Government of **Western Australia**
Department of **Water and Environmental Regulation**

HEALTHY ESTUARIES WA

Soil improvers

Fact sheet

Retain and Sustain: Understanding phosphorus loss from sandy soils

Healthy Estuaries WA is working with landcare groups and farmers in the south-west of Western Australia to keep nutrients in soils and out of waterways. We are helping farmers trial the new practice of applying soil improvers: materials with a high phosphorus-retention capacity on grey sandy paddocks to grab and hold phosphorus for plant growth.

While phosphorus is essential for productive pastures, managing how it behaves in the soil is key to making sure it supports plant growth without ending up in our waterways. This factsheet introduces why farmed grey sands are prone to losing phosphorus and how this can be tackled using soil improvers.

How is phosphorus held in soils?

Pasture production depends on **phosphorus (P)** staying in soils in *plant available forms*. This store of phosphorus depends on the capacity of soils to chemically bind (sorb) and retain the nutrient.

Plant-available phosphorus (often measured as Colwell P) is the phosphorus in the soil that plants can access and consists of unbound **(free-P)** and bound forms. Free-P can be leached or lost with water moving over or through the soil, where it may be carried into drains, rivers and estuaries. Bound phosphorus is attached to soil particles like iron and clay, making it far more stable in the soil. Free-P is not normally measured as part of agronomic soil tests but can be readily determined by many commercial soil testing laboratories.

Why are grey sands tricky?

Retention of phosphorus in soils is mostly through chemical binding **(sorption)** onto iron and clay minerals. This is measured in agronomic soil tests through the **Phosphorus Buffering Index (PBI**) which indicates the maximum retention capacity of soils before any was added to soils. PBI is important for holding phosphorus in soils for plant growth but is a double-edged sword – with too much or too little being problematic.

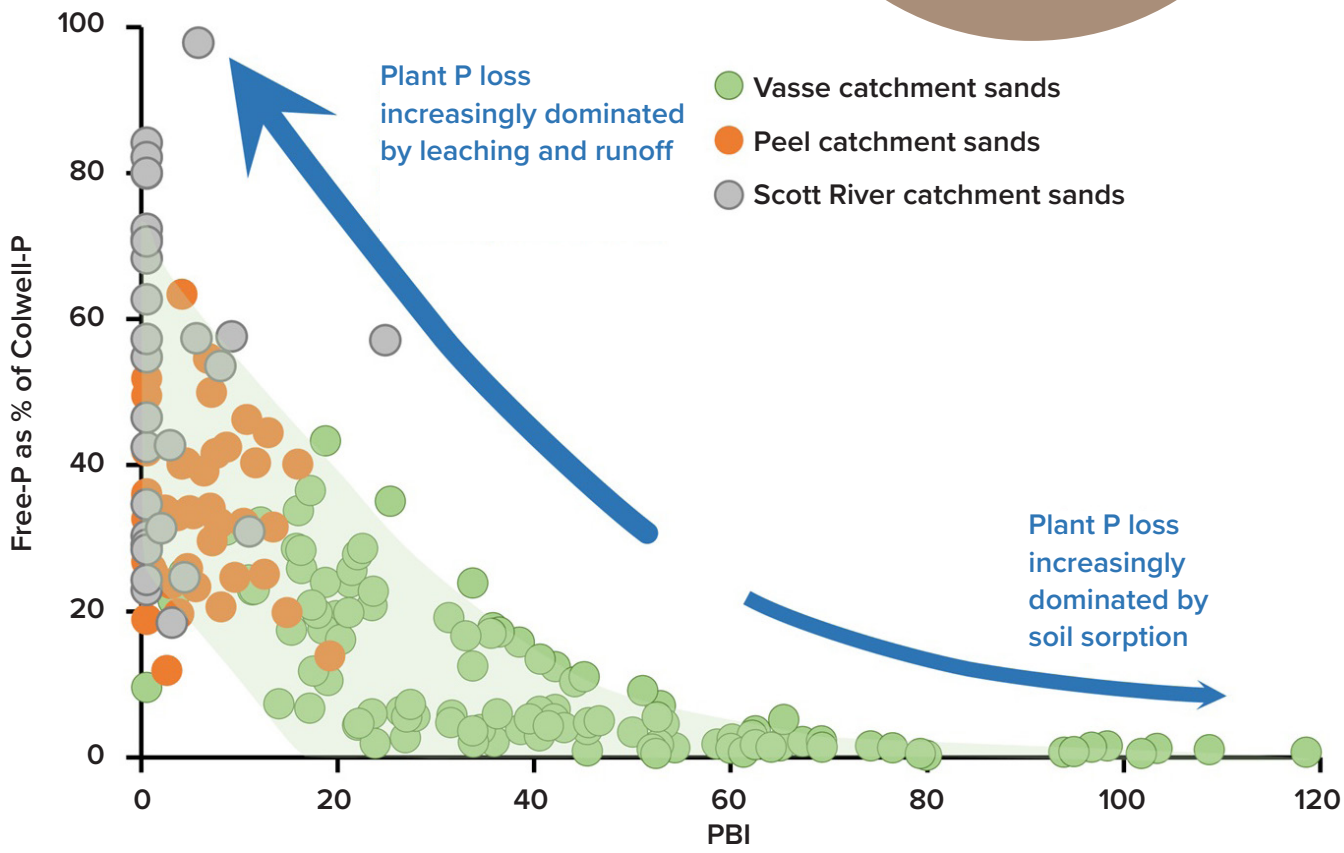
In high retention capacity soils **(high PBI)** such as gravels, red loams and clays, phosphorus slowly becomes locked within the iron and clay minerals in these soils and becomes inaccessible to plants. Farmers should keep this in mind when looking at their soil testing results.

In contrast, low P retention capacity soils **(low PBI)**, like grey sandy soils have virtually no natural capacity to hold phosphorus and a larger proportion of plant-available phosphorus remains as free-P. This means the nutrient is more prone to being leached or washed off soil surfaces with winter rains.

Grey sands/low PBI soil

Red loam/high PBI soil

More of the plant available P (Colwell P) can be present as free-P in low PBI soils - which increases the risk of loss through leaching and runoff

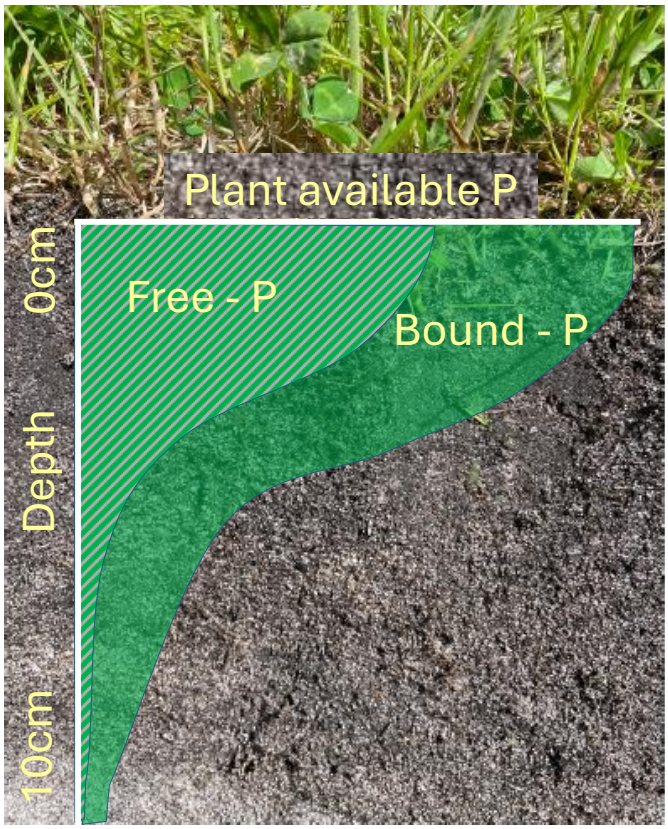


Free-P that is prone to being lost from soils can make up most of the plant-available P in low PBI sands

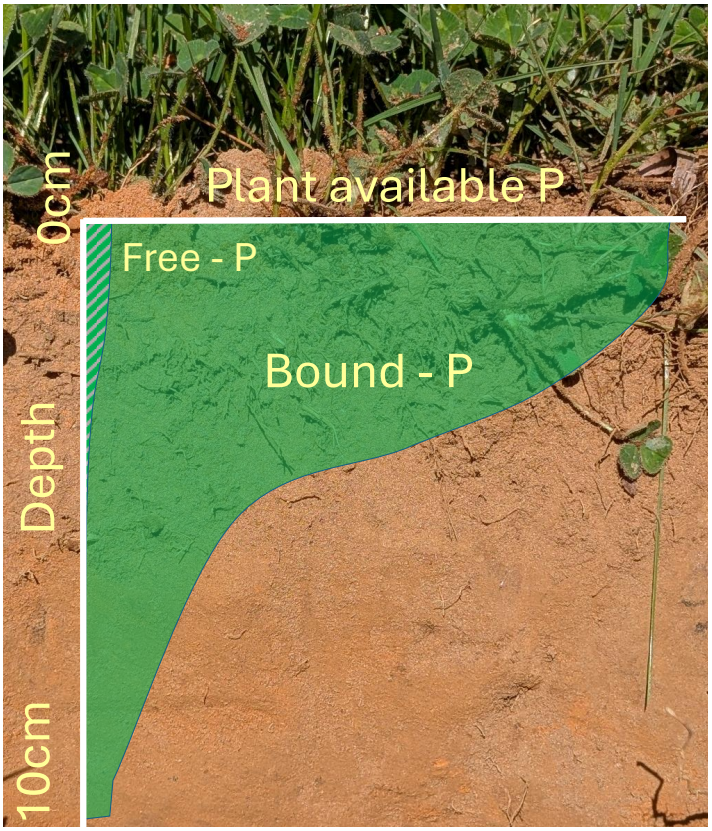
What happens at the surface of soils under pasture?

In pastures, phosphorus accumulates in the surface few centimetres of soils as a result of manure return from grazing and fertiliser applications over many years.

The phosphorus in surface layers can be more than **three times** the concentrations of underlying layers of the top ten centimetres. As the nutrient builds up, the phosphorus-holding capacity in the surface becomes saturated. Low-PBI soils cannot retain the intensive build-up of phosphorus, and it leads to the accumulation of high concentrations of free-P.



Phosphorus distribution in a low PBI sand



Phosphorus distribution in a high PBI soil

How does free-P fuel winter leaching and runoff?

The combination of high free-P and water movement through or across low PBI soils drives phosphorus loss to the environment. Phosphorus concentrations carried off the paddock are directly linked with the amounts of free-P in low PBI sands.

In higher or drier areas of paddocks, phosphorus loss mainly happens through **leaching**, where rain moves down through the soil and washes nutrients past plant roots. In low-lying areas, heavy rain on waterlogged soils can cause **runoff**, where water flows across the surface into drains or waterways. Leaching below the surface happens between these events as the waterlogging recedes.

Runoff from waterlogged sands with high free-P at the surface can result in high P losses to waterways

Iron Man Gypsum is a high iron oxide product that is effective at helping hold P in sandy soils

What can be done to reduce winter P losses from sands?

Top-dressing grey sandy soils with materials that capture and hold phosphorus helps keep free-P in soils for plant growth and reduces winter losses. This has been achieved in trials using Iron Man Gypsum™ (IMG), which improved the soils' ability to retain phosphorus in the bound, plant-available form in the surface few centimetres.

The improved phosphorus retention gradually leads to a build-up in plant available P over subsequent years. The addition of red or orange subsoil clays can also improve phosphorus retention but typically needs to be used at much higher rates and mixed into soils to achieve the same effect.

With good management of phosphorus fertiliser applications, a single application of soil improvers has benefits lasting for many years.

What this means for farmers

Using soil improvers to increase phosphorus retention can help farmers:

- **Save money** by keeping more fertiliser where plants can use it.
- **Reduce nutrient runoff** into creeks, rivers and estuaries, protecting the environment.
- **Improve soil health** in the long term.

Where to learn more

To find out more about what may work best on your property, get involved in **the Fertiliser Management Program** and contact your local landcare or catchment group. Landcare and catchment groups can provide guidance about the fertiliser management program and advise on whether soil improver opportunities may be appropriate and available for your property.

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For more information:
estuaries.dwer.wa.gov.au/strategies/innovative-remediation/soil-amendment/

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