

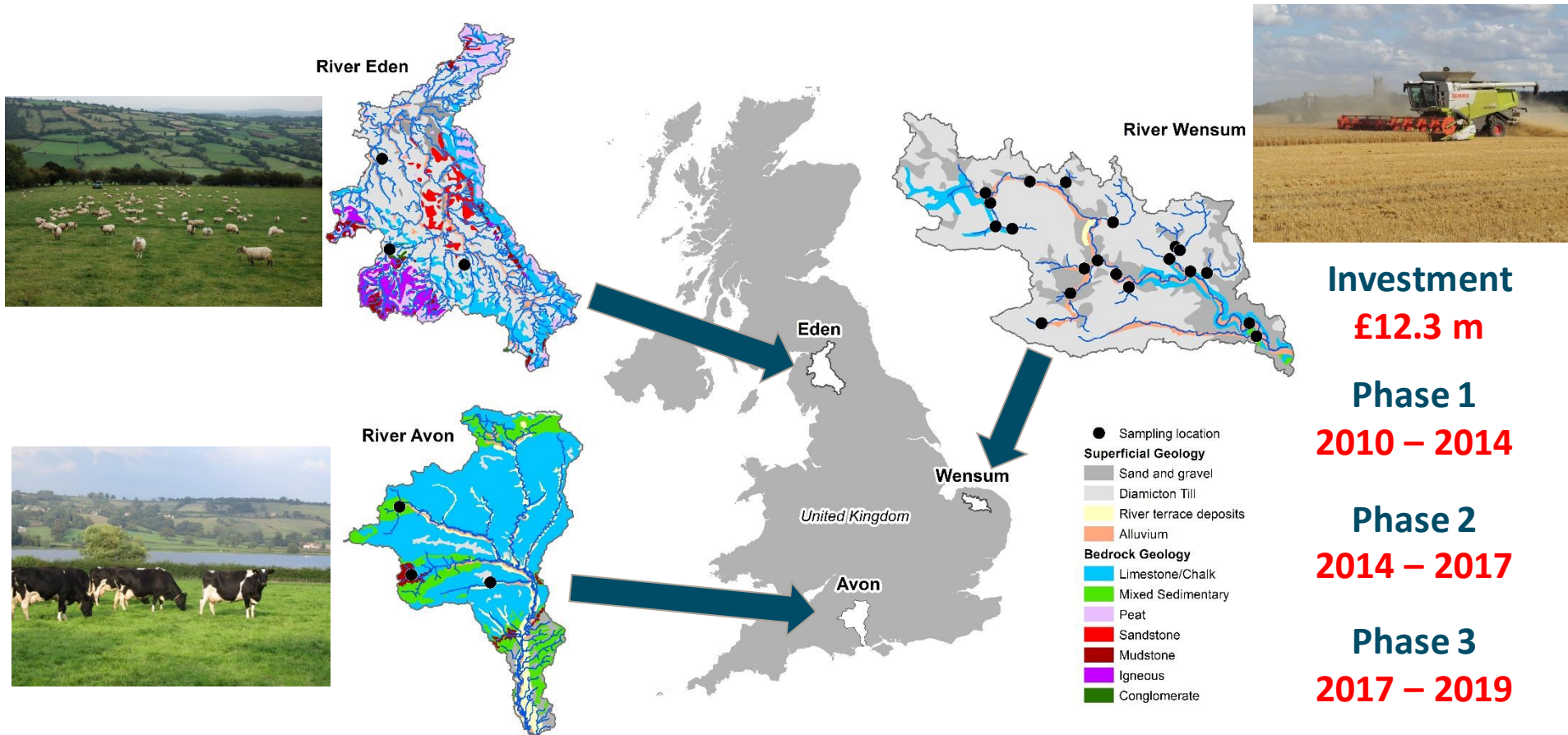
Farming to Protect Soil & Water Resources

River Wensum Demonstration Test
Catchment (DTC): 2010–2018



Catchment Science Research

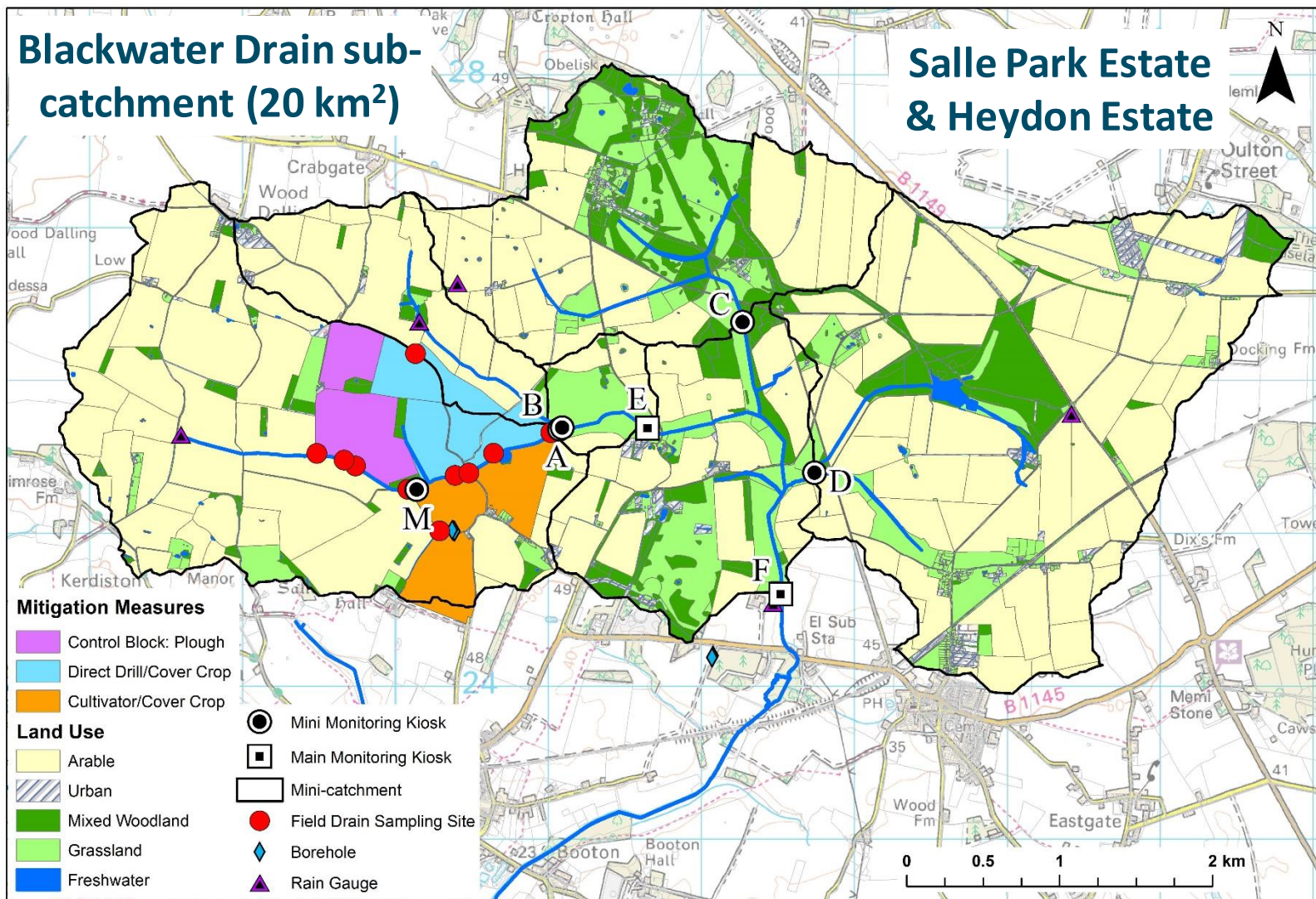
Demonstration Test Catchments (DTCs)



The DTC project aims to evaluate the extent to which on-farm mitigation measures can cost-effectively reduce the impacts of water pollution on river ecology while maintaining food production capacity.

Catchment Monitoring Programme

Wensum DTC study catchment



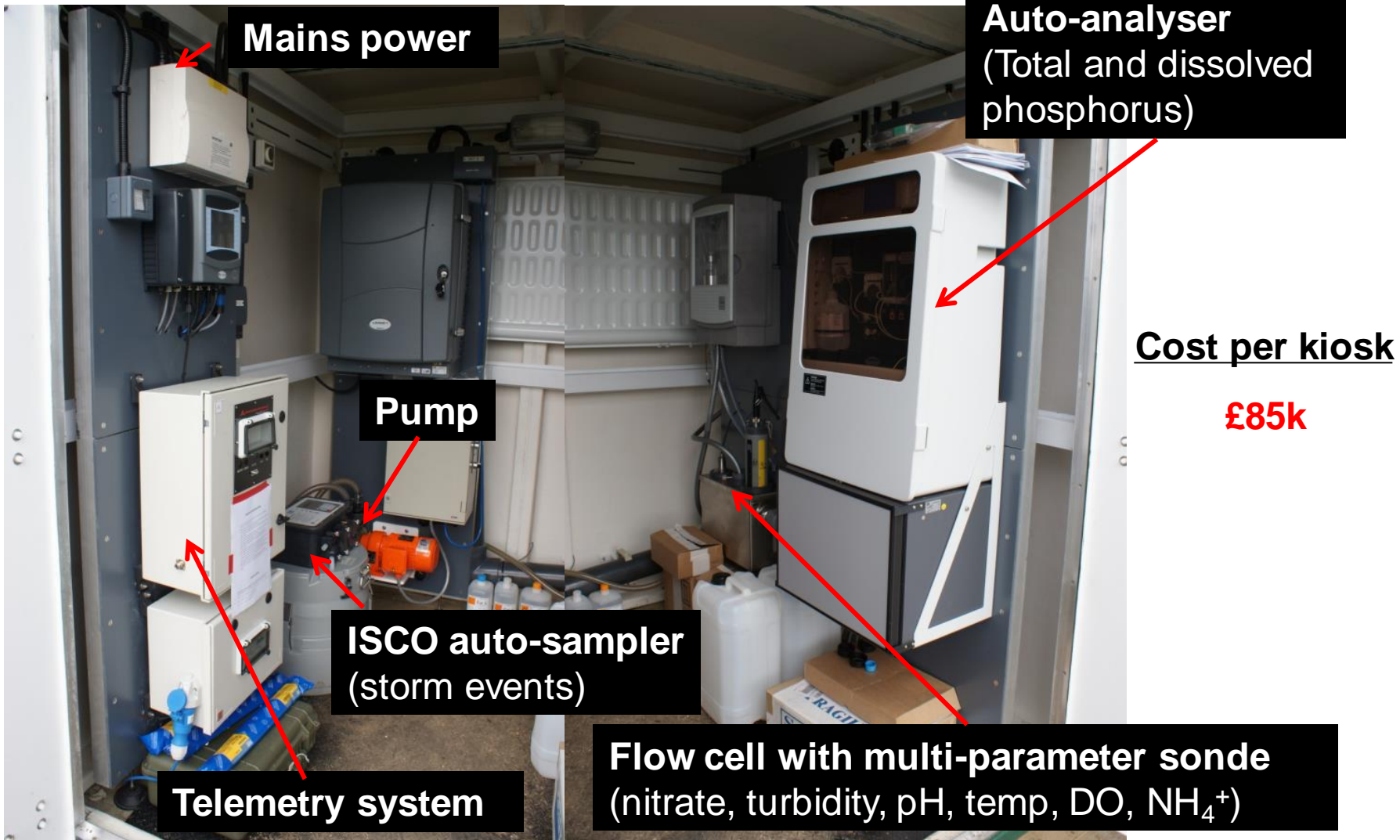
Catchment Monitoring Programme

Riverine monitoring: bankside kiosks



Catchment Monitoring Programme

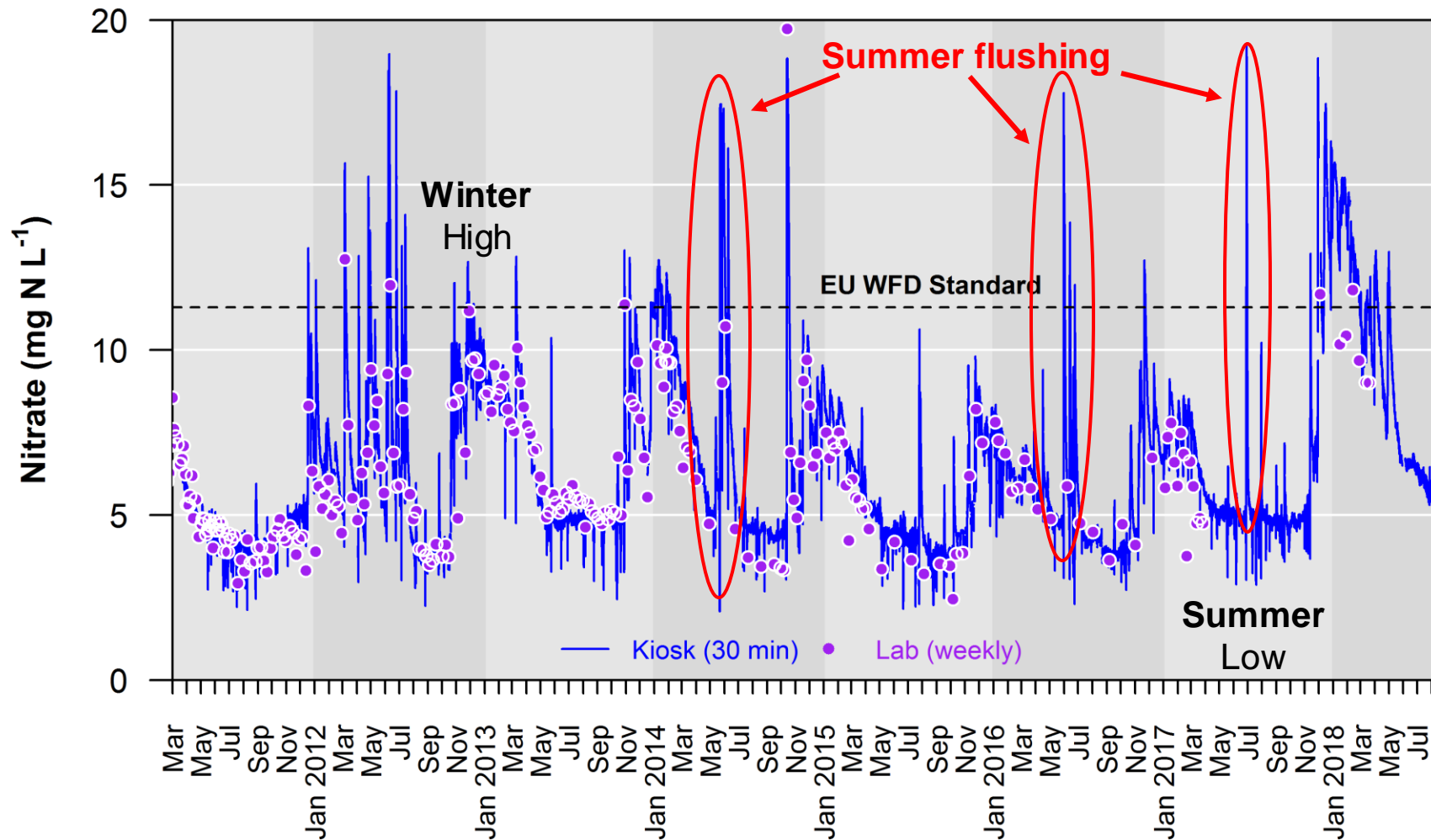
Riverine monitoring: bankside kiosks



Catchment Monitoring Programme

Riverine monitoring: bankside kiosks

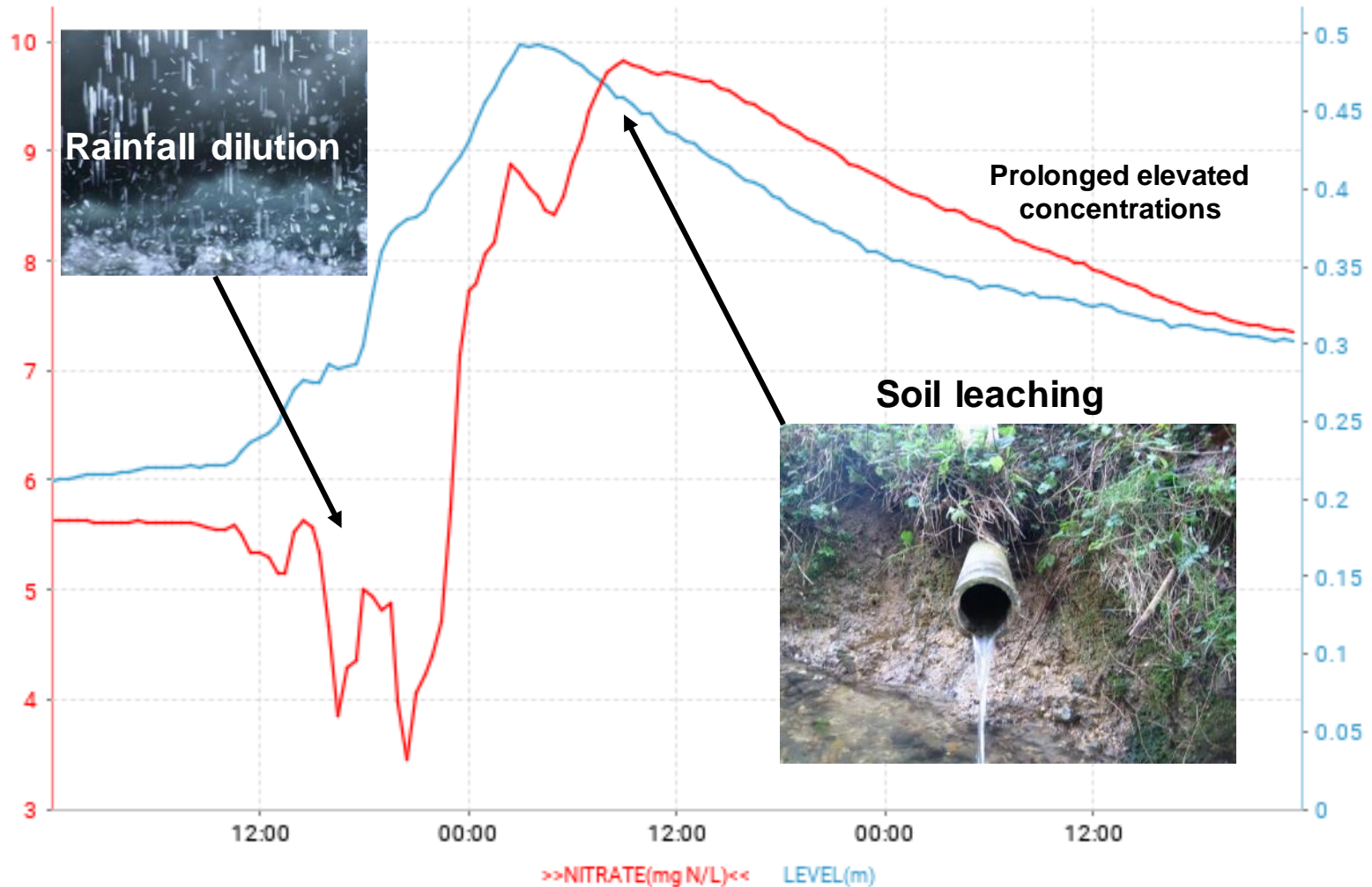
Stinton Hall Nitrate Concentration



Catchment Monitoring Programme

Riverine monitoring: nitrogen

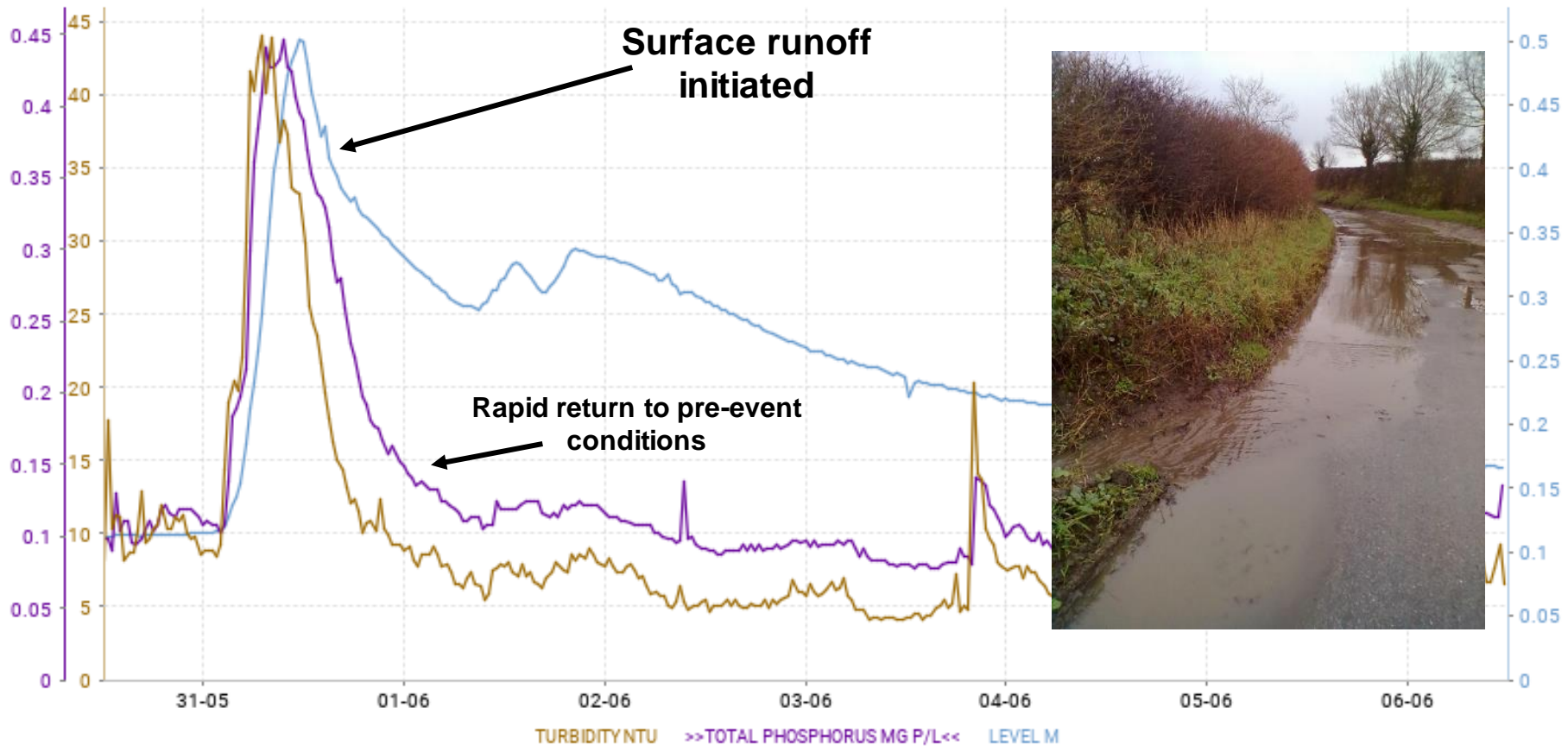
STINTON HALL FARM ANALOGUES 20/06/2016 00:00 - 22/06/2016 23:59 GMT



Catchment Monitoring Programme

Riverine monitoring: phosphorus and sediment

PARK FARM 30/05/2016 12:00 - 06/06/2016 11:59 GMT



Salle Farms Company



SALLE FARMS Co.

Helping to lead modern farming technology



2500 ha arable



Property, Christmas trees and grain handling facility



Crush Foods



Poul Hovesen
Estate Manager

Seven year crop rotation begun in mid-1990s – cultivation system as of **2012**

| | Crop 1 | Crop 2 | Crop 3 | Crop 4 | Crop 5 | Crop 6 | Crop 7 |
|---------------------------|-----------------------|--------------------------|---------------------------|-----------------------------|------------------------------|---------------------------|--------------|
| Organic Manure | | Limex 70 + Turkey Manure | | | | Limex 70 | |
| First Preparation | Plough | Plough | Stubble Cutter | Plough | Plough | Plough | |
| Weed Control | | | Glyphosate | | | | |
| Second Preparation | Press followed by NZA | Press followed by NZA | Discordon followed by NZA | NZA Springtine Cultivator | Press followed by NZA | NZA Springtine Cultivator | Discordon |
| Drilling | Rapid | Rapid | Rapid | Compactor / Precision Drill | Rapid | Rapid | Rapid |
| Planted Crop | Winter Barley | Winter Oilseed Rape | Winter Wheat | Sugar Beet | Winter Wheat / Spring Barley | Spring Beans | Winter Wheat |



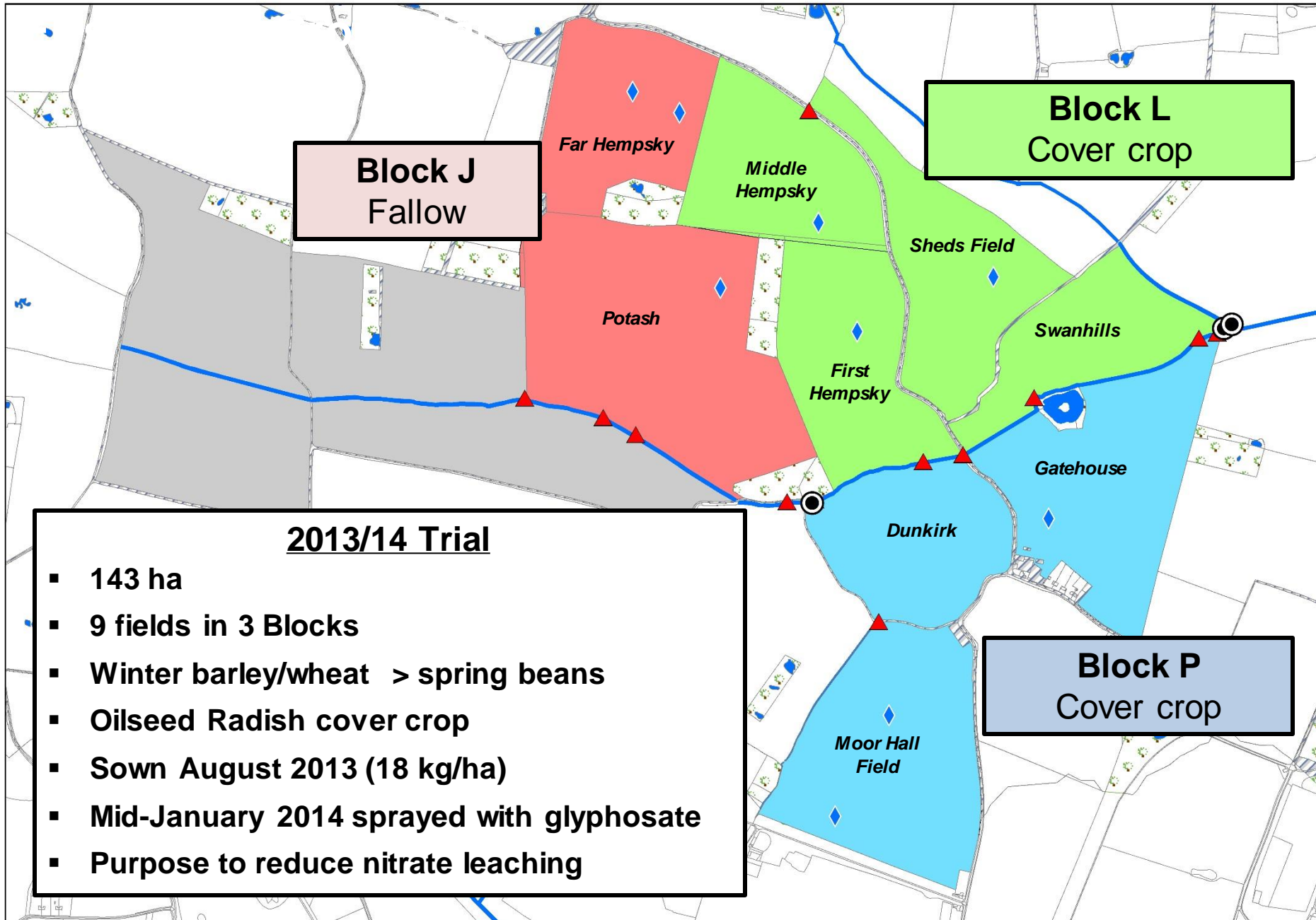
Nutrients | Sediment | Pesticides | Soil





Nutrients: Winter Cover Crops





Winter Cover Crops

Trial 1: November 2013

Block J



Block P



Block L



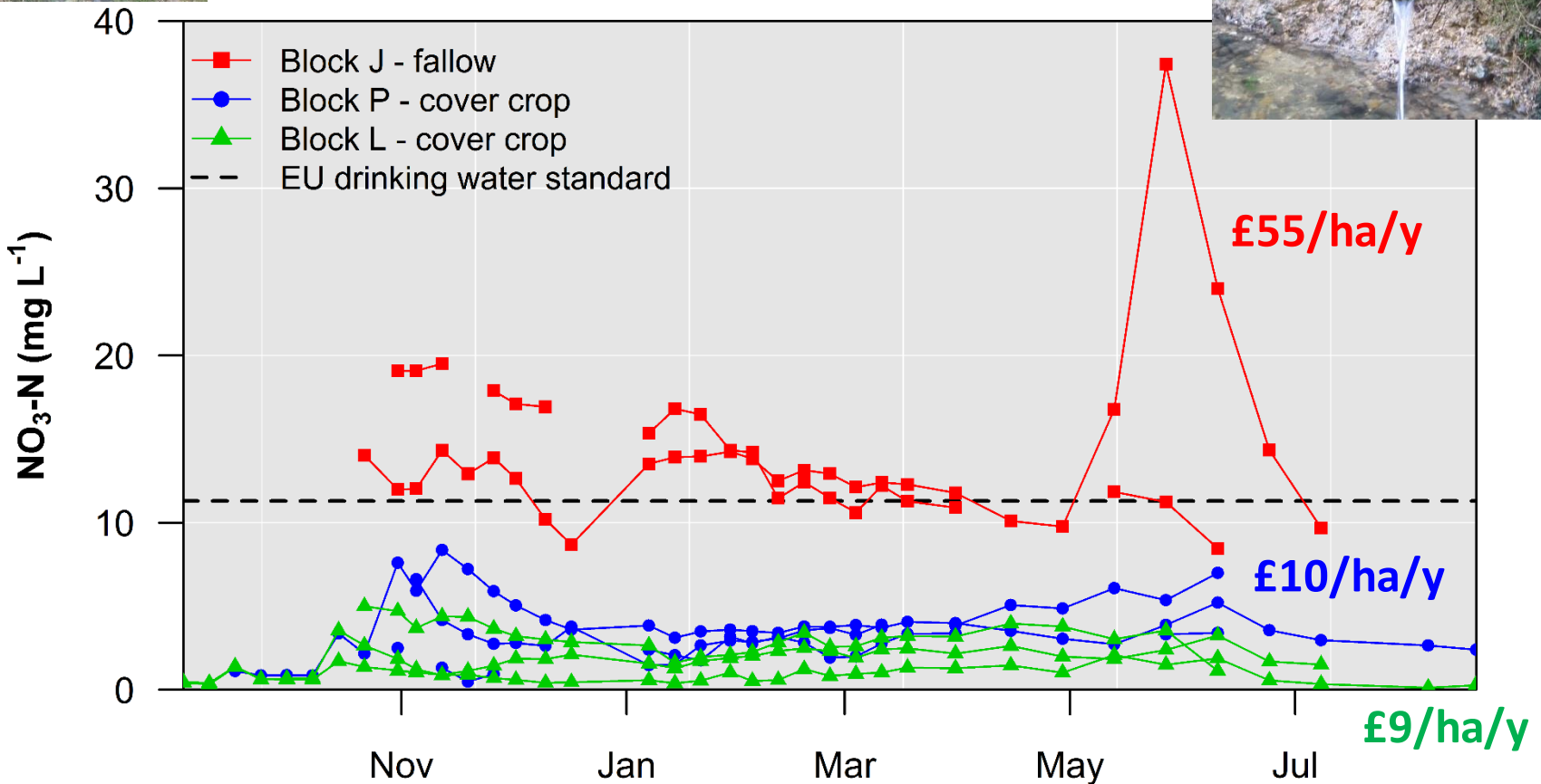
Winter Cover Crops

Field Drain Monitoring



P = **75%** reduction in N losses

L = **88%** reduction in N losses



Winter Cover Crops

Economics: Farm returns

First Cover Crop Trial in Winter 2013/2014

| | Block J | Block P | Block L |
|-----------------------------------------|----------------|----------------|----------------|
| | Fallow | Cover crop | Cover crop |
| Gross output beans: Yield (t/ha) | 5.80 | 6.55 | 6.24 |
| Output at £260/t (£/ha) | 1334 | 1435 | 1506 |
| Costs: Establishment (£/ha) | 96 | 128 | 67 |
| Applications (£/ha) | 90 | 120 | 120 |
| Variable costs (£/ha) | 318 | 415 | 432 |
| Harvesting (£/ha) | 85 | 85 | 85 |
| Total costs (£/ha) | 589 | 704 | 748 |
| Margin (£/ha) | 745 | 731 | 758 |

Output
+ 8-12%
with a
cover crop

Costs
+ £120–160/ha
with cover crop

Acknowledgement: Data supplied by Salle Farms Co.

Winter Cover Crops

Economics: Farm returns

Second Cover Crop Trial in Winter 2015/2016

| | Block 1 | Block 1 | Block 2 | Block 2 |
|------------------------------------|--------------|-------------------------|--------------|-----------------------|
| | Spring Beans | | Sugar Beet | |
| | Fallow | Cover crop OS Radish | Fallow | Cover crop mixture |
| Gross output: Yield (t/ha) | 5.9 | 4.7 | 64.3 | 85.6 |
| Bean output @ £230/t (£/ha) | 1,355 | 1,090 | | |
| Beet Output @ £25/t (£/ha) | | | 1,606 | 2,141 |
| Costs: Establishment (£/ha) | 107 | 143 | 158 | 147 |
| Applications (£/ha) | 94 | 85 | 105 | 102 |
| Variable costs (£/ha) | 293 | 338 | 562 | 592 |
| Harvesting (£/ha) | 85 | 85 | 200 | 200 |
| Total costs (£/ha) | 580 | 650 | 1,025 | 1,041 |
| Margin (£/ha) | 775 | 440 | 581 | 1,100 |

Sugar
beet
yield
+33%

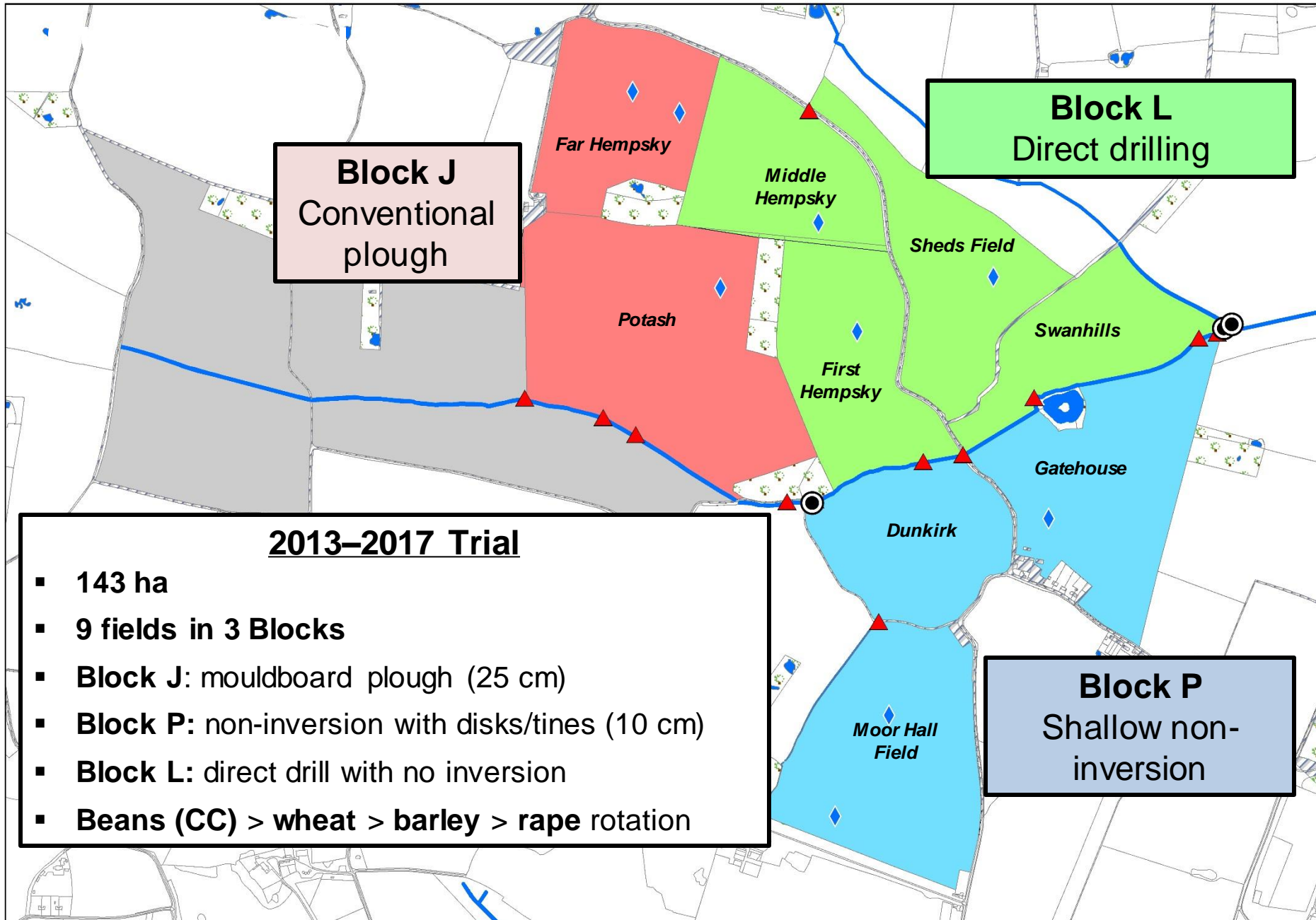
**£16
higher
£519
higher**

Acknowledgement: Data supplied by Salle Farms Co.



Soil Improvement: Reduced Tillage





Reduced Tillage

Agricultural Equipment



Block J: mouldboard plough



Block P: TopDown + Carrier (non-inversion)



Blocks J + P: Rapid drill



Block L: Seed Hawk direct drill

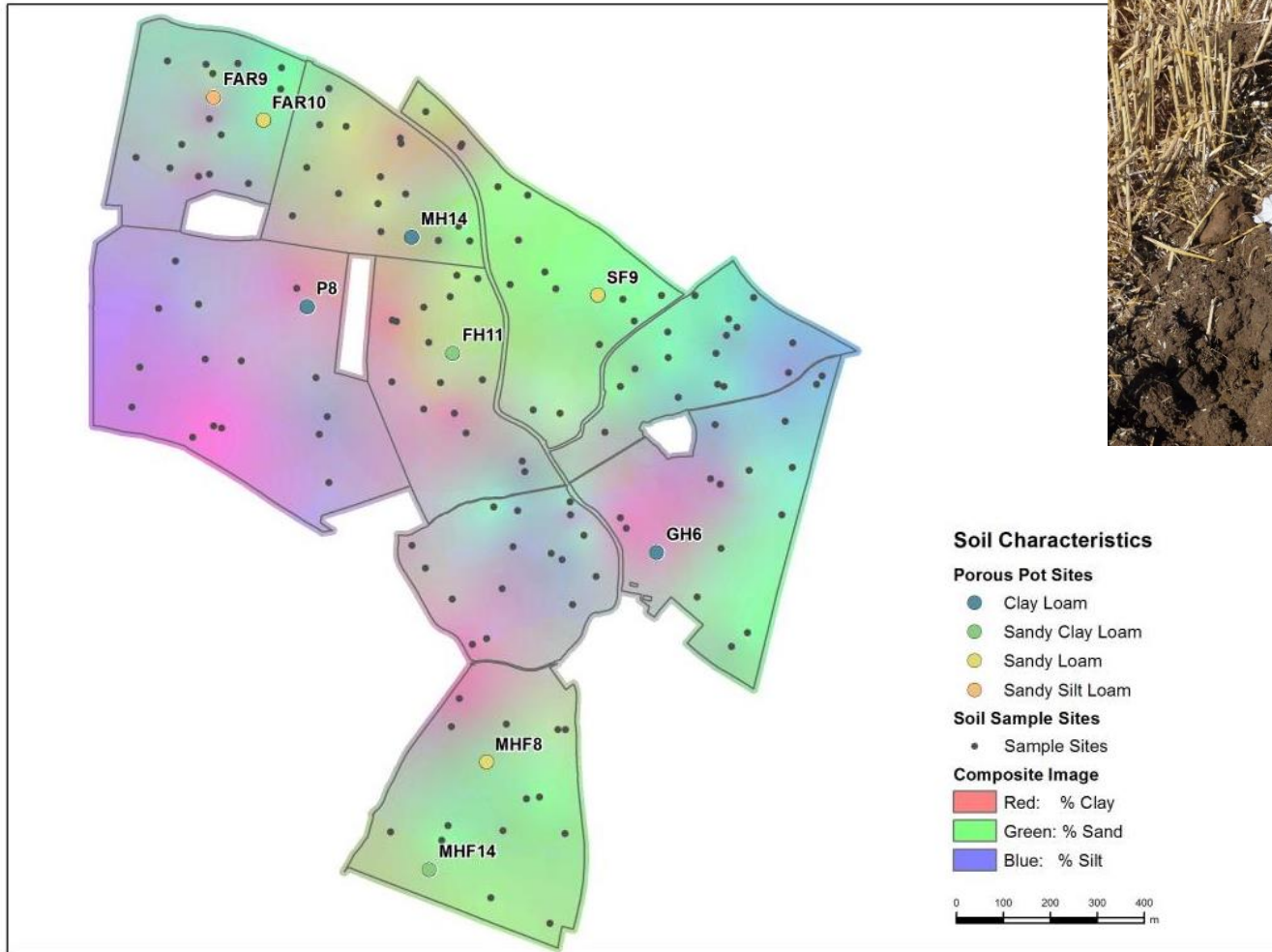


Cultivation

Sowing

Reduced Tillage

Soil assessments

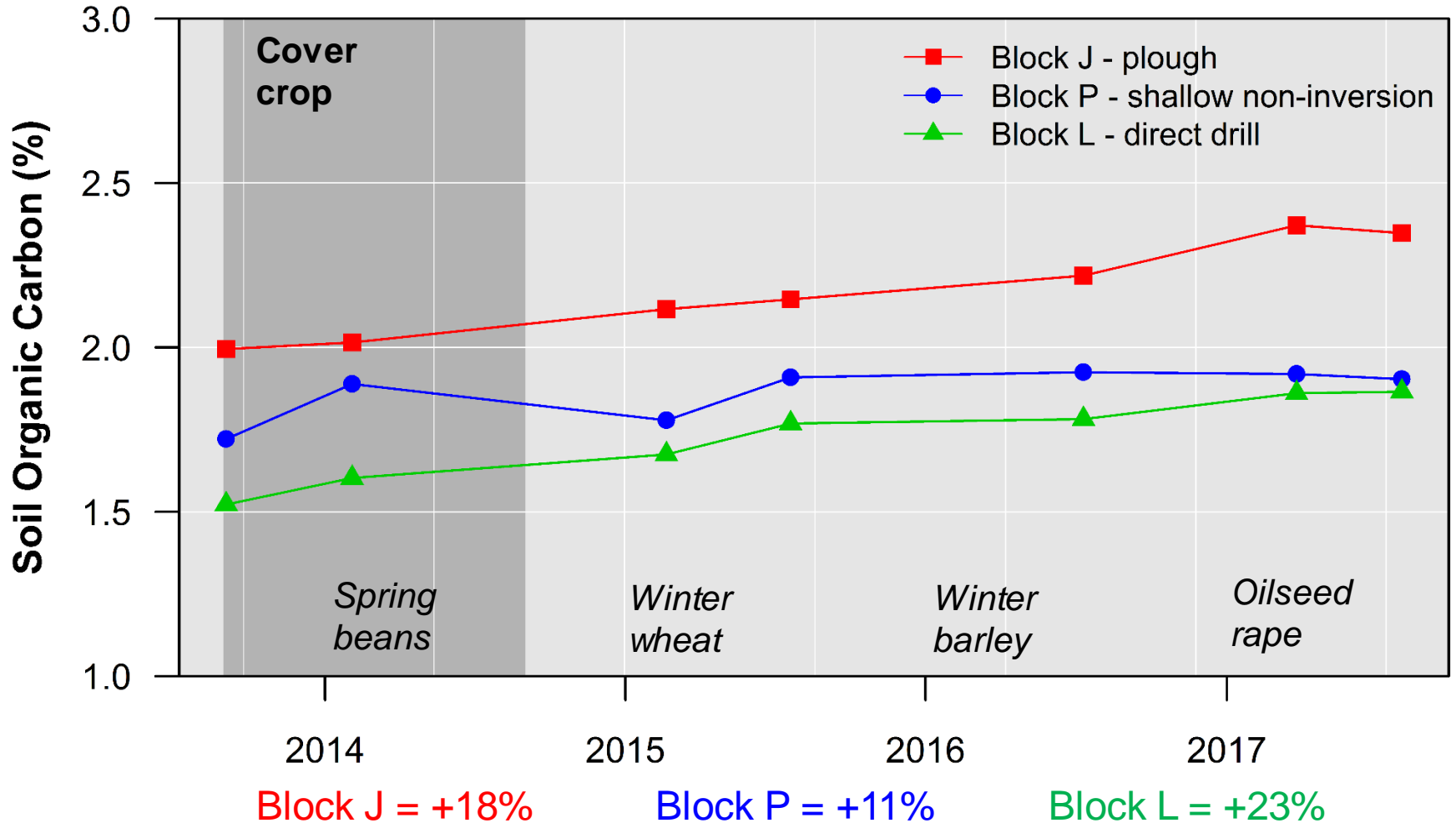


- Soil texture
- Soil structure
- Infiltration rate
- Bulk density
- SMN
- P, K, Mg indices
- OC content
- Soil biology

Aim: to assess the physical, chemical and biological condition of the soils

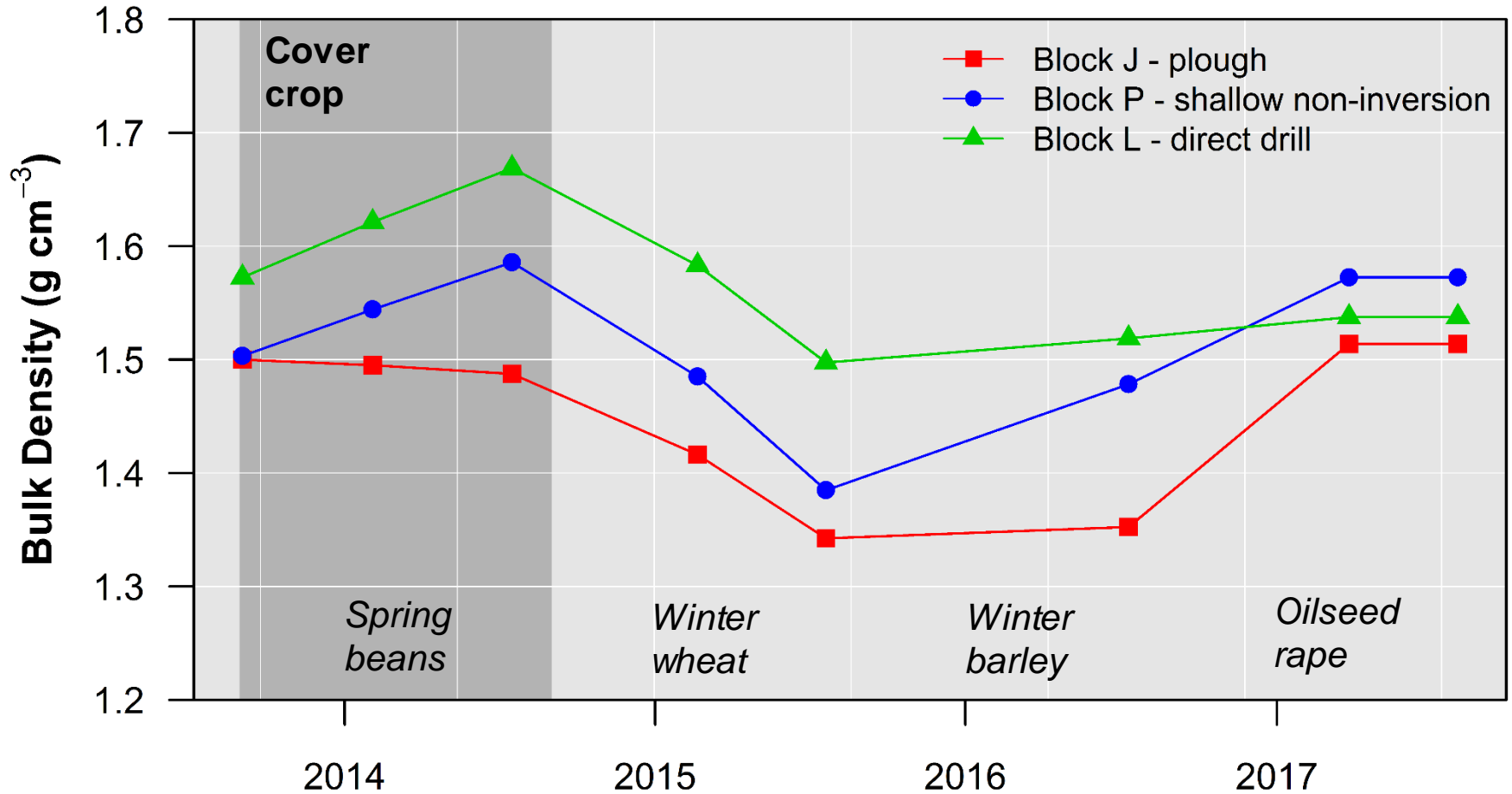
Reduced Tillage

Soil Chemistry: Organic Carbon



Reduced Tillage

Soil Structure: Bulk Density



Reduced Tillage

Economics: Farm Returns

| | | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
|-----------------------------|----------------------|----------------------|--------------|---------------|-----------------|
| | | Spring beans + CC | Winter wheat | Winter barley | Oilseed rape |
| Block J | Total cost (£/ha) | 589 | 784 | 561 | 600 |
| <i>Plough</i> | Output (£/ha) | 1,334 | 1,694 | 1,086 | 1,734 |
| | Margin (£/ha) | 745 | 910 | 525 | 1,134 |
| Block P | Total cost (£/ha) | 748 | 782 | 581 | 553 |
| <i>Shallow non-inv.</i> | Output (£/ha) | 1,506 | 1,695 | 1,099 | 1,729 |
| | Margin (£/ha) | 758 | 913 | 518 | 1,176 |
| Block L | Total cost (£/ha) | 704 | 788 | 598 | 550 |
| <i>Direct drill</i> | Output (£/ha) | 1,435 | 1,620 | 1,086 | 1,613 |
| | Margin (£/ha) | 731 | 832 | 488 | 1,063 |

Block P: yield **0 – 4% higher** | costs **-8% – +4%** | Margins **0 – 4%** above Block J

Block L: **Lowest** fuel/labour costs | **highest** pesticide/fertiliser inputs | **Lower** yields
Margins **4 – 10%** below Block P

Reduced Tillage

Implications for the Farming System

Salle have now applied the shallow tillage system across their entire arable area.

| | Crop 1 | Crop 2 | Crop 3 | Crop 4 | Crop 5 | Crop 6 | Crop 7 |
|----------------------------|----------------------|------------------------------|---------------------|------------------------------|------------------------------|------------------------------|------------------|
| Organic Manure | | Limex 70 + Turkey Manure | | Turkey Manure | | Limex 70 | |
| Cover Crop Drilling | | | | Opus / Bio-Drill 50mm Points | | Opus / Bio-Drill 50mm Points | |
| Cover Crop Control | | | | Glyphosate (Nov/Dec) | | Glyphosate (Nov/Dec) | |
| First Preparation | Carrier Straw Harrow | Opus 50mm Points | Carrier CrossCutter | | Opus 50mm Points / Plough | | |
| Weed Control | Glyphosate | | | | | | |
| Second Preparation | Opus 50mm Points | | Opus 50mm Points | NZA Spring Tine Cultivator | | NZA Spring Tine Cultivator | Opus 50mm Points |
| Drilling | Rapid | Opus / Bio-Drill 50mm Points | Rapid | Compactor / Precision Drill | Rapid | Rapid | Rapid |
| Planted Crop | Winter Barley | Winter Oilseed Rape | Winter Wheat | Sugar Beet | Winter Wheat / Spring Barley | Spring Beans | Winter Wheat |

Average crop establishment costs across the seven year rotation have been calculated at £44/ha compared to £62/ha under the old system (a 29% reduction).

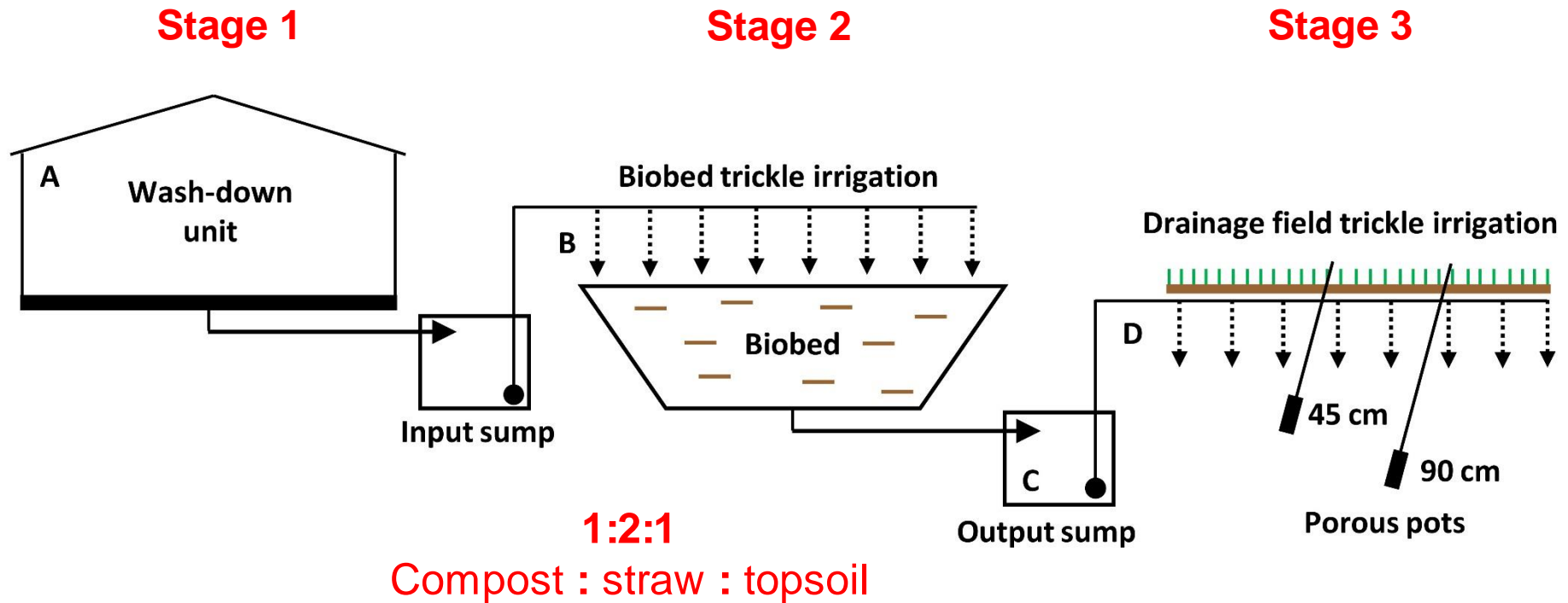


Pesticides: Biobed



Manor Farm Biobed

Experimental Design



Constructed in 2013 with Catchment Sensitive Farming (CSF) funding

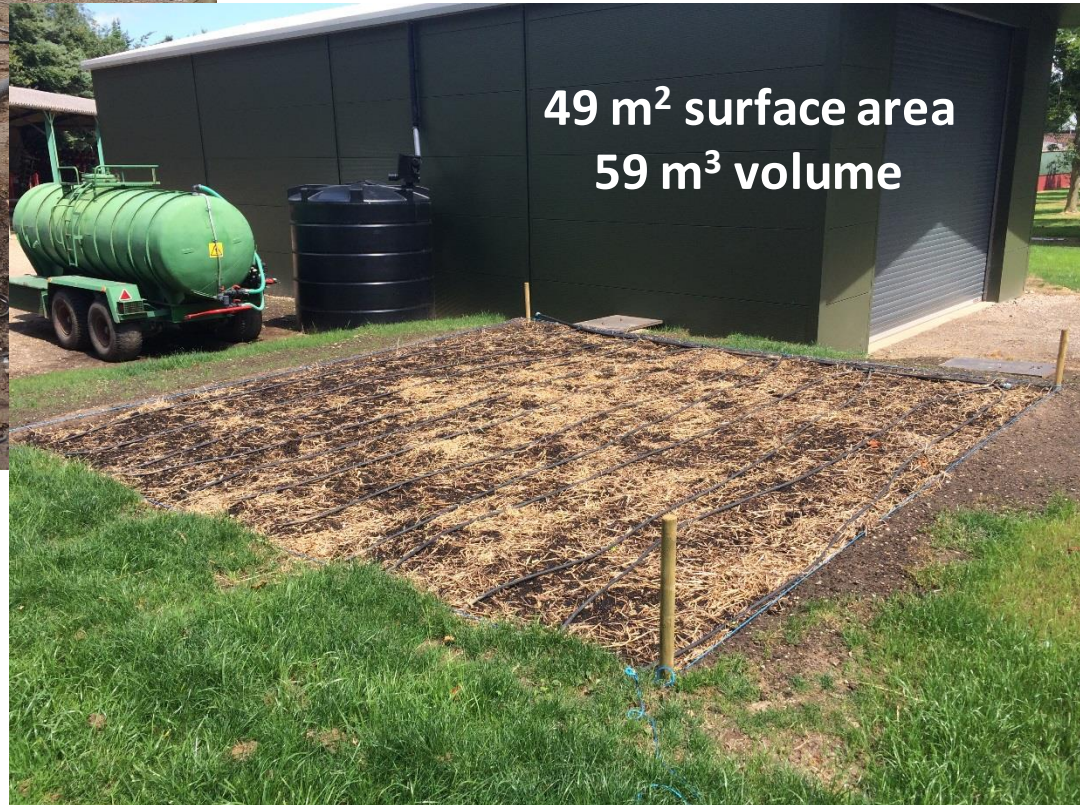
Manor Farm Biobed

Stage 1: wash-down facility



Manor Farm Biobed

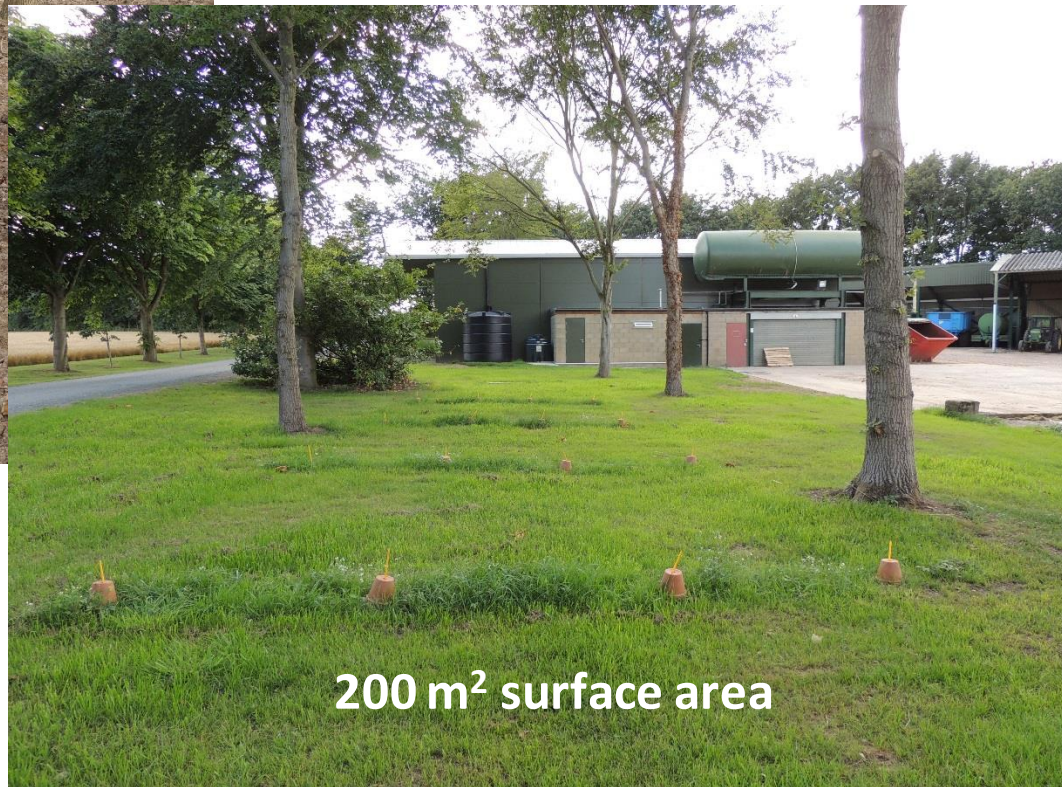
Stage 2: biobed and sumps



49 m² surface area
59 m³ volume

Manor Farm Biobed

Stage 3: drainage field



200 m² surface area

Manor Farm Biobed

Pesticide removal efficiency: 2013 - 2015

| Pesticide | Biobed Sump | | | Porous Pot | | | |
|--------------------|---------------------------------------------|--------|----------------|---------------------------------------------|----------------|-------|----------------|
| | Mean Concentration ($\mu\text{g L}^{-1}$) | | | Mean Concentration ($\mu\text{g L}^{-1}$) | | | |
| | Input | Output | Efficiency (%) | 45 cm | Efficiency (%) | 90 cm | Efficiency (%) |
| Propyzamide | 2551.3 | 60.0 | 97.6 | - | - | - | - |
| Chloridazon | 2547.7 | 81.9 | 96.8 | - | - | - | - |
| Triclopyr | 958.5 | 32.8 | 96.6 | 1.2 | 96.3 | 2.5 | 92.4 |
| Ethofumesate | 26935.1 | 980.9 | 96.4 | - | - | - | - |
| Chlorotoluron | 150.4 | 6.9 | 95.4 | - | - | - | - |
| Bromoxynil | 167.3 | 11.3 | 93.2 | 1.1 | 90.3 | 1.6 | 85.8 |
| 2,4-D | 2944.9 | 213.7 | 92.7 | 2.2 | 99.0 | 6.5 | 97.0 |
| Mecoprop | 803.7 | 112.7 | 86.0 | 3.0 | 97.3 | 6.6 | 94.1 |
| MCPA | 30.4 | 4.8 | 84.2 | 1.1 | 77.1 | 1.6 | 66.7 |
| Fluroxypyr | 1162.0 | 224.6 | 80.7 | 9.3 | 95.9 | 16.0 | 92.9 |
| Dicamba | 223.5 | 43.8 | 80.4 | 9.1 | 79.2 | 13.9 | 68.3 |
| Carbetamide | 15.3 | 3.0 | 80.4 | - | - | - | - |
| Clopyralid | 1025.5 | 238.1 | 76.8 | 5.5 | 97.7 | 16.2 | 93.2 |
| Metsulfuron-methyl | 32.9 | 8.1 | 75.4 | - | - | - | - |
| Metazachlor | 5561.0 | 1754.9 | 68.4 | - | - | - | - |



Sediment: Silt traps





Roadside Silt Traps

Installation

Constructed October 2016

ST2

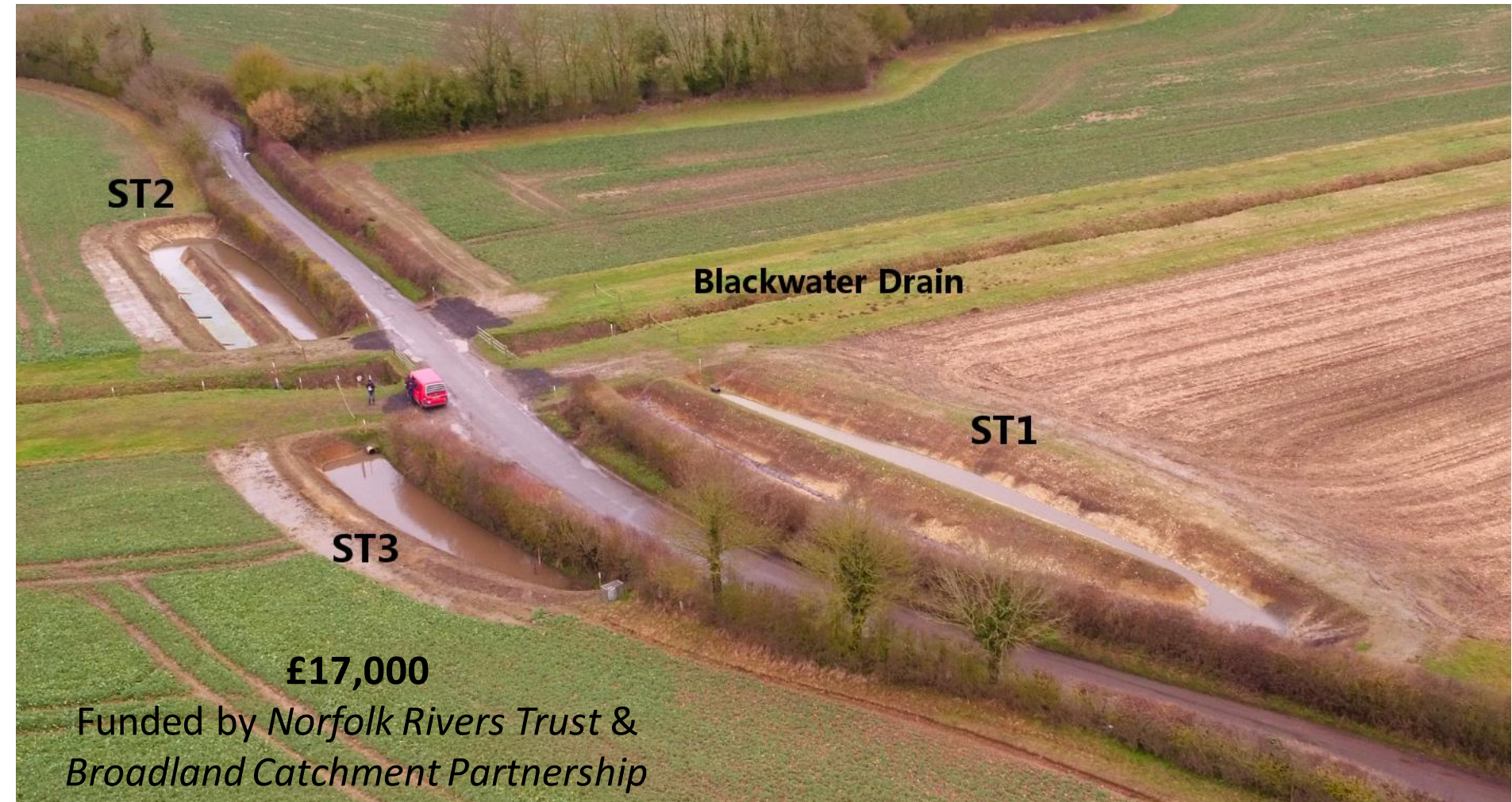
Blackwater Drain

ST1

ST3

£17,000

Funded by *Norfolk Rivers Trust & Broadland Catchment Partnership*



Roadside Silt Traps

Sediment retention

Silt trap 3 (Nov 2016 – Nov 2017)

Sediment retained: **7,253 kg**

Damage cost: **£392**

TP retained: **11.6 kg**

Damage cost: **£148**

TN retained: **29.7 kg**

Damage cost: **£13**

Total mitigated
damage cost: **£553**

Trap cost: **£3,600**

Payback time: **~7 years**



Damage costs per tonne

TP: £12,790

N: £430

Sed: £54

River sediment load downstream

2011-2016 average: **15 t y⁻¹**

2016/17: **6.3 t y⁻¹**

Further info: wensumalliance.org.uk

Acknowledgements



Kevin Hiscock, Andrew Lovett, Richard Cooper, Gilla Sünnerberg, Steve Dugdale, Trudie Dockerty, Emilie Vrain



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