

Specific Management and Robust Targeting of Riparian Buffer Zones



Daire Ó hUallacháin

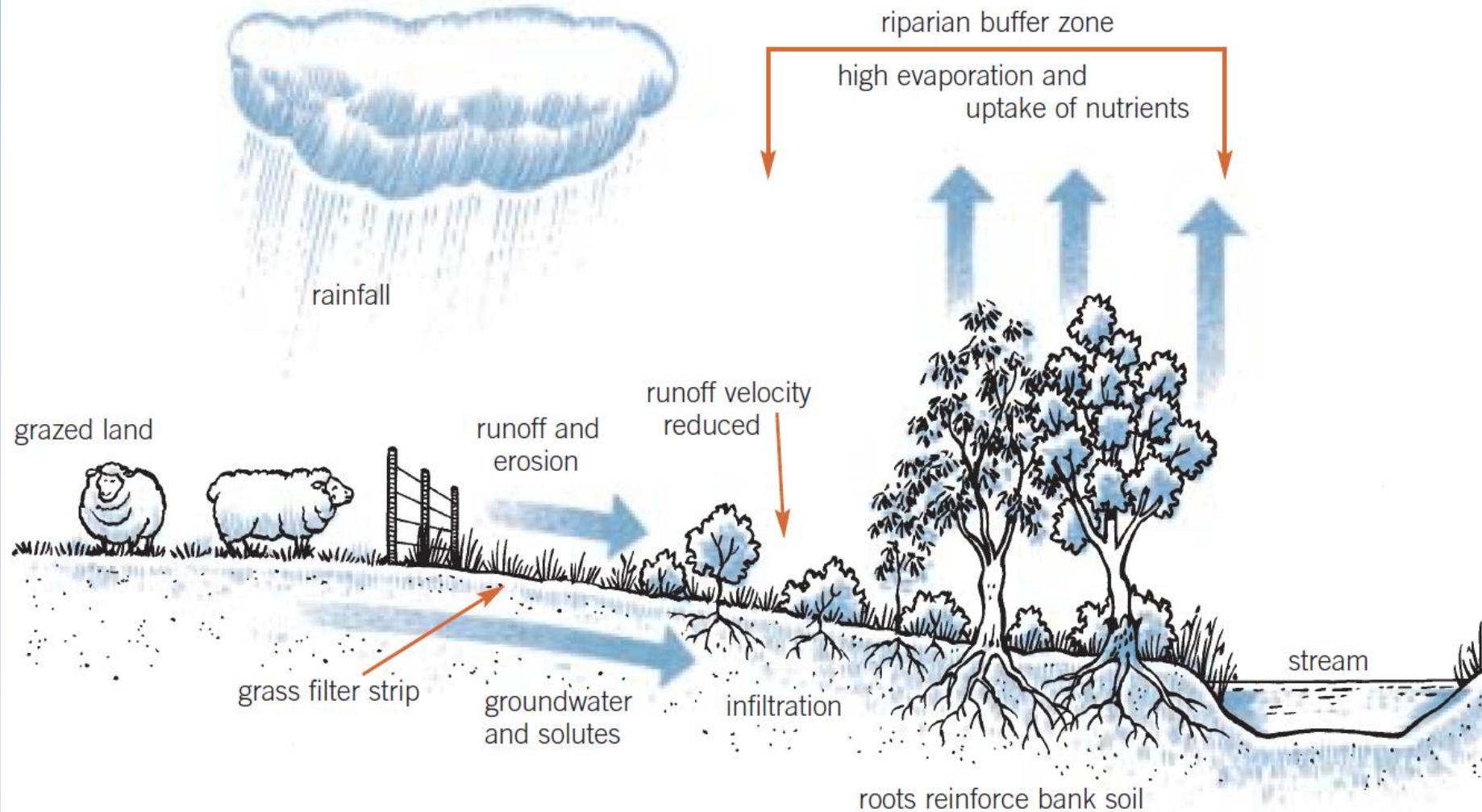


Riparian margins

- Bands of land adjacent to water bodies that are planted with permanent vegetation
- Play a significant role in the reduction of diffuse inputs
- Four main processes
 - sedimentation,
 - infiltration,
 - adsorption,
 - dilution.



Processes that occur in the riparian zone to improve water quality and stabilise streambanks. Illustration Paul Lennon.



Legislation



TUTORY INSTRUMENTS



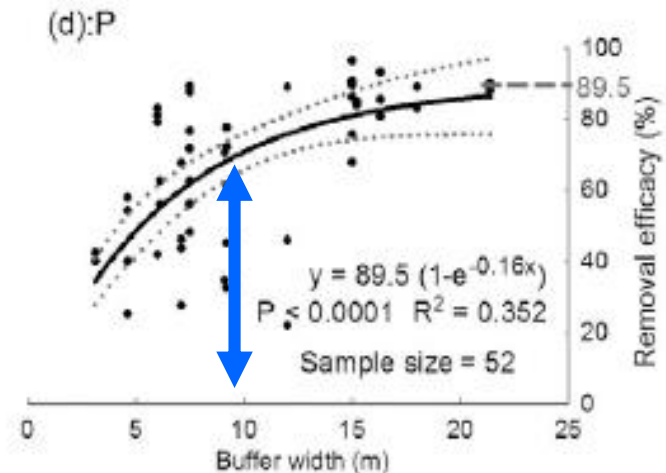
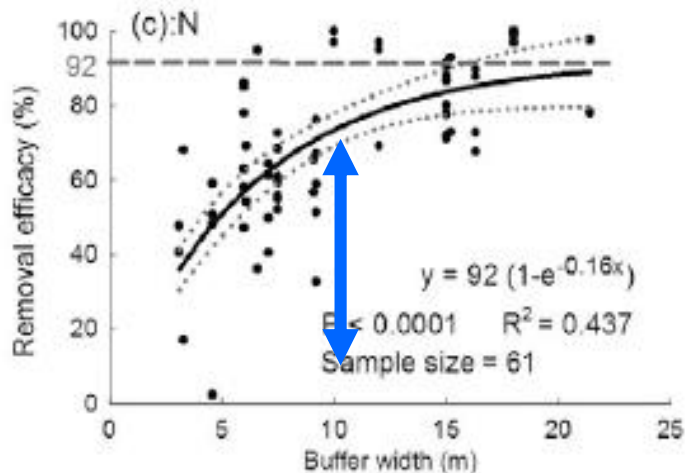
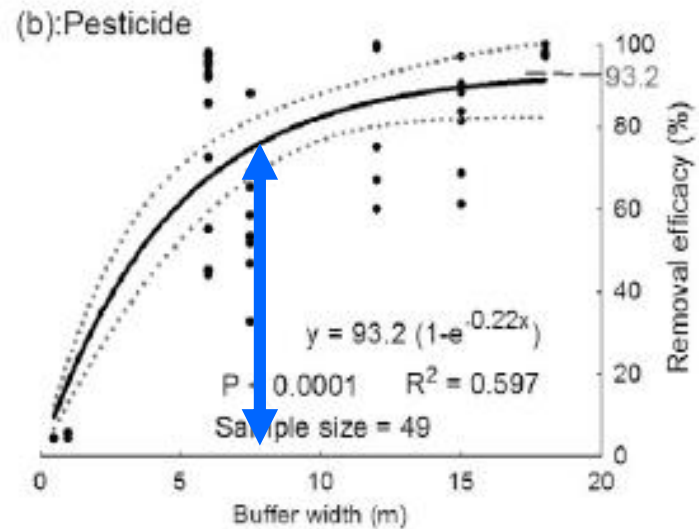
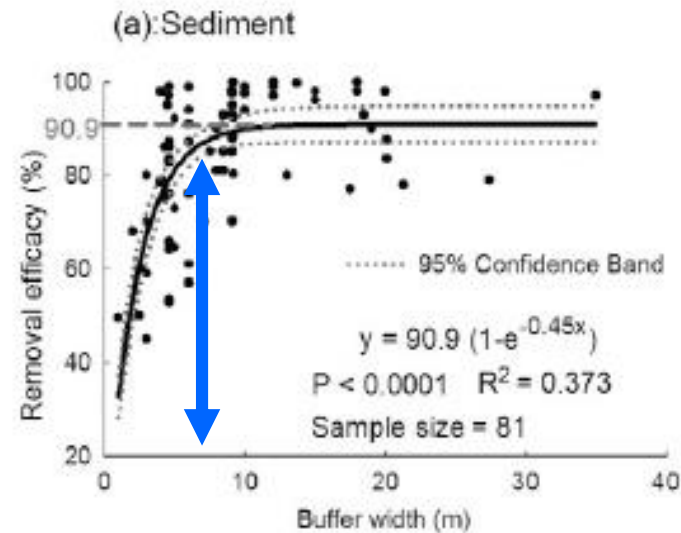
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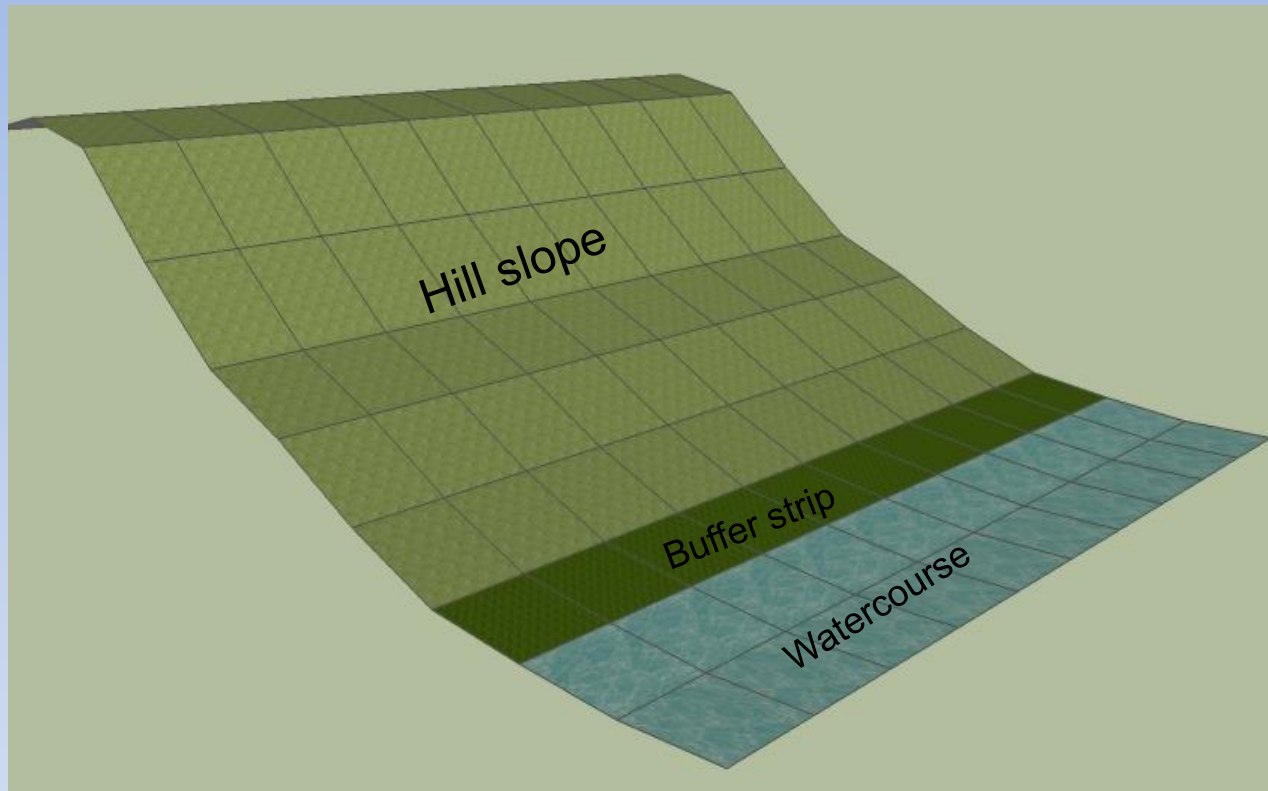


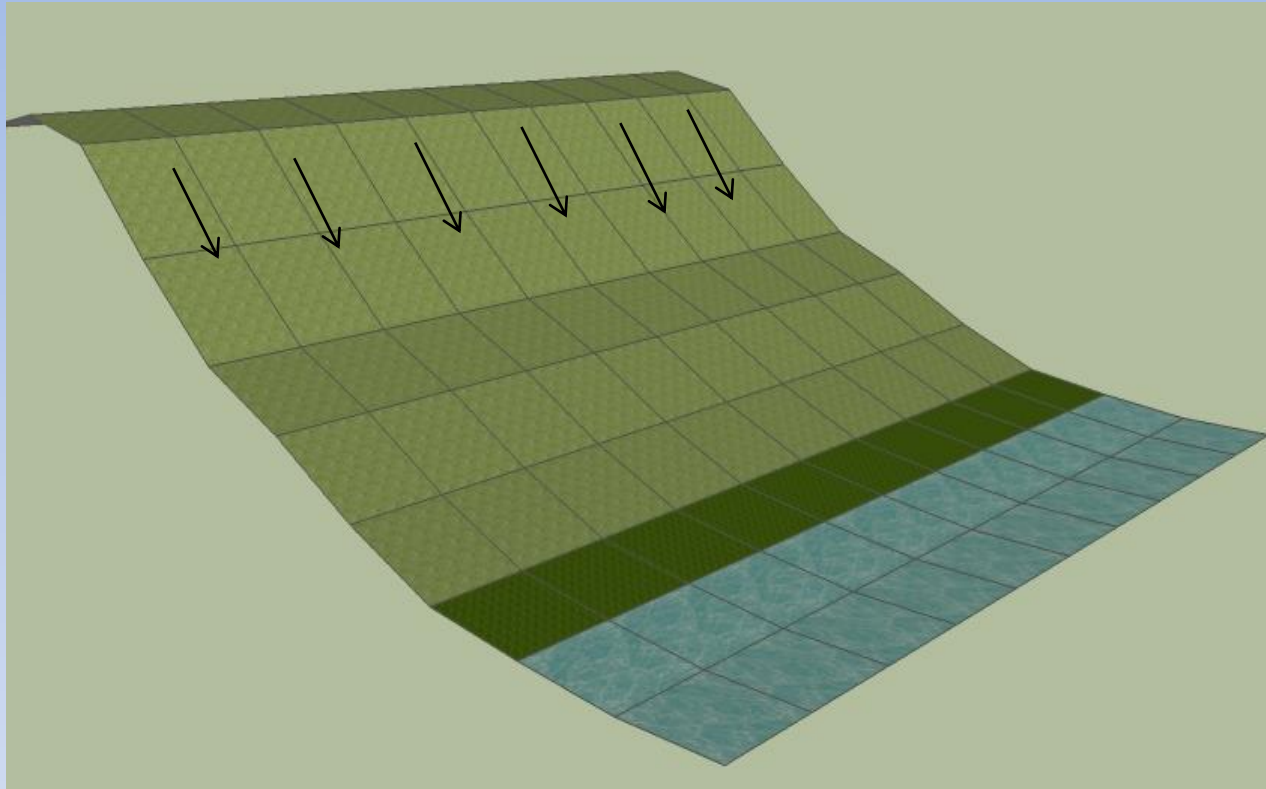
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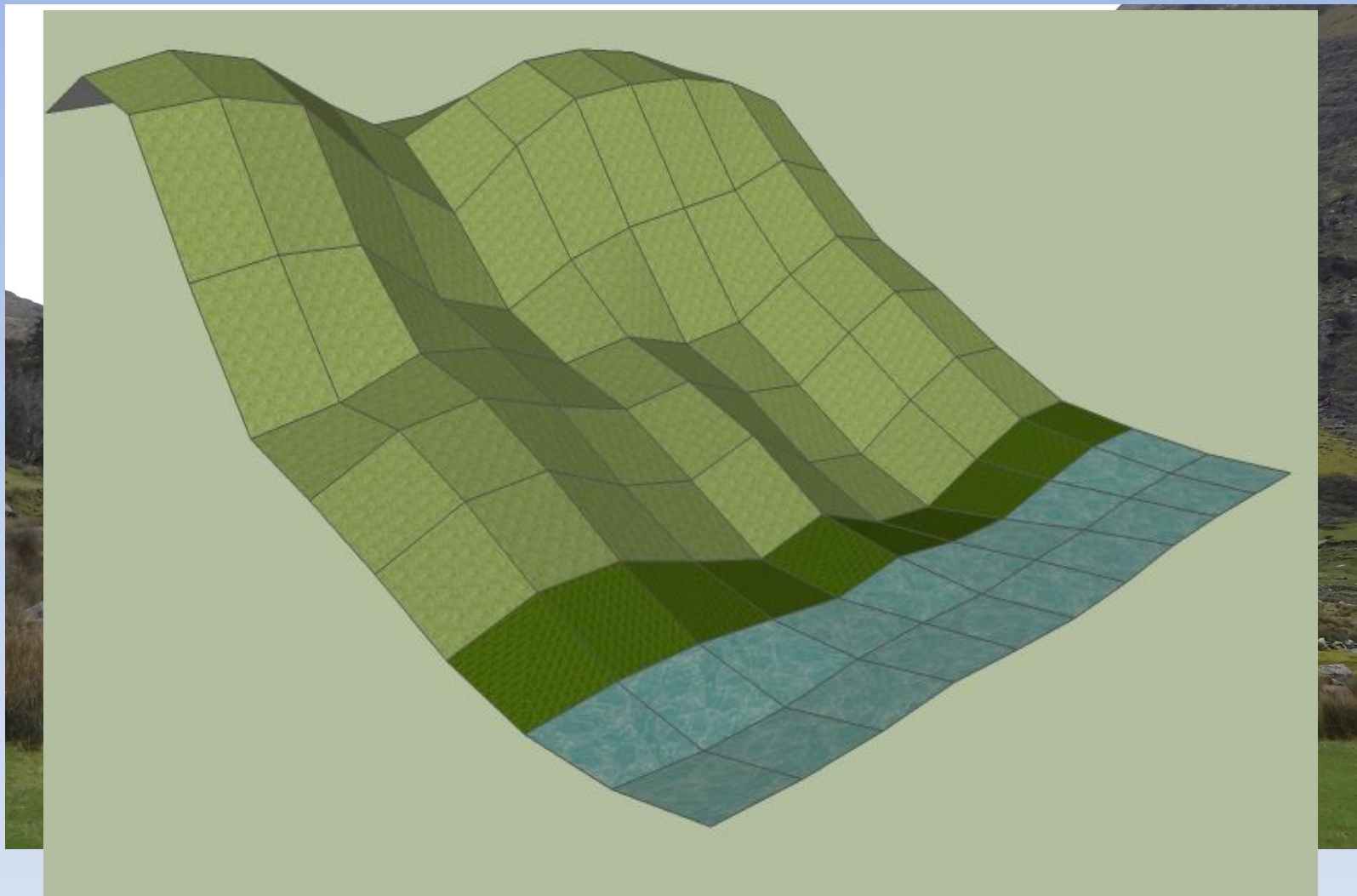
L. No. 272 of 2009

ENVIRONMENTAL OBJECTIVES
REGULATIONS 2009











Margin management and design

- GAEC -2m, No fert/pest
- AEOS – Vegetation, No fert/pest, no stock, can mow, GAEC
- GLAS -
 - Rip Margin (3m-30m)- Vegetation, No fert/pest, no stock, mow, GAEC....
 - approx 200 farmers
 - Cattle exclusion (1.5m)- Vegetation, No fert/pest, no stock....
 - 18,000 farmers



Protection of Watercourses from Bovines			€1.50/m/yr
Riparian Margin	a)	3 metre width	€0.90/m/yr
	b)	6 metre width	€1.20/m/yr
	c)	10 metre width	€1.60/m/yr
	d)	30 metre width	€3.60/m/yr



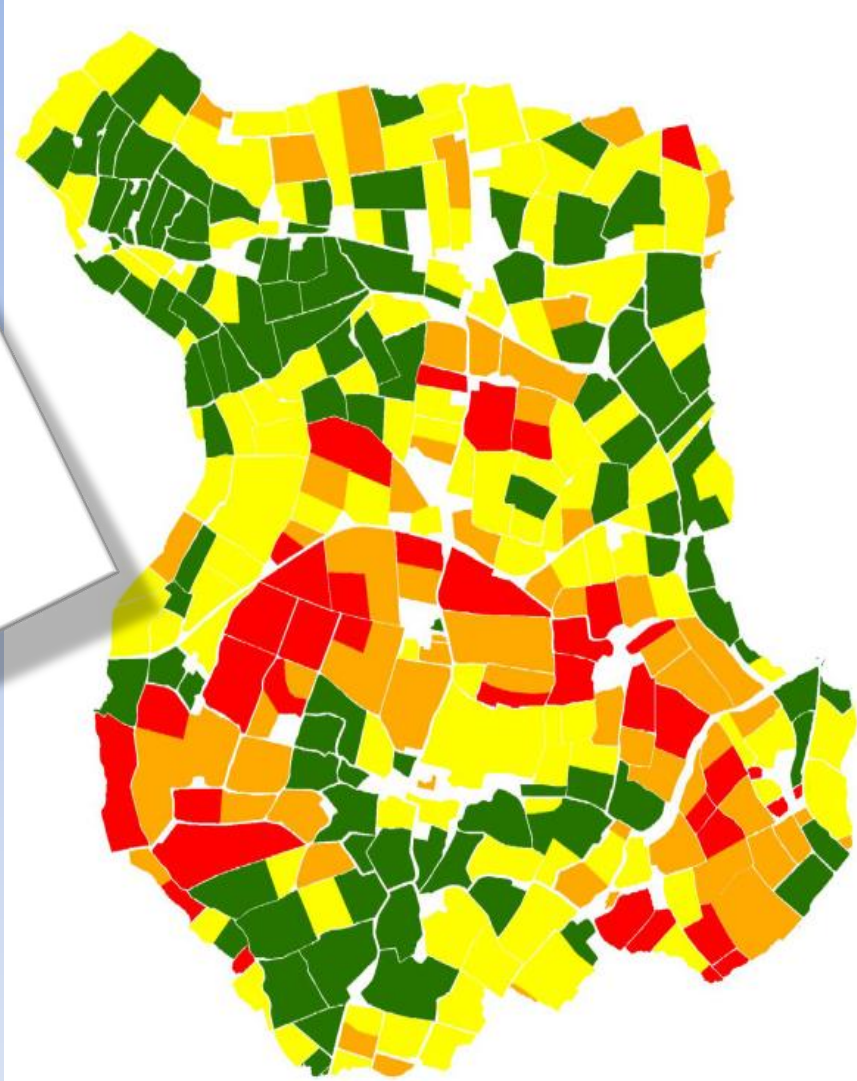
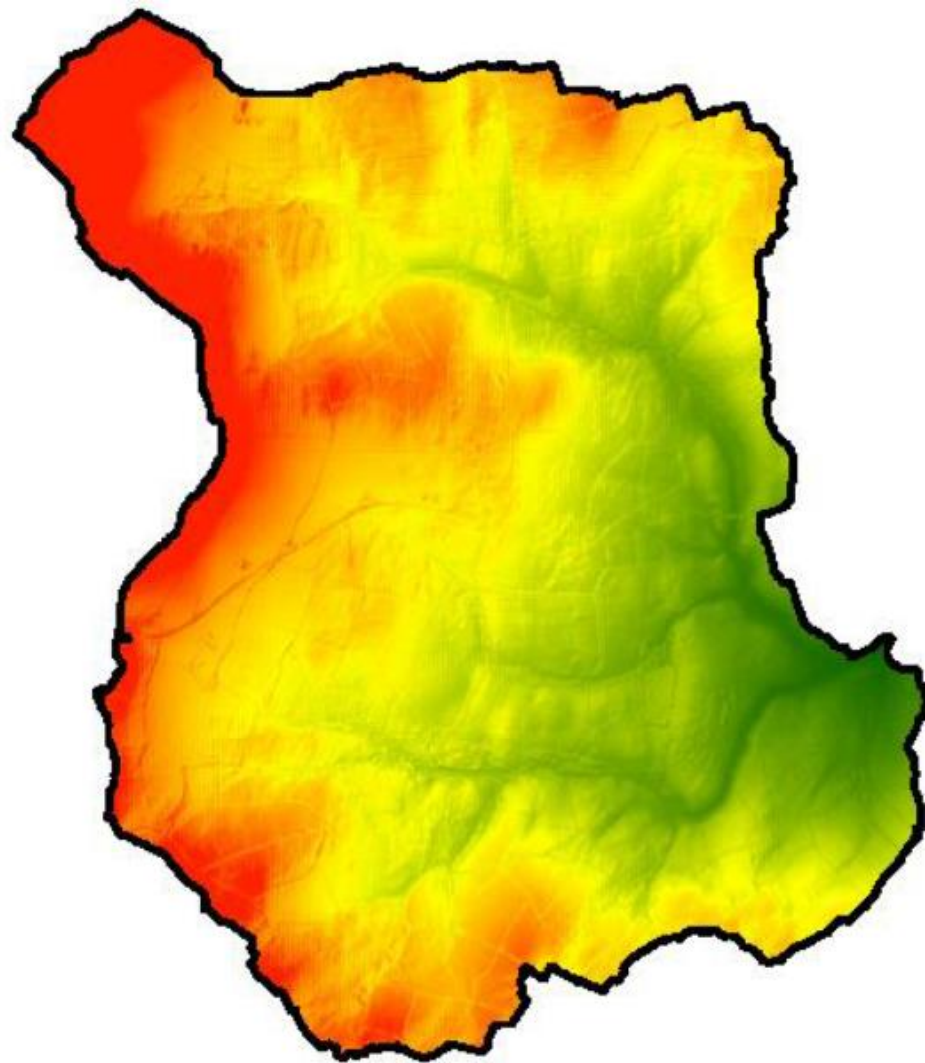
SMARTER_BufferZ

Ensure optimal targeting and management of riparian buffers for the effective management of Irish rivers.

Approach:

- Compile literature on effectiveness and spatial data to guide targeting
- **Right Place:** Buffer placement within Prioritised Catchments
- **Right Measure:** Optimise the right buffer for pollution pathways and wider multiple benefits'
- Develop tools to support decision-making on placement, design and maintenance







Flow

Breakthrough point

Flow Sink

Delivery point

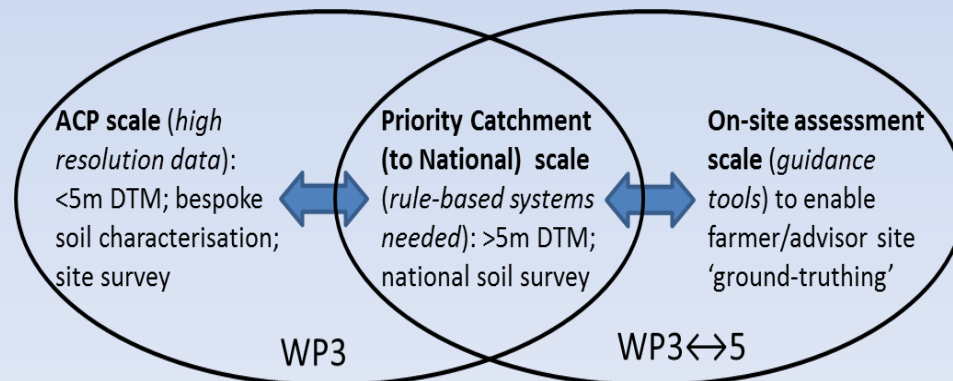
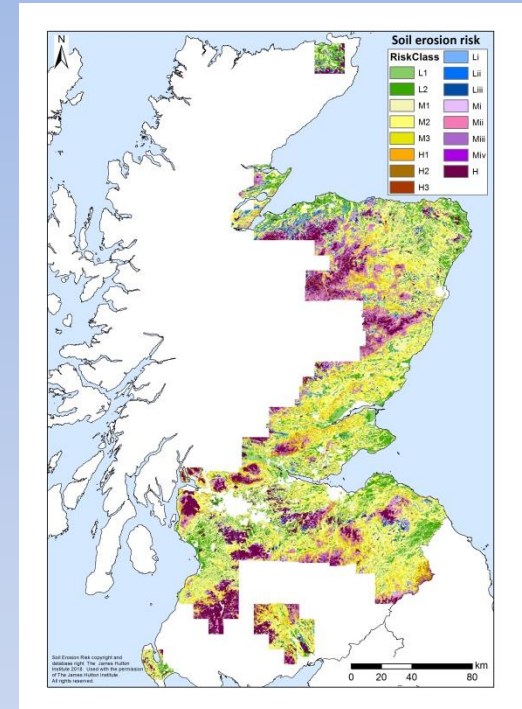
Targeting of riparian margins to
'Delivery points' -
Reduction of 89-96% in costs
(compared to blanket implementation)

Thomas et al. (2016) *STOTEN*

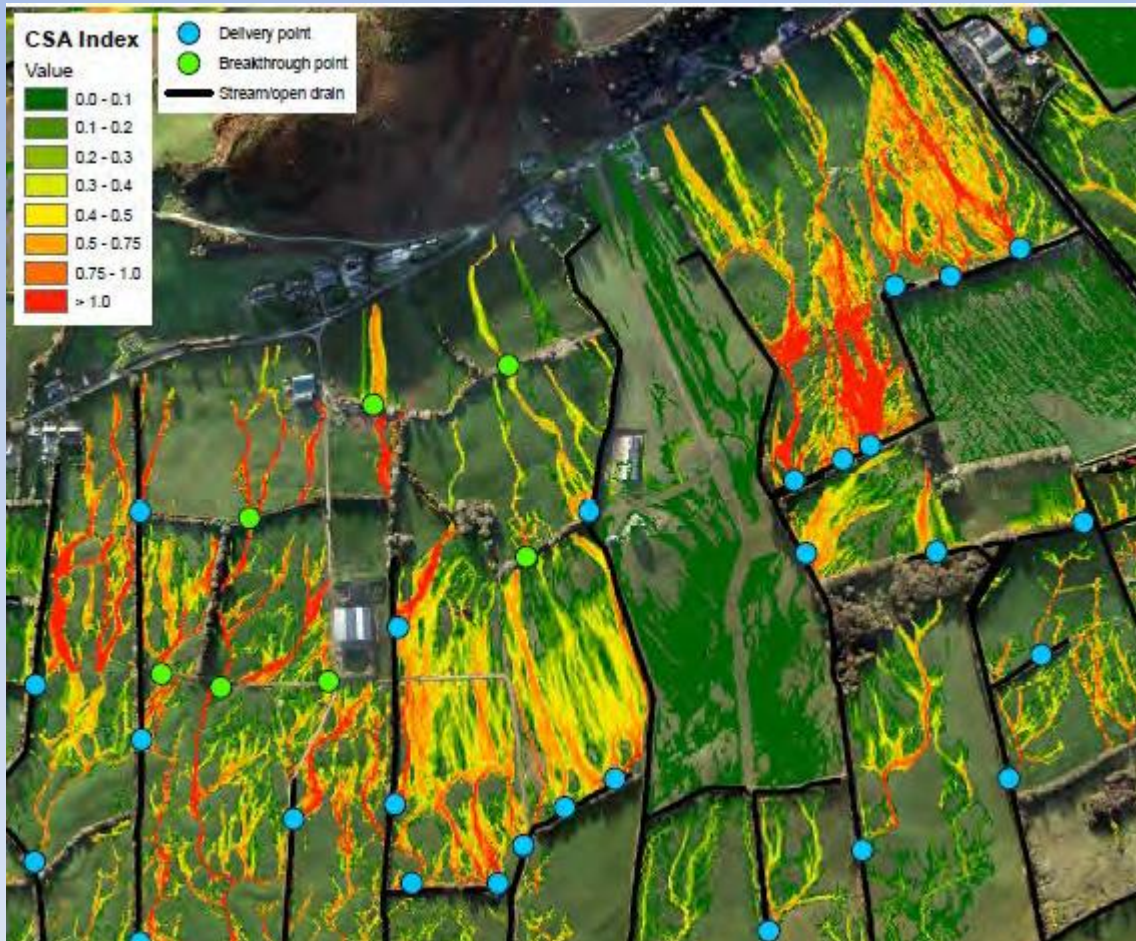
WP3 - Right Place - Buffer placement within Prioritised Catchments

Objectives

- Review landscape factors for siting of riparian buffers
- Buffer placement methods developed for ACP catchments
 - Breakthrough points- Classification
- Risk -impacts tool for a Priority Catchment, then validation on the ACP data-rich catchments –
 - DIFFUSE TOOLS - EPA
- Catchment 'typologies' approach of source-delivery-receptor risk factors



Diffuse tools



Revised WP3

- Combine national datasets (e.g. DiffuseTools) with field-based data (e.g. ACP, new assessments.....others?).
- Characterise
 - Hillslope/pollution pathways
 - Flow path
 - Delivery point
- Role of LAWPRO/ASSAP/others?

SCENARIO 1

Poorly draining soil and low permeability subsoil

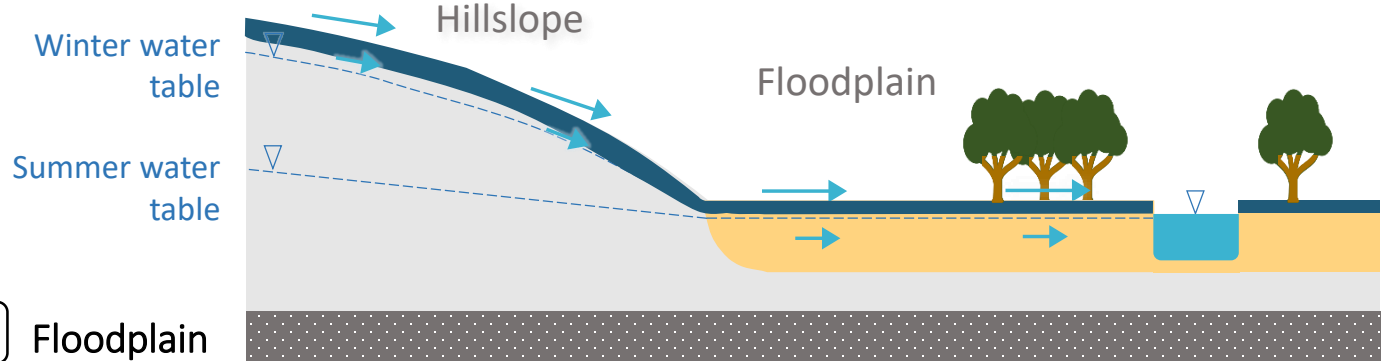
Scenario description

- Main pathways: overland and near surface.
- Vertical pathway: insignificant.
- Bypassing of the floodplain can occur in ditches/small watercourses.
- Main significant issues: PO_4 , TP and sediment.

Legend

-  Poorly draining alluvium
-  Poorly draining soil
-  Low permeability subsoil
-  Bedrock
-  River/Stream
-  Flowpaths
-  Critical Source Area (CSA)
-  Delivery Flowpaths in CSA

1a Floodplain



SCENARIO 2

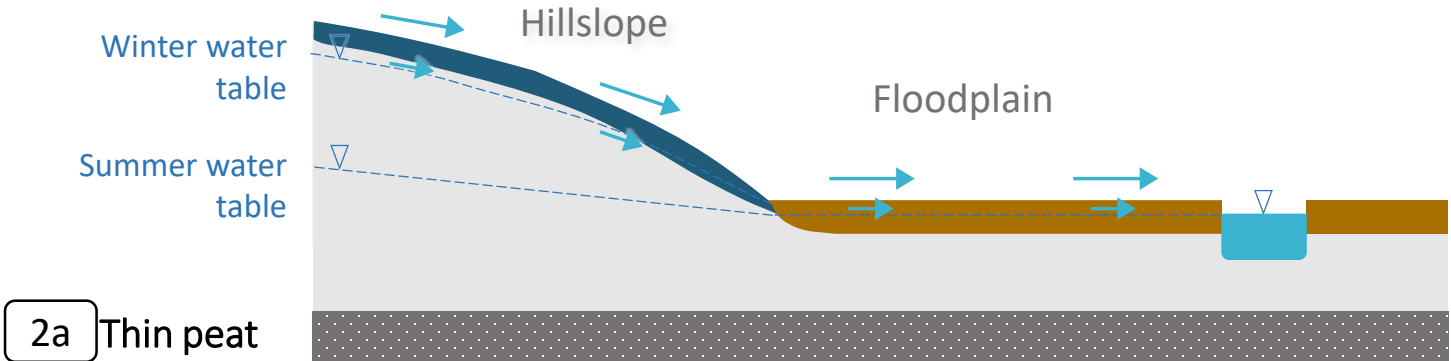
Poorly draining soil and low permeability subsoil with peat in floodplain

Scenario description

- Main pathways: overland and near surface.
- Vertical pathway: insignificant.
- Bypassing of the floodplain can occur in ditches/small watercourses.
- Main significant issues: NH_4 , sediment and, potentially, PO_4 .

Legend

-  Peaty soil on peat
-  Poorly draining soil
-  Low permeability subsoil
-  Bedrock
-  River/Stream
-  Flowpaths
-  Critical Source Area (CSA)
-  Delivery Flowpaths in CSA



SCENARIO 3

Freely draining soil, moderate permeability subsoil and permeable bedrock

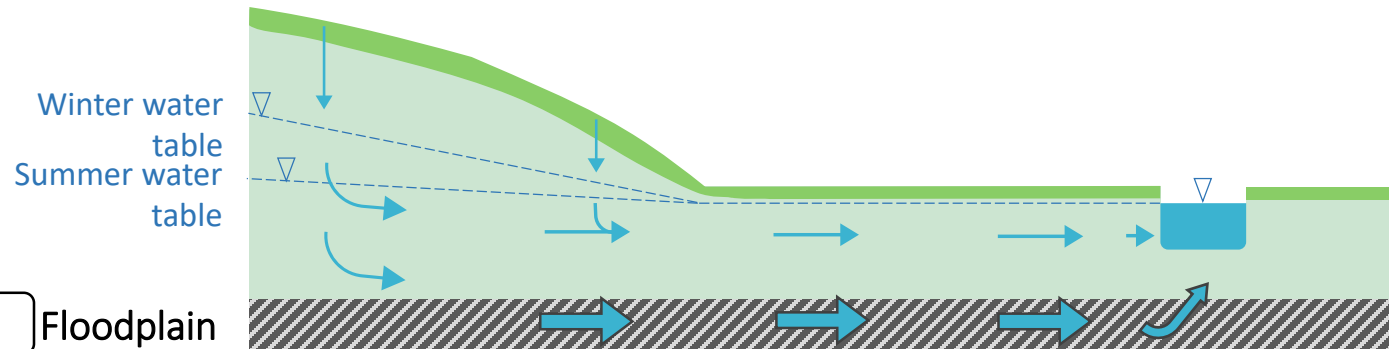
Scenario description

- Main pathways: vertical to water table and then horizontal towards the river in subsoil and bedrock.
- In some circumstances, there may be poor draining soils in the floodplain.
- Main significant issue: NO₃.

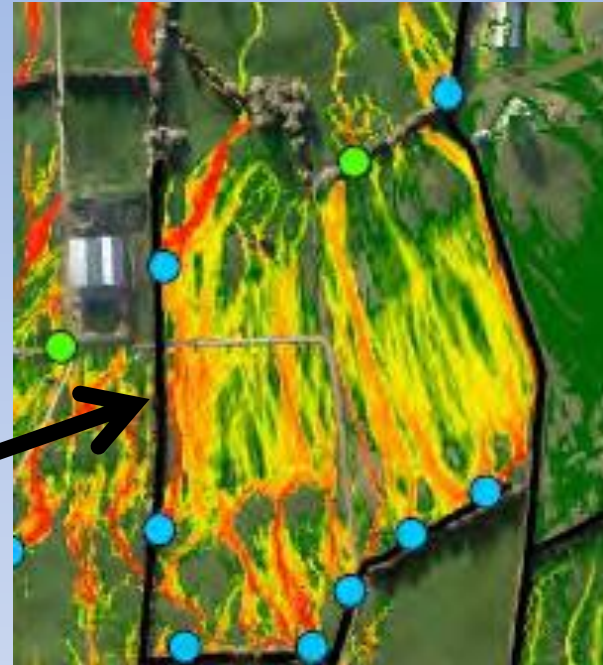
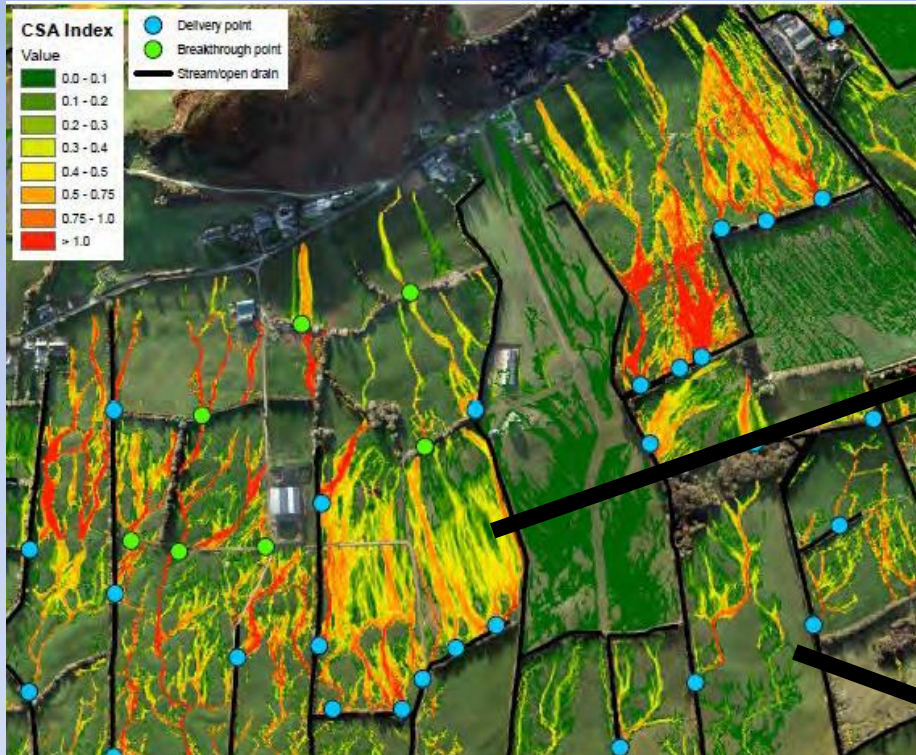
Legend

-  Freely draining soil
-  Poorly draining soil
-  Moderate/high permeability
-  subsoil Permeable
-  bedrock
-  River/Stream
-  Flowpaths
-  Dominant flowpaths

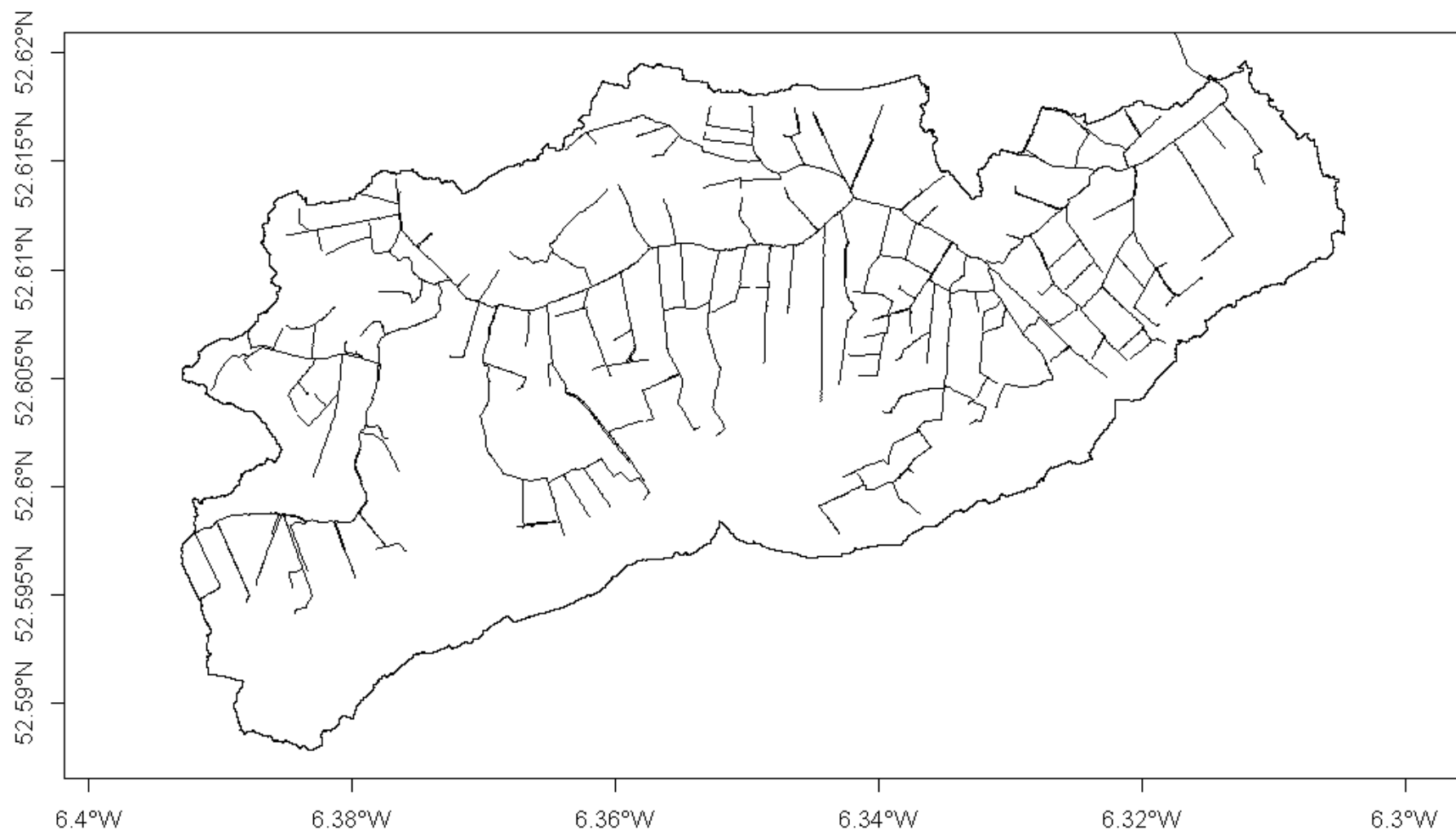
3a Floodplain



Characterise Flowpaths

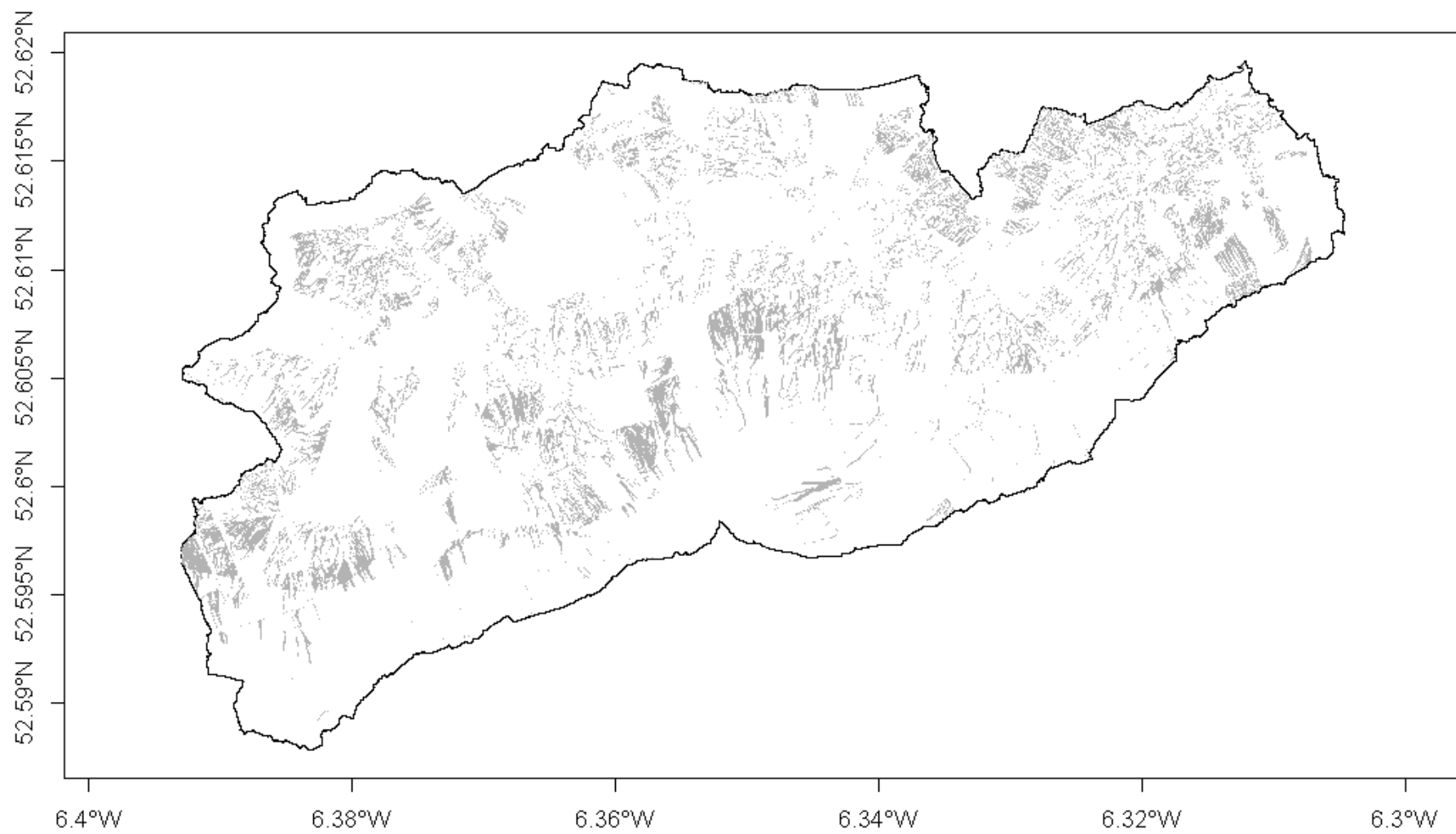


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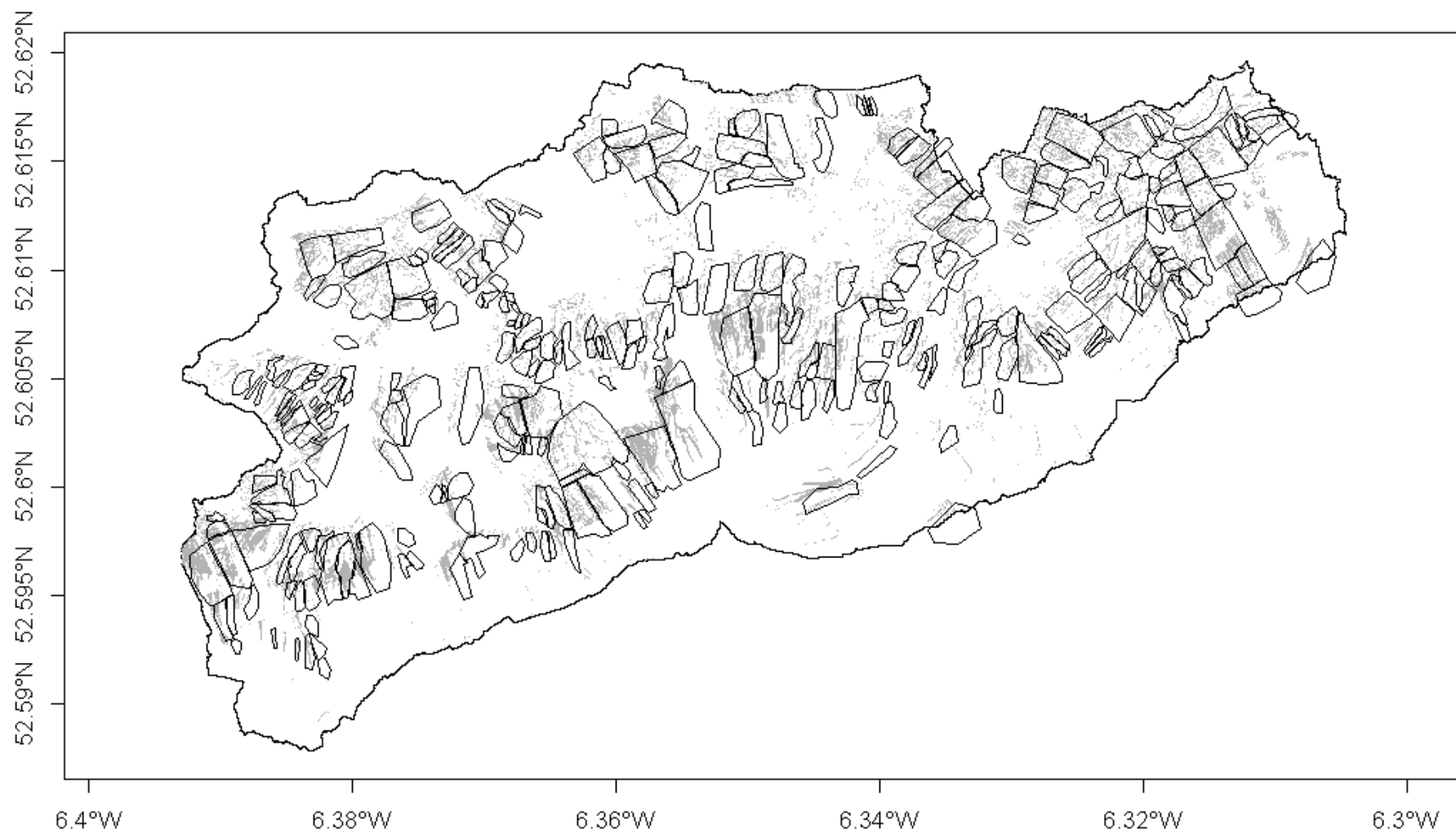


Latitude

Longitude

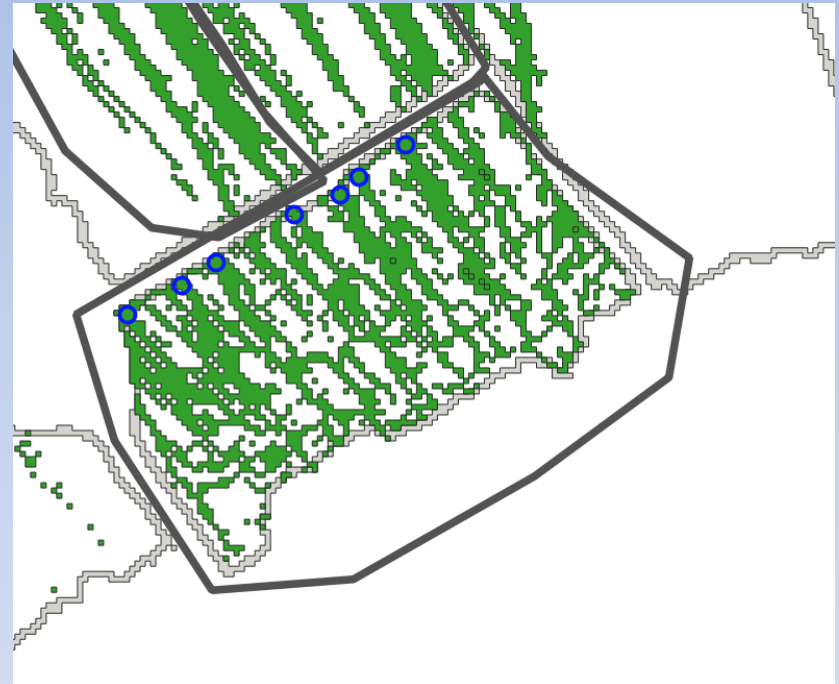
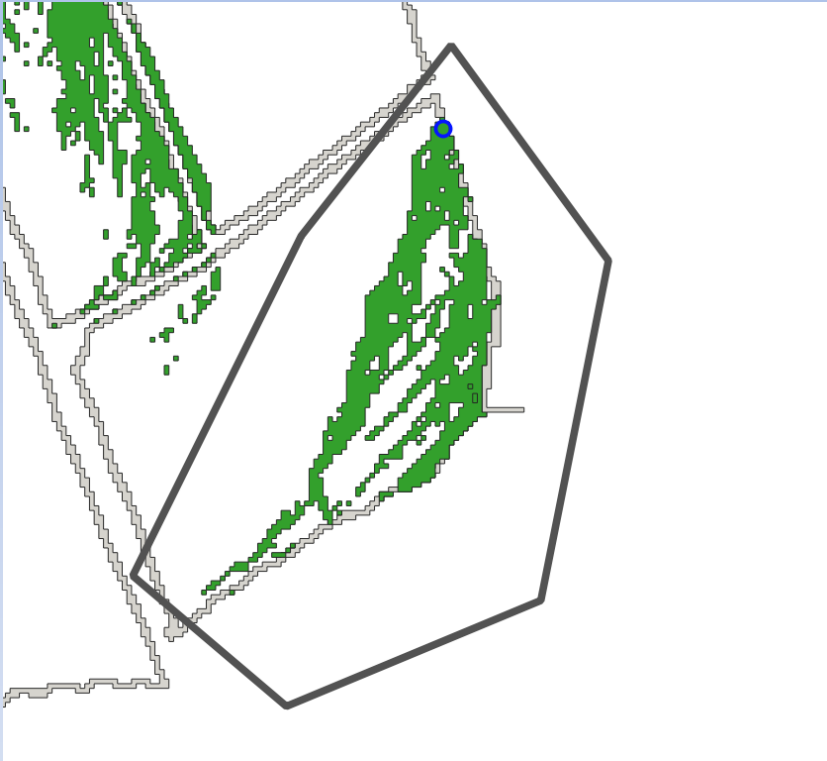


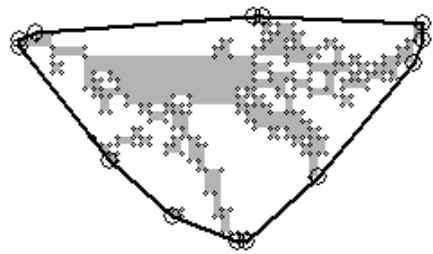
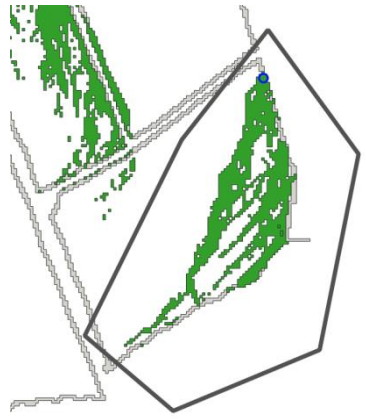
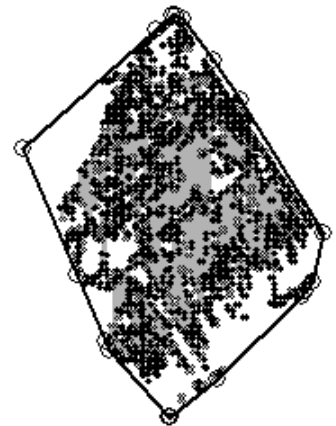
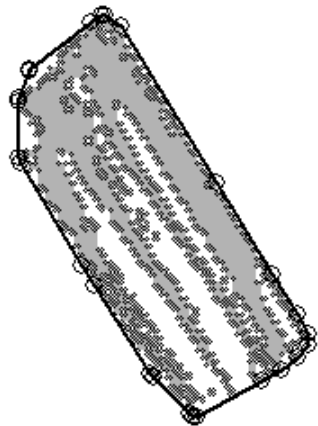
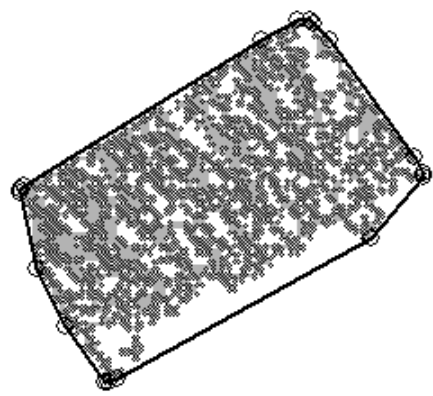
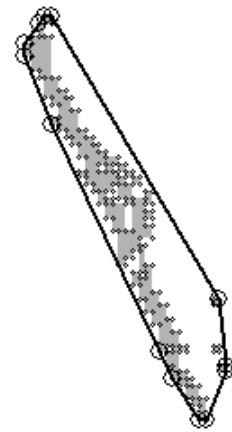
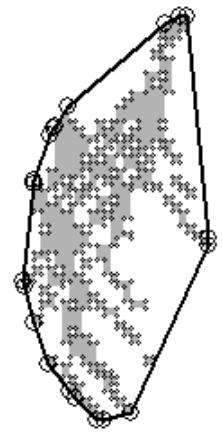
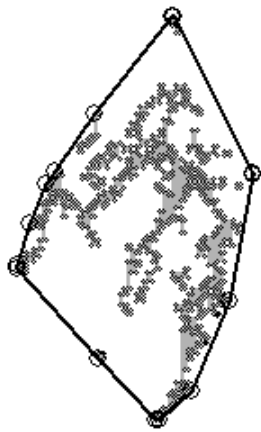
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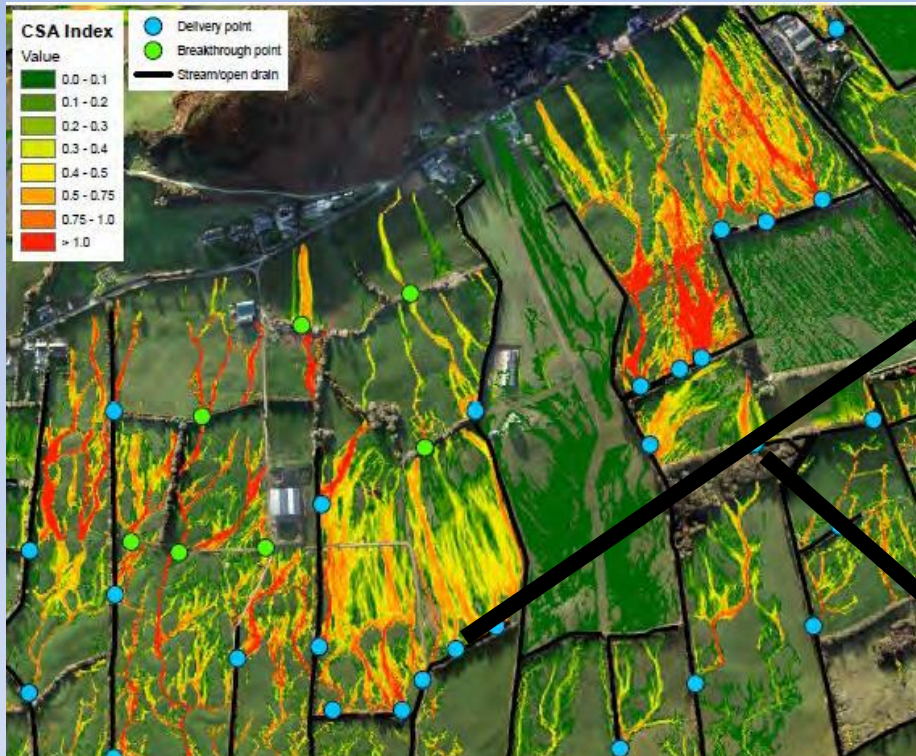
Latitude

Two more examples.....





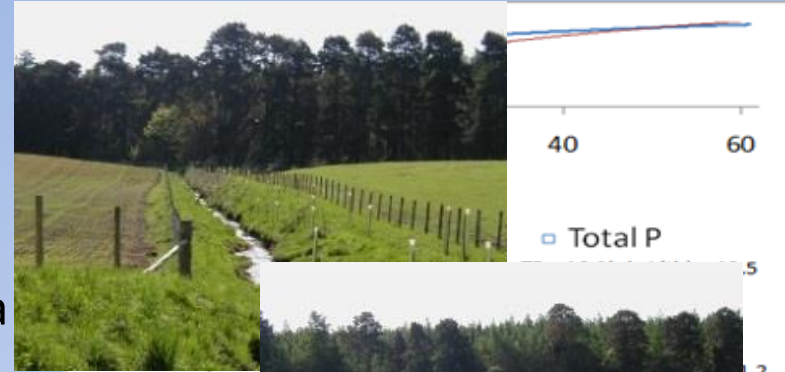
Characterise delivery points



WP4 - Right Measure: Optimising the right buffer for the risk situation

Objectives

- Effectiveness review: detailed for P, N and SS.
- Evidence for varying buffer P mitigation across a matrix of differing buffer designs in interaction with different landscape.
- ACP + other data used to quantify P delivery mitigation scenarios for the different buffer design/landscape combinations.
- Model in a number of AforA



Mitigation action	Diagrammatic representation		Mode of action
	Cross section	Aerial view	
Linear grass buffer strip over all field edges bordering a watercourse			<p>Sets back agricultural activities with a linear strip that is enhanced over the regulatory minimum width.</p> <p><i>Provides:</i> moderate erosion interception, limited habitat improvement, no interception of subsurface pathways</p>
Linear buffer strip with managed vegetation			<p>Trees or wildflower specific seed mixes planted.</p> <p><i>Provides:</i> Enhanced habitat benefits and tree roots and canopy intercept subsurface and aerial pollutant pathways.</p>
Targeted denitrification buffer zone protecting areas of groundwater upwelling			<p>Buffer widths are maximised at key locations of upwelling groundwater (and minimised elsewhere).</p> <p><i>Provides:</i> Denitrification is locally encouraged by letting water pass slowly through saturated soils where organic matter contents are large.</p>
Targeted grass erosion buffer zone at surface runoff delivery points			<p>Buffer widths are maximised at key locations of erosion delivery to the channel (and minimised elsewhere).</p> <p><i>Provides:</i> A widened grass filter strip capable of trapping moderate erosion at delivery hot-spots.</p>
Targeted erosion buffer zone with erosion traps (sculpted ground)			<p>Widened buffer areas contain engineered sediment traps at erosion hot-spots (widths minimised elsewhere).</p> <p><i>Provides:</i> Sculpted ground (bunds) and leaky barriers provide more certain functioning for erosion control at challenging delivery locations.</p>
Targeted buffer zone with actions to intercept subsurface artificial soil drains			<p>Widened buffer widths contain approaches to intercept subsurface tile drains (widths minimised elsewhere).</p> <p><i>Provides:</i> A range of solutions (mini-wetlands, ability to irrigate drain water onto <u>topsoils</u>) that tackle major preferential subsurface pathways</p>
Do only the regulatory minimum			<p>The minimum mandatory widths of no cultivation and no spread zones for slurry/manure are applied.</p>

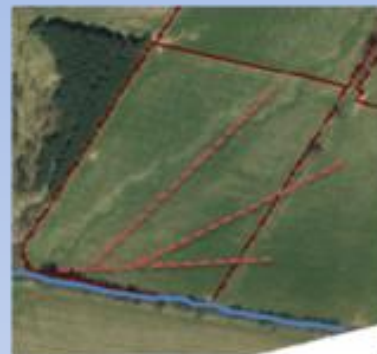
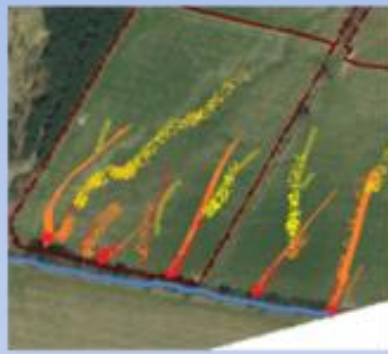
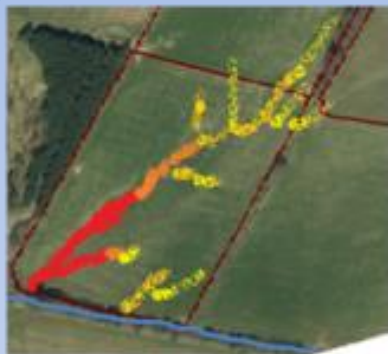
Hydrology
Buffer

Dominant
major surface
flowpath

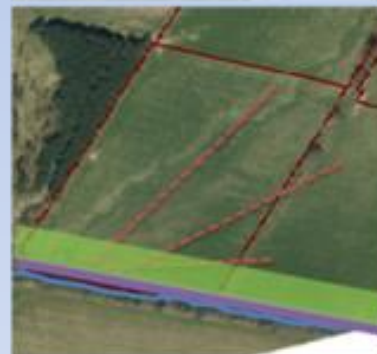
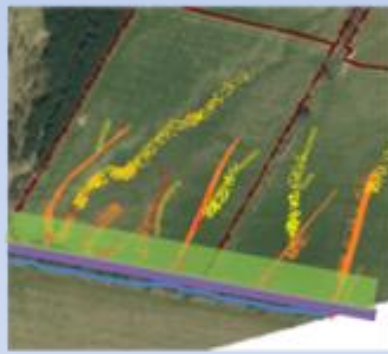
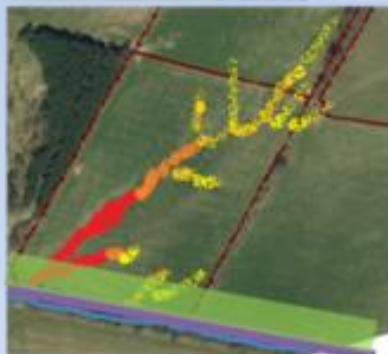
Numerous
minor surface
flowpath

Dominant
flow through
drain network

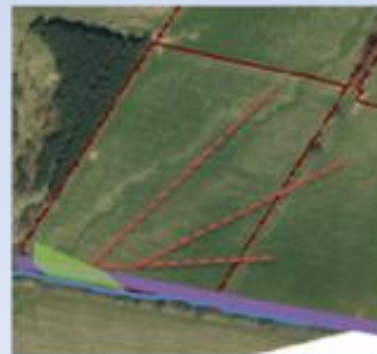
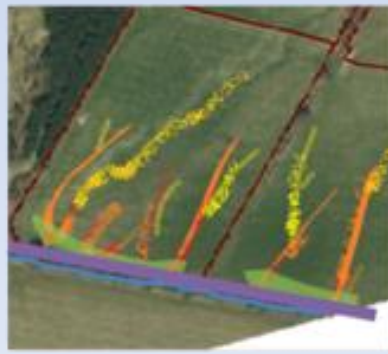
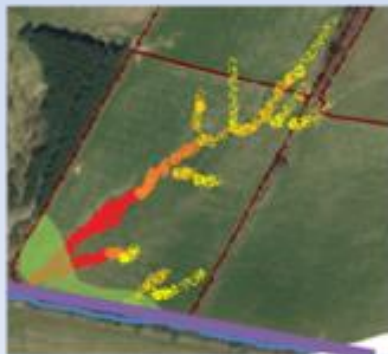
No buffer



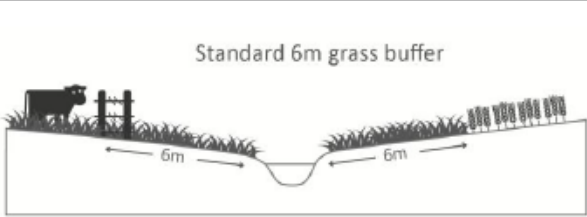


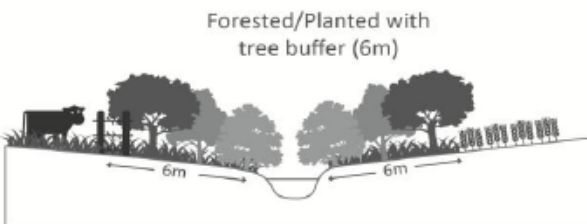
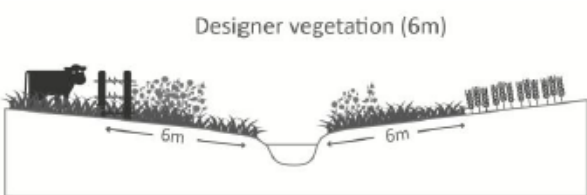
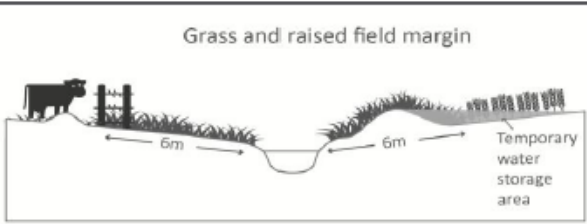
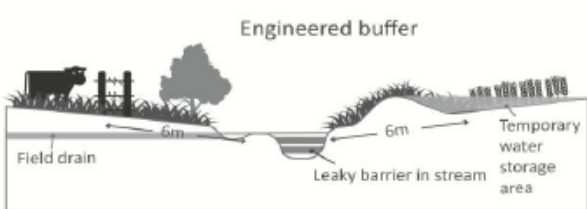
Linear 'surface
flow' buffers:
2m (purple)
10 m (green)



Spatially &
flowpath
optimised
buffers



5 measures packages based on a 6 m margin

Package	Schematic	Cost & effort	Acceptance	Specific aspects
<u>Vegetated</u> Buffer	 <p>Standard 6m grass buffer</p>			Commonly adopted, familiar measure for basic set of outcomes
<u>Wooded</u> Buffer	 <p>Forested/Planted with tree buffer (6m)</p>			Acceptable, benefits for C, biodiversity, airborne spray drift, deep rooting to GW
<u>Designer</u> vegetation	 <p>Designer vegetation (6m)</p>			Specific biodiversity goals, pollinator habitat, can use nutrient mining plants
<u>Raised</u> field margin	 <p>Grass and raised field margin</p>			Raised ground for more extreme erosion control, fine particles, flood benefits
<u>Engineered</u> buffer	 <p>Engineered buffer</p>			Specific options to tackle drains and bring wetness diversity. Includes margin and cross-ditch measures

Objectives

- # Visual Evaluation of Soil Structure
- Soil structure affects root penetration, water availability to plants and soil aeration. This simple, quick test assesses soil structure based on the appearance and feel of a block of soil dug out with a spade.
- The scale of the test ranges from Sq1, good structure, to Sq5, poor structure.
- Equipment:**
- Garden spade approx. 20 cm wide, 22-25 cm long.
 - Optional: light-coloured plastic sheet, sack or tray -50 x 80 cm, small knife, digital camera.
- When to sample:**
- Any time of year, but preferably when the soil is moist.
If the soil is too dry or too wet it is difficult to obtain a representative sample.
Roots are best seen in an established crop or for some months after harvest.
- Where to sample:**
- Select an area of uniform crop or soil colour or an area where you suspect there may be a problem. Within this area, plan a grid to look at the soil at 10, preferably more, spots. On small experimental plots, it may be necessary to restrict the number to 3 or 5 per plot.
- Method of assessment:**
- | Step | Option | Procedure |
|---|--|--|
| 1. Block extraction and examination | Loose soil | Remove a block of soil ~15 cm onto the sheet, tray or the ground |
| | Firm soil | Dig out a hole slightly wider and deeper than the undisturbed soil, cut down each side |
| 2. Examine soil block | Uniform structure | Remove any compacted soil or debris from surface |
| | Two or more horizontal layers or differing structure | Estimate the depth of each layer and prepare photographs |
| 3. Break up block (take a photograph - optional) | | |
| 4. Break up or major aggregates to confirm score | | |
| 5. Assign score | | |
| 6. Confirm score from: | | |
| Block extraction and size | Match the soil to the pictures category by category to determine which factors are increasing score: | |
| Aggregate shape and size | Factors increasing score: | |
| Roots | Difficulty in extracting the soil block | Larger, more angular, less porous, presence of large worm holes |
| Anaerobism | Clustering, thickening and deflections | Pockets or layers of grey soil, smelling of sulphur and presence of ferrous ions |
| Aggregate fragmentation | Break up larger aggregates ~ 1.5 - 2.0 cm or diameter fragments to reveal their type | |
| 7. Calculate block scores for two or more layers or differing structure | Multiply the score of each layer by its thickness and divide the product by the overall depth
e.g. for a 25 cm block with 10 cm depth of loose soil (sq1) over a more compact (Sq3) layer:
$(1 \times 10)/25 + (3 \times 15)/25 = sq\ 2.2$ | |
- Scoring:** Scores may fit between Sq categories if they have the properties of both.
Scores of 1-3 are usually acceptable whereas scores of 4 or 5 require a change of management.
- Contact Information:**
- Brian Ball, DRUG, b.ball@lancaster.ac.uk
Rachel Garmann, University of Lancaster, Rachel.Garmann@lancaster.ac.uk
Tom Bailey, Independent Consultant, tom.bailey@bt.com and
Lars Munkholm, University of Aarhus, Denmark, lars.munkholm@agrsci.dk

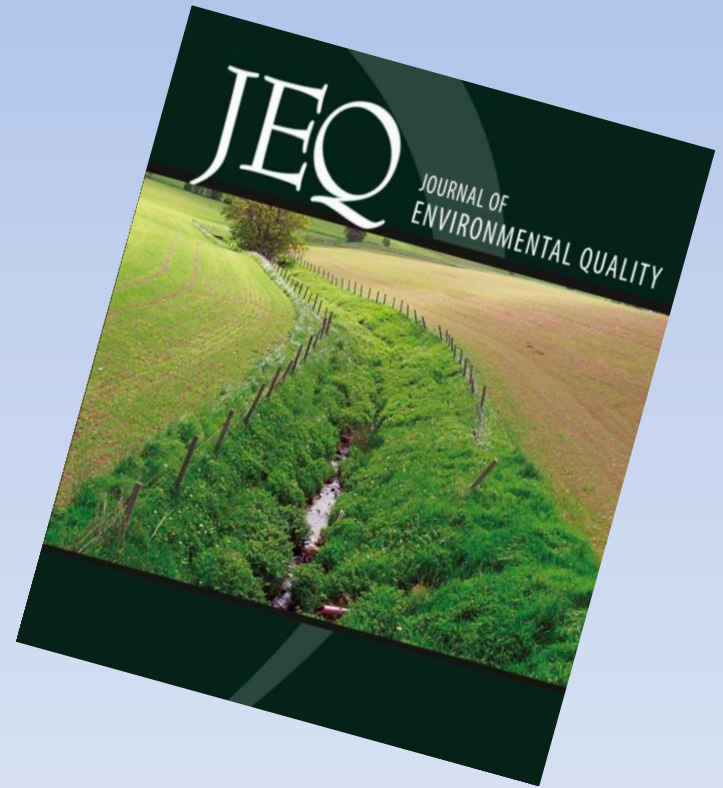
Buffer Demonstration

- Link with ongoing/future work
 - EIPs
 - LIFE sites
 - Blue Dot sites
 - Teagasc Farms in AforA
 - Other projects - SlowWater
 - ASSAP/LAWPRO sites?



Web resources + Dissemination

- www.smarterbufferz.ie
- @smarter_bufferz



Lessons learned + Best practice

Lessons learned

Best practice

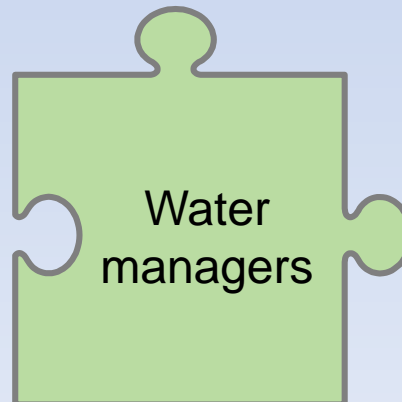
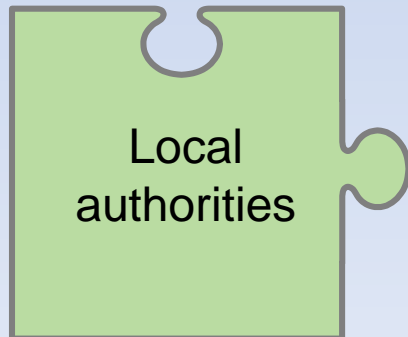
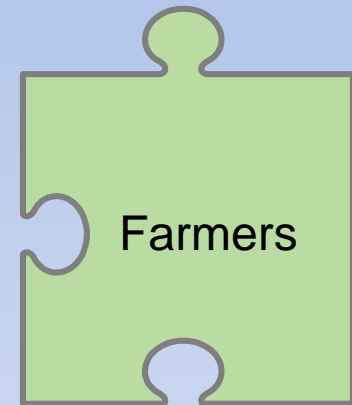
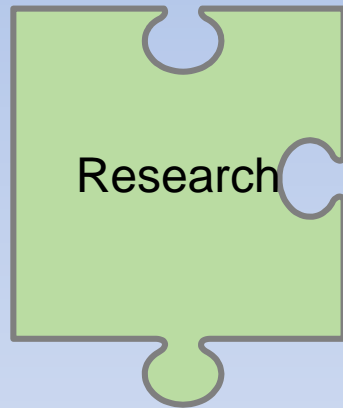
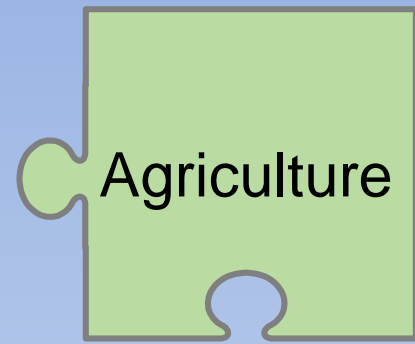
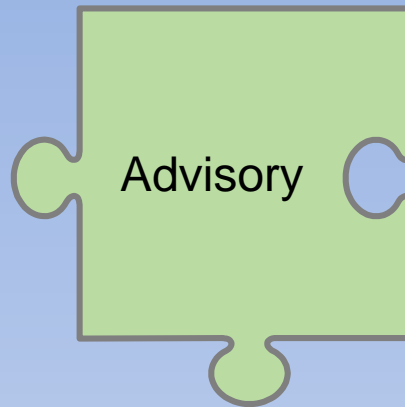
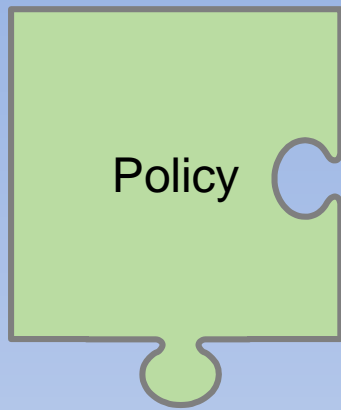
Novel solutions





Engagement with LAWPRO& ASSAP +

- Recommending potential trial/ demonstration catchments
- Interaction with existing data for trial catchments
 - Potential for additional data collection by field officers?
- Development of scorecards
- Dissemination
 - Collation of best practice
- ASSAP + LAWPRO suggestions?



THANK YOU

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Model Catchments

	Poorly drained	Well drained
Agricultural Catchments Programme	<ul style="list-style-type: none"> Owenavorrhagh (Ballycanew - ACP) 	<ul style="list-style-type: none"> Lough Mask and Carra (?) (Cregduff-ACP)
Teagasc Farm in catchment	<ul style="list-style-type: none"> Annalee (Teagasc Ballyhaise) 	<ul style="list-style-type: none"> Dead and Cauteen (Teagasc Solohead) Clonakilty (Teagasc Clonakilty)
EIP/LIFE	<ul style="list-style-type: none"> Upper Caragh (KerryLIFE; Freshwater Pearl Mussel EIP) 	<ul style="list-style-type: none"> Glenaboy (BRIDE EIP) Bannow (Duncannon EIP)
Natura2000	<ul style="list-style-type: none"> Upper Caragh (Caragh River Catchment SAC) Annalee (Ballyhaise) (Lough Oughter SAC) 	<ul style="list-style-type: none"> Clonakilty (Clonakilty) (Clonakilty SAC) Glenaboy Bannow (Bannon Bay SPA Hook Head SAC) Lough Mask and Carra Mweelrea SAC/ Lough Mask SPA
LAWPRO/ ASSAP suggestion*	<ul style="list-style-type: none"> ?? 	<ul style="list-style-type: none"> ??
Blue Dot	Multiple....	Multiple...

*Suggestions could be based on availability of high resolution data, good catchment walkover data, good farm walk data, good farmer engagement