been situated) provides the best guide to environmental risk.



Soil sampling with hand auger



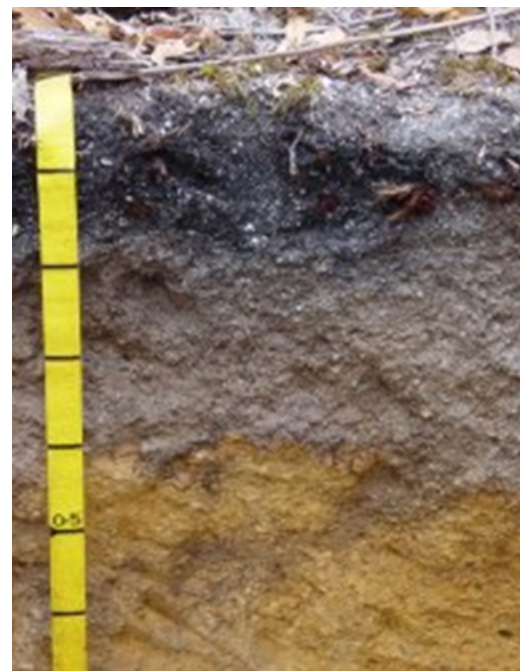
Collect one set of composite (bulked) topsoil and subsoil samples for each block of paddocks. A block of paddocks is a group of adjacent paddocks used simultaneously to run pigs. For piggeries that operate with a radial paddock system, one radial would constitute a block of paddocks. Similarly, if a piggery uses eight adjacent rectangular paddocks at a time this would constitute a block of paddocks. For each block of paddocks, compile a composite soil sample collected from at least ten holes distributed across the nutrient-rich land areas.

Soil sampling with soil rig



Sampling a representative background plot at the same time will provide baseline data for interpreting analysis results. A representative background plot is typically a 20 m diameter area located on land that has a similar soil type and is physically close to the land being monitored. Sampling the representative background plot at the same time as the pig paddocks provides a basis for comparison when interpreting soil test results. Representative background plots should be on land that has not been used for outdoor pig production, irrigated with effluent or spread with manure, or recently had fertiliser applied. Carefully note the location of the representative background plot so samples can be collected from the same location each time. For each representative background plot, compile samples for each sampling depth from soil from ten holes. If the soil was sampled prior to the use of the land for pigs, and it had not recently had fertiliser, effluent or manure applied, these results can also be considered as background levels.

Example soil profile





For both the block of paddocks and any representative background plot, sampling depths should be in accordance with the conditions of any planning or development consent, approval, permit or licence. If these do not apply, a single composite sample can be compiled for each of the following depth ranges:

- 0 to 0.1 m
- 0.3-0.6 m or 0.3 m to the base of either the root zone or the base of the soil profile (if less than 0.6 m in depth)

It is important that soil analysis parameters meet the conditions of any planning or development consent, approval, permit or licence. If this does not apply, use the soil analysis parameters specified in the National Environmental Guidelines for Rotational Outdoor Piggeries (2013) (revised):

Parameter	Depth	
	0-0.1 m	0.3-0.6 m (or to base of root zone)
pH	✓	✓
Electrical conductivity	✓	✓
Nitrate-nitrogen	✓	✓
Available phosphorus	✓	✓
Potassium	✓	✓
Organic carbon	✓	-
Exchangeable cations and CEC	✓	✓

An agronomist or soil scientist can assist in interpreting soil analysis results. Trigger levels for further investigation for some key parameters are given below:

- Salinity (EC) rating of moderate or higher: ECSE exceeding 3.8 dS/m
- Nitrate-nitrogen concentration in the subsoil exceeding:

Sand	1.2 mg NO ₃ N/kg
Sandy-loam	1.5 mg NO ₃ N/kg
Loam	1.7 mg NO ₃ N/kg
Clay-loam	2.0 mg NO ₃ N/kg
Medium clay	3.5 mg NO ₃ N/kg
Self-mulching clay	4.5 mg NO ₃ N/kg

- Available phosphorus for different methods: Colwell P

Clay <30%, pH <7	31 mg P/kg
Clay <30%, pH >7	59 mg P/kg
Clay >30%, pH <7	75 mg P/kg
Clay >30%, pH >7	85 mg P/kg

Olsen P exceeding 25 mg P/kg

Bray P exceeding 20 mg P/kg

BSES P

<30% clay	31 mg P/kg
>30% clay	131 mg P/kg

- Exchangeable sodium % (ESP) 6%

Results can be evaluated by comparison with these triggers for further investigation or with the results for a representative background plot. A soil scientist can help with further interpretation.



If interpretation of the analysis results confirms that soil nutrients are at suitable levels, the area can be used for ongoing or subsequent pig phases. If the results show high or unsuitable levels, take action to reduce soil nutrients to acceptable levels. This will generally involve destocking the land and growing and harvesting plant material from the area.

Different soil testing is recommended during the crop / forage / pasture phase to ensure the agronomic needs of the crops are being met. Because pig manure is not a balanced fertiliser, the plants will strip some nutrients more quickly than others. After a year or two, there may still be a significant phosphorus surplus over the whole paddock but nitrogen may be limiting. The situation is more complicated where significant hotspots are present. While some nutrients may become deficient on the parts of the paddock that started with less nutrients, the hot spots may still have a generous supply. For that reason, it is important to test topsoil samples from across the paddock so you are informed of the nutrient status, and fertiliser needs, of different parts of the paddock. Precision fertiliser application may be needed to ensure nutrients are applied only where they are in short supply and needed to optimise the crop yield. Regular agronomic testing during the crop / forage / pasture phase is recommended to ensure correct fertiliser decisions are made.

References and Further Reading

Australian Pork Ltd 2013 (revised) National Environmental Guidelines for Rotational Outdoor Piggeries, Australian Pork Ltd, Deakin.

Australian Pork Ltd, ND, Nutrient Balance Calculator for Rotational Outdoor Piggeries, <http://australianpork.com.au/industry-focus/environment/outdoor-production/>

Other Fact Sheets in this Series

- Developing a Nutrient Management Plan for a Rotational Outdoor Piggery
- Land and Water Protection Measures for Rotational Outdoor Piggeries
- Promoting More Even Distribution of Manure Nutrients in Rotational Outdoor Piggeries.

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