## Phosphorus interaction in soils and water Karen.Daly@teagasc.ie





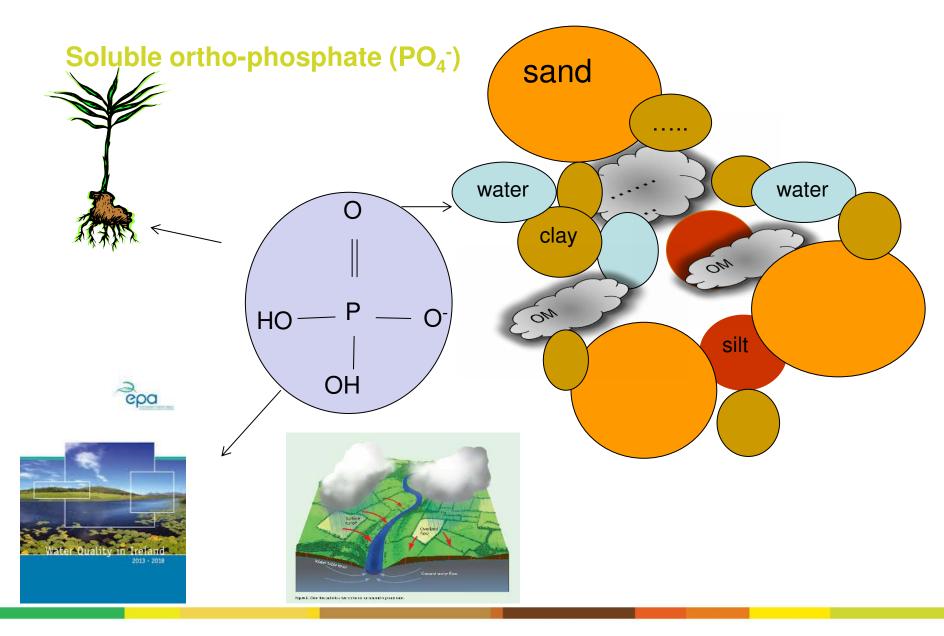
## <u>Phosphorus dynamics in soils</u>

- Phosphorus forms soil & water
- Interactions with other elements and soil properties
- What this means for build-up and drawn-down of P?

## Pinch-points for P loss on the farm

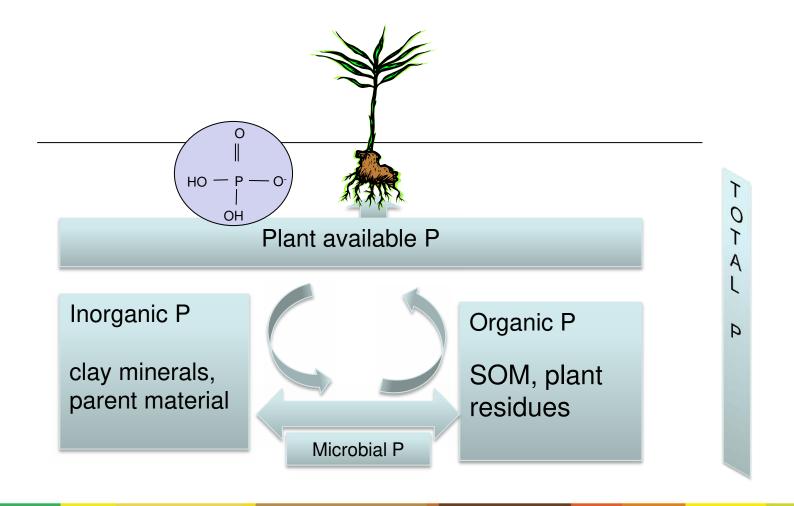
- Landscape processes & pathways
- Farm scale connectivity what P measure and where?







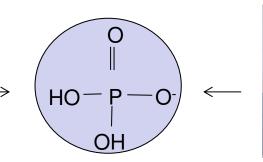
#### P in soil: A simple conceptual model of soil P cycle...unlike N!





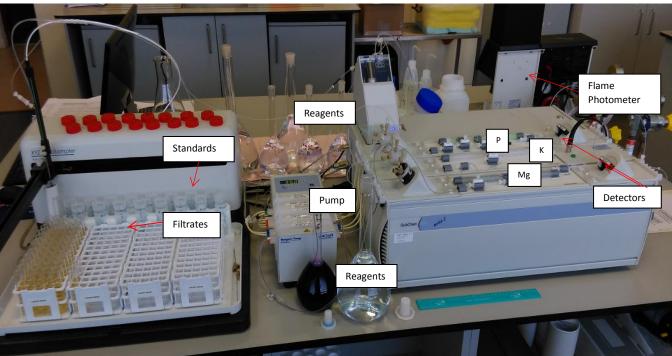












## We have connected STP with WQ



#### https://www.teagasc.ie/news--events/daily/environment/



#### Irish soils & P

#### Current methods:

Soil sampling typically every 2- 4 ha, once in 5 years.

Base decisions on few parameters Should we correct for soil type?

## P Index System

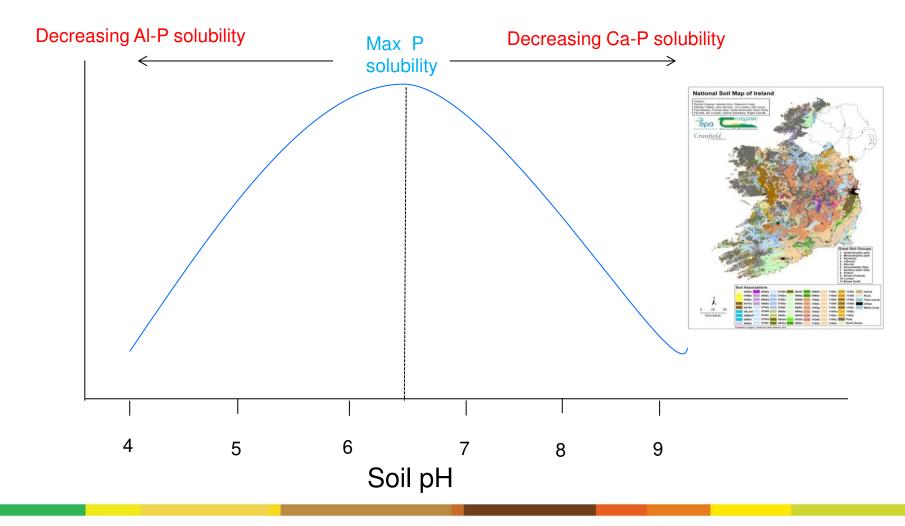
- 1: Deficient
- 2: Low
- 3: Optimum
- 4: Excessive



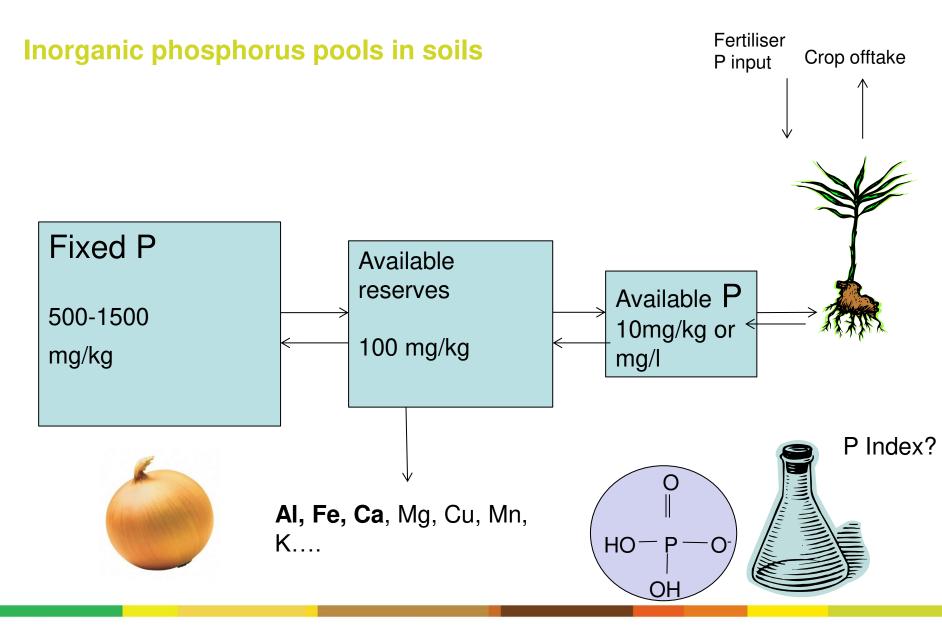




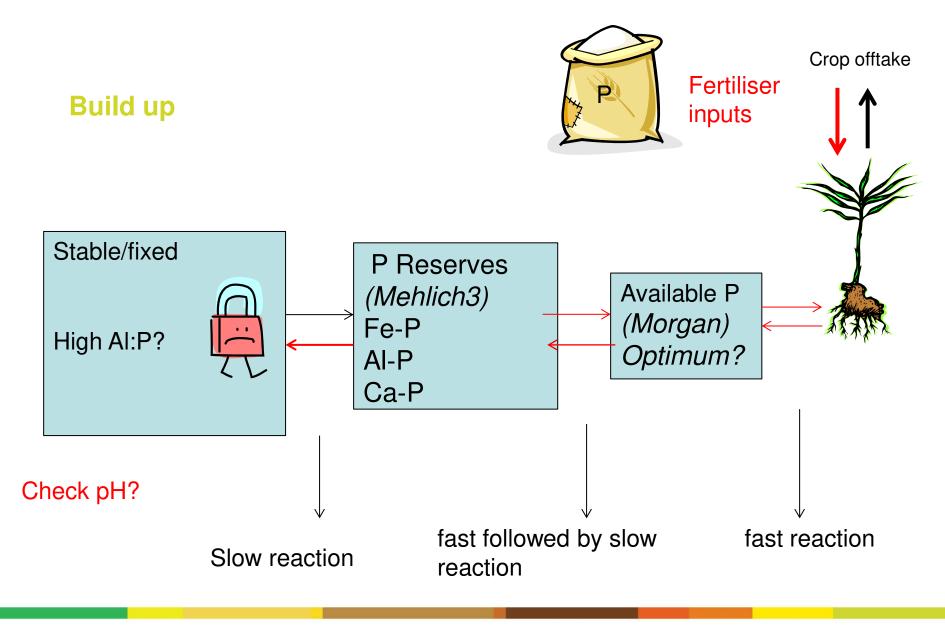
## Soil controls on P solubility & availability





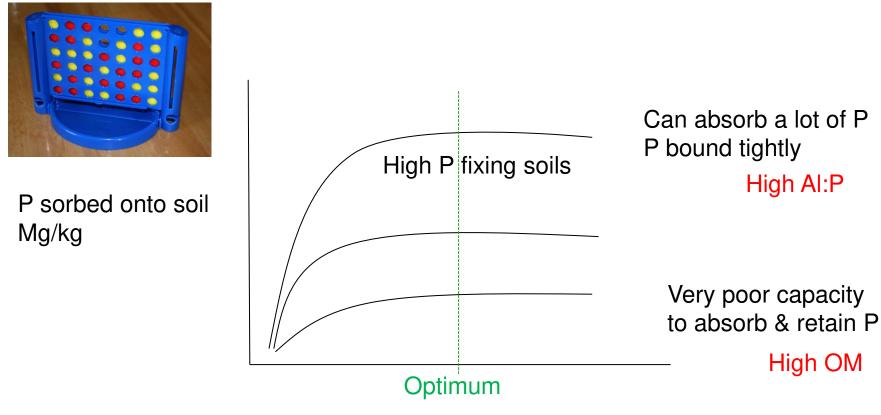








# Phosphorus sorption: what happens when we add P to soil Build-up?

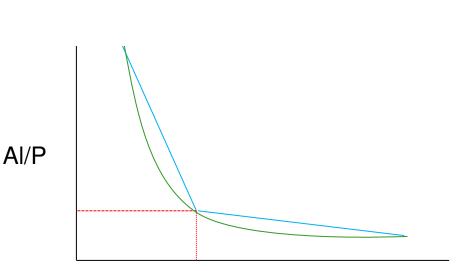


Concentration of P in solution mg/L

Be patient with the high P fixers (takes time) & careful with poor P retainers



#### How do these things control P release into solution/water



In Irish soils, AI controls binding energies

optimum

How tight P is 'stuck' onto soil matrix

Al also is a sorption site...placeholder for P.

As P is added, some sorption sites need to fill up first before P can be released into solution

Plant available P/soluble ortho-P

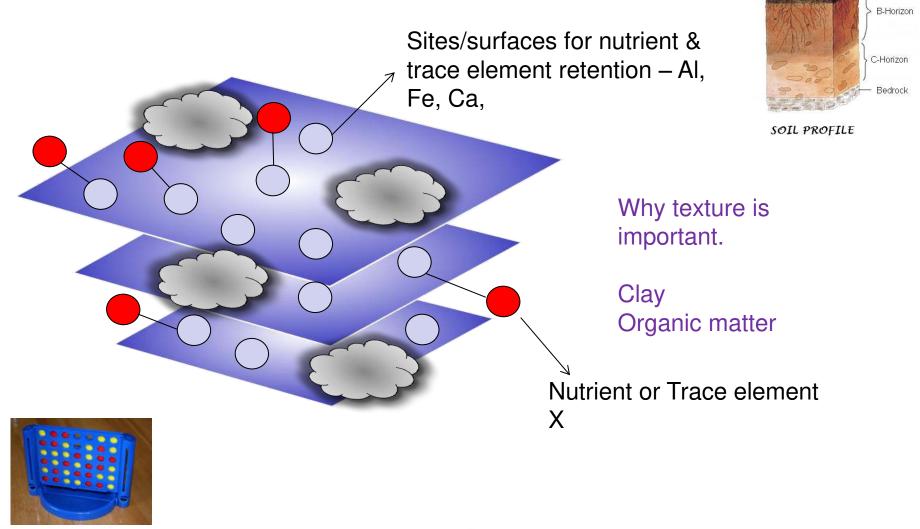
Draw-down, or decline from Index 4 to 3 will differ...again give it time.





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#### What's happening on the soil matrix....



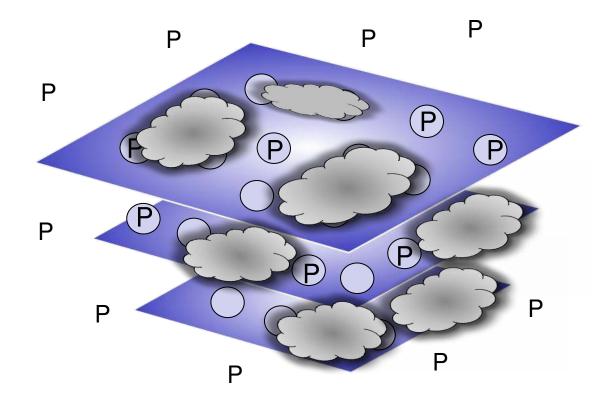


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A-Horizon

#### **Organic Matter Influences on P (low P sorption).**

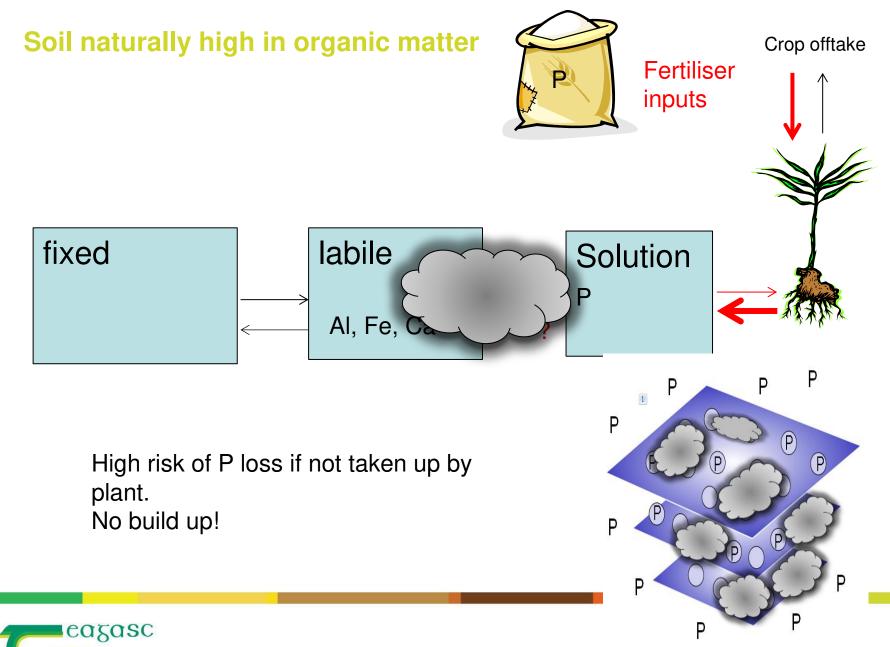
#### Too much of a good thing?





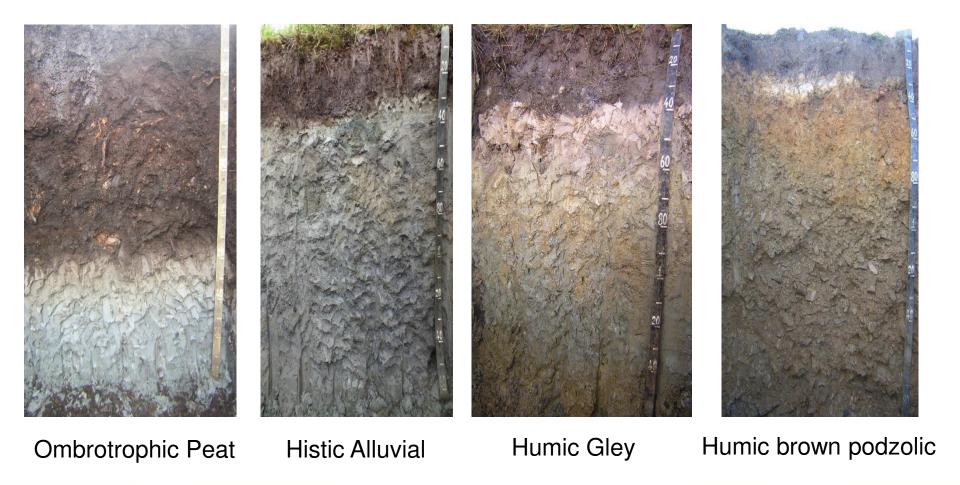
>20% OM in 10 cm depth





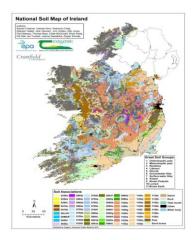
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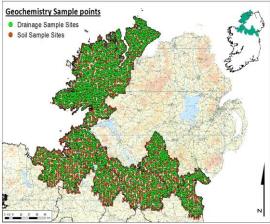
#### High organic matter soils: Histics, humics and Peats





## Providing the data to 'know your soil' and understand **P** dynamics.







Agri-environmental Indicators for P in Irish soils





**Geological Survey** Suirbhéireacht Gheolaíochta Ireland | Éireann

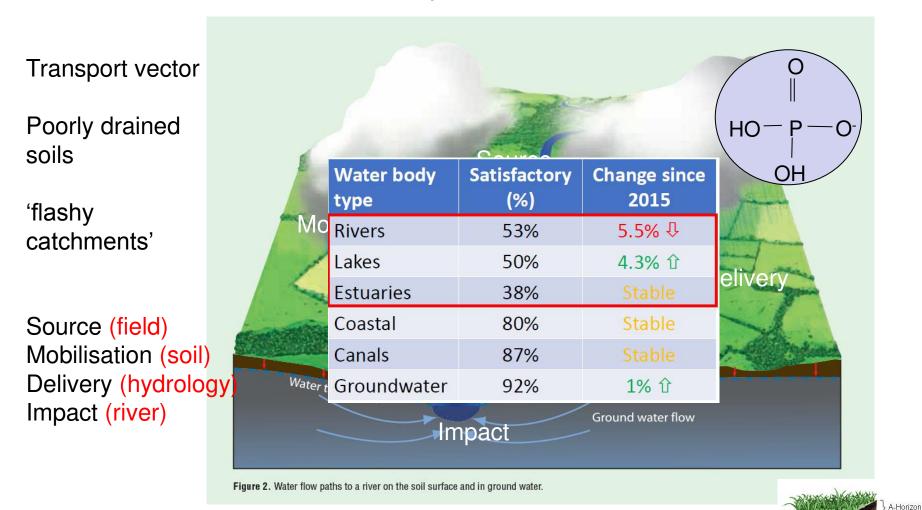
An Roinn Cumarsáide, Gníomhaithe ar son na hAeráide agus Comhshaoil Department of Communications, Climate Action & Environment



Morgan P, Al, Fe, Ca, texture, %OM/pH. Agronomy & water quality models



#### Landscape scales of diffuse P loss





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SOIL PROFILE

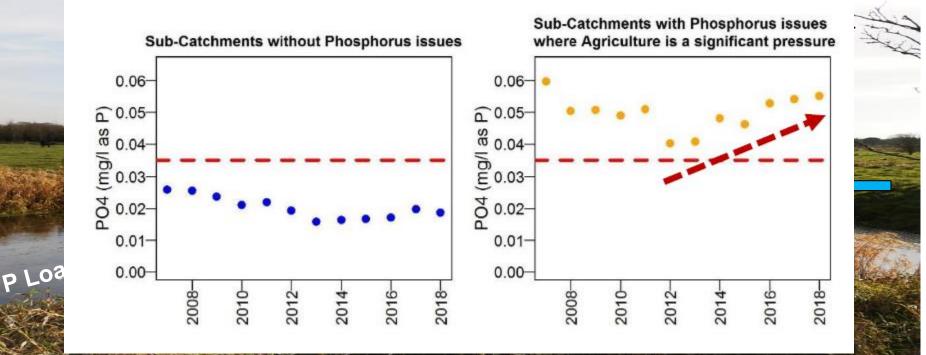
B-Horizon

C-Horizon

Bedrock

#### Why is P loss is a poorly drained soils issue?

#### P loss to water expressed as load kg/ha/yr



Flow rate is a function of soils' response to rainfall/water

## Let's talk about farms on poorly drained soils...

# What are the critical source areas (pinchpoints) for P at farm scale?



#### Where are the pathways for P on the farm?



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#### And runoff from roads & yards...into ditches!



Look out for Owen Fenton's webinar in July on soil hydrology!

@ROADRUN\_Project





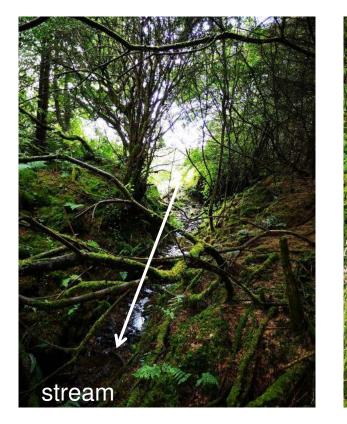


## Connectivity: links the pathways up Ditches, Drains, Gripes, Sheoughs, Marein Drain....??





#### **On-farm ditch connectivity to streams and outlets**









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#### The most extensive connectivity feature on a farm?

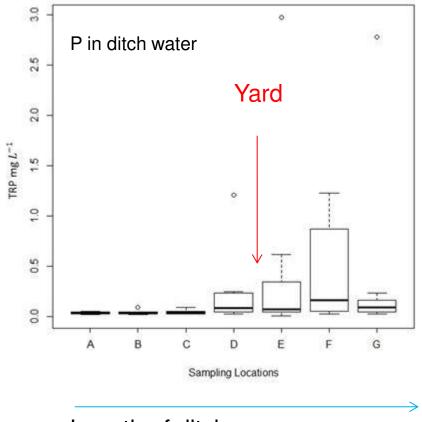
#### Legend







#### How ditch water is influenced by what it's connect to?

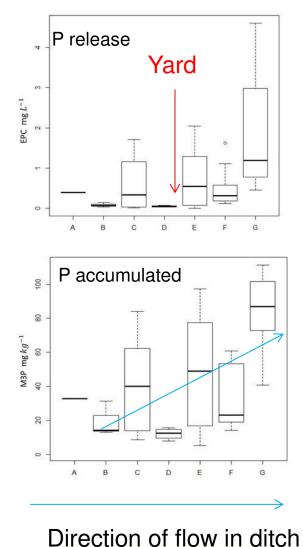




Length of ditch



## What's in sediment samples along length of ditch?



P P F Sediment P release

Over time, sediment can accumulate P, Sediment becomes a source of P...

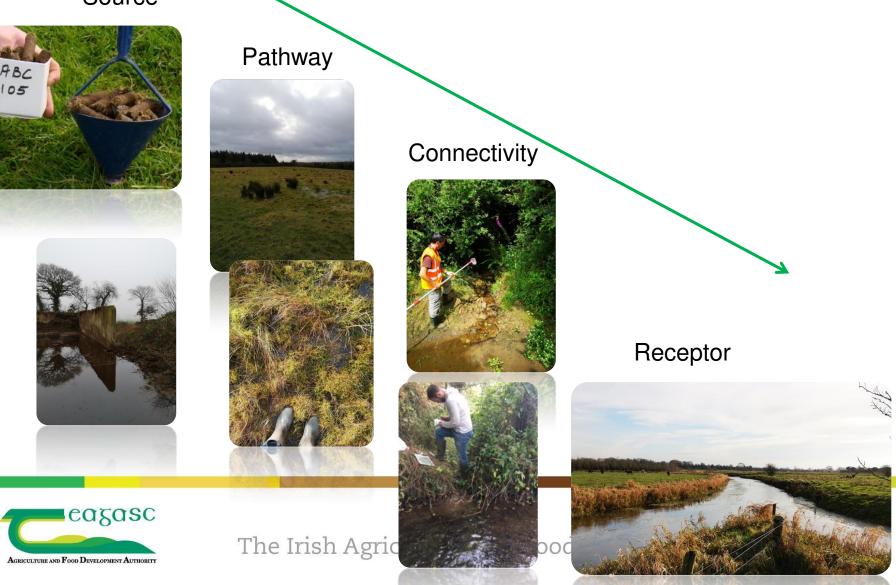
Water

For more on sediment: Daire O'Huallachain Webinar (July).

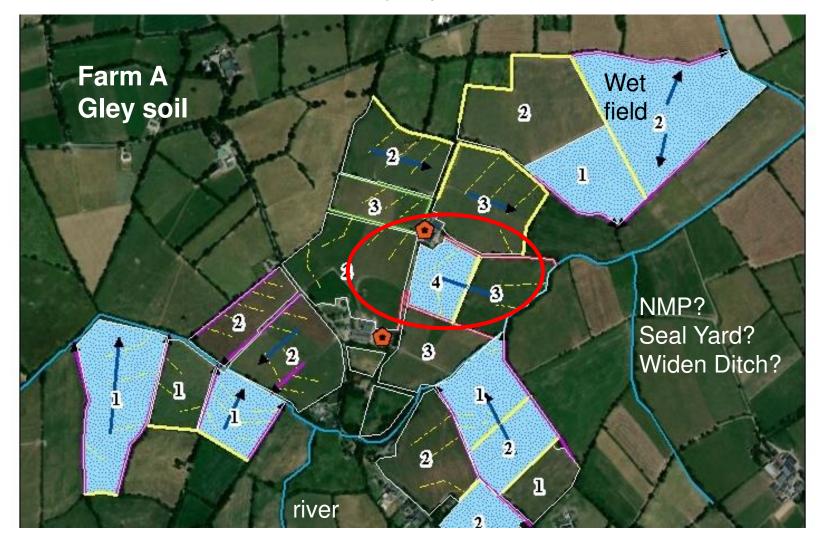


## Bringing it all together: pinchpoints for P on the farm?

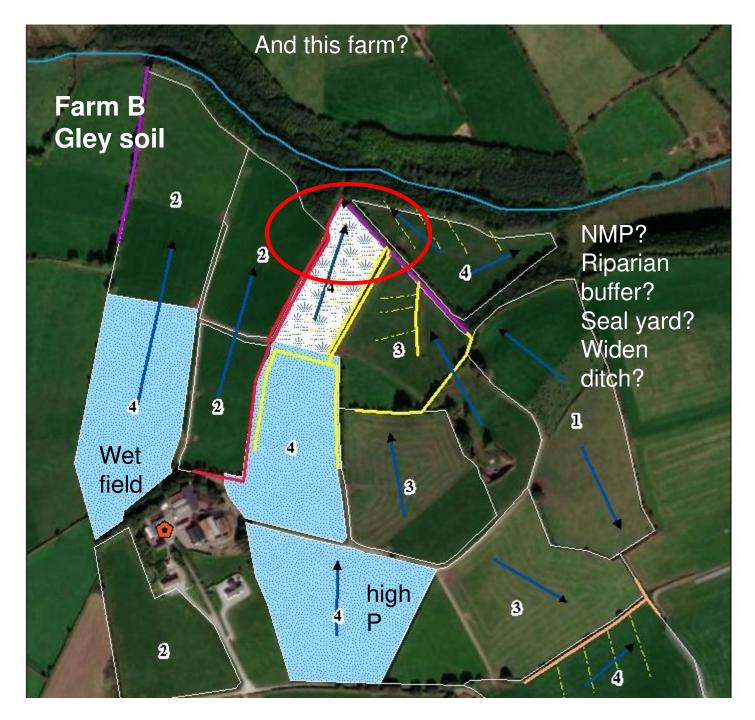
Source



What P measure would you put on this farm & where?



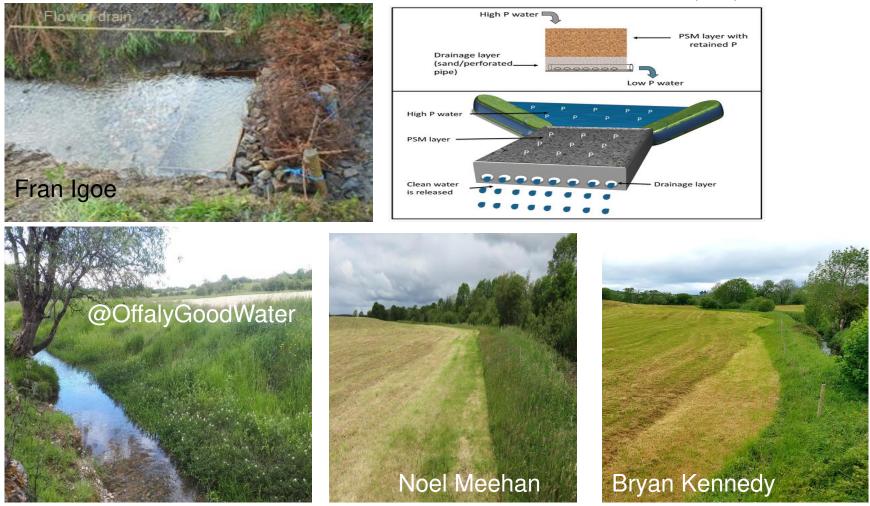




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#### **Dis-connectivity or breaking the pathway...**



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#### Penn and Bowen (2018)

## Take home messages

#### Know your soil

- soil pH
- high organic matter soils are (>20% OM in 10 cm)
- slow to respond to build-up/draw down? (high AI:P or high Ca)

#### Identify the critical source areas/pinchpoints for P on your farm?

- Look for connectivity ditches, drains, wet fields
- Are they connected to a source? High soil P, farm yard
- Are they connected to a stream, river nearby.

#### Measure up?

- NMP even distribution of P
- Seal leaks from yard
- Will a bufferstrip work?
- Trap sediment & widen a ditch?





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# Thank you for listening!

