Department of **Water and Environmental Regulation**
Department of **Primary Industries and Regional Development**
GOVERNMENT OF WESTERN AUSTRALIA

Treating P loss to improve water quality in estuaries – current science and future prospects

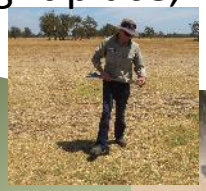
Brad Degens, Svenja Tulipani, Bronte Grant, Mark Shackleton, Malcolm Robb

Outline

- What are recent investigations & trials starting to show ?
- What do these say about future prospects ?

REI - Multiple strategies

Phosphate inputs
Fertilizer management
(right amount, right place, right time)



Receiving water treatment with P binding clays

Paddock loss
Soil retention,
drainage,
riparian zones

Treatment along the way

Soil Amendments

In-drain treatment & dosing with P-binding clay

Soil amendments to reduce runoff P from paddocks

- **Activities:** Paddock trials of IMG in farming systems – 2 yrs results
- Focus
  - Quantifying benefits including longevity of these, dependence on rates.
  - Verifying risks to production system & environment
- Previous trials
  - Incorporated with soil used for turf production (CSIRO)
  - Top-dressed pasture with no disturbance (Bullsbrook – Chem Centre)

What has been found so far ?

- Effectiveness of IMG depends on application rates, incorporation method and soil P status
  - Reasonably large application rates needed (~ 20 t/ha)
  - Large runoff and leaching benefits immediately possible (P reduction >90% in runoff and >95% in leachates)
  - Maximum reduction in leachates with incorporation
  - Lighter top-dressed rates are less effective for runoff and leaching
  - May need > 20 t/ha to treat high P status soils
- Few other soil benefits for so far and no effects on plant nutrition
- Potential aquatic Mn risk – high Mn leaching to groundwater in acidic sands

What does this mean ?

- Future use/adoption depends on costs vs benefits as well as practicalities
- Benefits
  - Retained P/ha, some long-term improvement in soil quality
  - Reduced P loss to surface water
  - Depend on application rate and method (surface vs incorp.)
- Costs
  - Freight (~$30/tonne to Peel)
  - Material cost (future bulk IMG ~$20/tonne ?)
  - Spreading ($35 for 20 t/ha)
  - $1100/ha or $110 000/100 ha for light rate (20t/ha)

Future prospects – Soil amendments

- Availability of material
  - Waste to product regulation currently being reviewed
  - Amendments to legislation ?
  - Proponent required to apply for classification as product for specific use ?
  - Future market for product ?
- Adoption and use of product on farms
  - Upfront costs > benefits to farming system
  - Large material volumes – practical handling, application
  - Longevity of benefits depends on nutrient management
  - On-farm use is potentially a large part of future product market

Future prospects – Soil amendments

- Possible implementation approach
  - Co-investment/incentive program partnering with landholders
  - Best targeted at high runoff P risk areas on farms – couple with existing soil testing & fertilizer management program
  - Longevity (>10 years) to achieve scale of intervention needed to improve runoff WQ to estuary

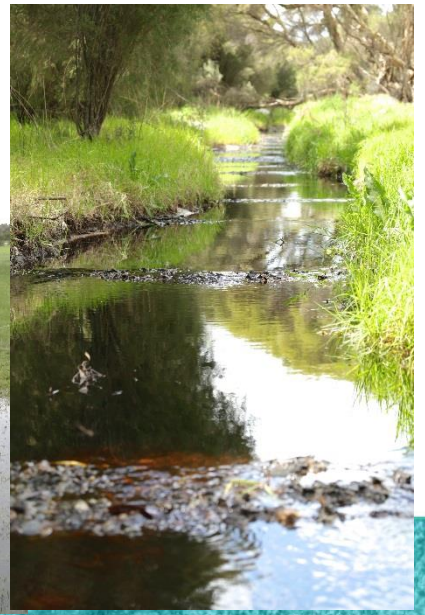


Amending drain sediments to remove P from flowing waters

- **Activities:** Investigating removal of soluble P from flowing waters in open drains by amending bed sediments to improving P adsorption capacity
- Focus on :
  - Identifying best practical design & siting
  - Quantifying effectiveness & longevity
  - Assessing risks to environment
- Pilot to reach scale trials in Gull Rd drain in progress – 5 designs with IMG (incorporated directly or pre-blended)

What have we found so far ?

- Effectiveness varies widely depending on design and flow conditions
  - Best short-term P retention in geotextile bags or riffles but P adsorbing materials progressively washed out
  - Slow rates of treatment with laminar flow beds (< 0.3 kg P/100m/yr) with better retention of P adsorbing materials
  - Greater rates of treatment targeting high P in groundwater (average. 1 kg P/100m/yr).
- Potentially some aquatic risks (soluble Mn and particulate Fe) with limited control once installed



What does this mean ?

- Limited treatment rates even with significant channel amendment (e.g. at best 10% annual P load in Gull Rd)
- Performance likely to further decline over time (surface algae, detritus barriers)
- Most benefit by targeting groundwater discharge zones with high P
- Design & flow conditions influence short-term risks of Mn dissolution and Fe transport – needs further investigation

Future prospects – In-drain treatment

- Availability of material (as for soil treatment)
  - Greater challenge in being certain about risk to environment for product use with sediments
  - Limited future market to justify proponent application ?
- Adoption and use of product
  - Upfront costs, scale of intervention (bed disturbance) vs magnitude & longevity of benefits ?
  - Pre-blending for larger channels – significant works
- Implementation possibilities
  - Direct incorporation in paddock level swales – minimises risks, maximises benefits ?
  - Targeted intervention

Direct treatment of phosphate in drains & rivers using P-binding clays

- **Activities** – development, up-scaling and trialling of a new high P adsorbing clay (hydrotalcite) for in-stream dosing or ponded water applications
- Focus on:
  - Upscaling production & handling
  - Testing clay performance in controlled conditions
  - Trialling clay application rates to assess benefits and risks in ponded and flowing waters

Current status

- Dosing at 0.5 to > 2t/ML needed to achieve P concentrations that minimise algal growth
- Particular conditions limit P removal (dissolved organic carbon, salinity, alkalinity) & longevity of adsorption (hyper-salinity)
- Surface dosing of stationary waters can minimise algal growth by dual action (removing water P, capping P seepage from bottom mud)
- Large amounts required to continuously treat flowing catchment waters (& dosing infrastructure)
- Have achieved significant improvement in clay production & application methods – x 10 faster, half the waste water, more concentrated product
- Potential aquatic risks with some application methods (increased turbidity, benthic smothering)

What does this mean ?

- 10’s - 100’s tonnes clay required to dose waterbodies = efficient production, handling and application methods
- Possible to locally produce with future cost <$10,000/tonne
- High certainty, high effectiveness P treatment while addressing P losses from catchment
- Potential treatment for brackish or stratified pools to minimise algal blooms where fuelled by P from bottom muds (legacy P).
- Clays are a strong P binder but not a permanent locking agent

Future prospects – P binding clays

- Availability of product
  - Further refining and testing of up-scaled production needed for cost-effective production
  - Commercialisation with a local, permanent production capacity
- Use of product
  - Targeted pre-season treatment of sections of rivers prone to algal blooms
  - Long-term treatment of sediment P
  - Potential direct treatment algal blooms
  - Targeted dosing of high P drains – dosing plants
- Implementation
  - Partnership approach for trials & future application: state, local government & catchment councils
  - Targeted intervention

Concluding comments

- Amending soils to improve soil P retention

  Work towards product approval & implementation strategy

  - Defining on-farm benefits, risks, application strategies
  - Build landholder & community support, understand scale of intervention

- Amending drains to remove P from drain waters

  Potential paddock level, GW discharge treatment option

  Limited benefit likely as a broad-scale intervention

- Applying clays to directly reduce P for algal blooms

  Work towards improving efficiency of production, developing local application strategies & defining longevity of benefits

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