Portsmouth Water SB AAN Trial 2023-24

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Catchment Sensitive Farming
Working together for a healthy environment

Portsmouth Water

Introduction:

The planning of efficient nutrient applications and subsequently reducing the risk of nutrient leaching into the water and wider environment is a high priority for the East Hampshire and Western Streams catchment and Portsmouth Water. To reduce these inputs, this trial will aim to provide further evidence on the value of Additional Available Nitrogen (AAN) analysis. AAN testing is not widely encouraged by agronomists and therefore not commonly implemented into nutrient management planning as the exact science is yet to be established.

The prospect of investigating the impact of using Additional Available Nitrogen (AAN) as a tool to inform nutrient management planning is one to be encouraged. There is a lack of knowledge on the ground in using AAN to inform nitrogen inputs and if applied to a nutrient management plan, does it have the potential to save costs in inputs, and thus reduce the amount of nitrogen being applied in the catchment?

The Trial:

The aim of this trial is to provide a case study for the benefits of taking AAN, alongside Soil Mineral Nitrogen (SMN) testing into consideration when nutrient management planning. The yield of the following cash crop will then be assessed to see if AAN is a viable and practical measure in nutrient planning.

One of the main concerns to growers regarding the AAN testing is the cost, Portsmouth Water and Natural England have agreed to cover the costs of the trial crop.

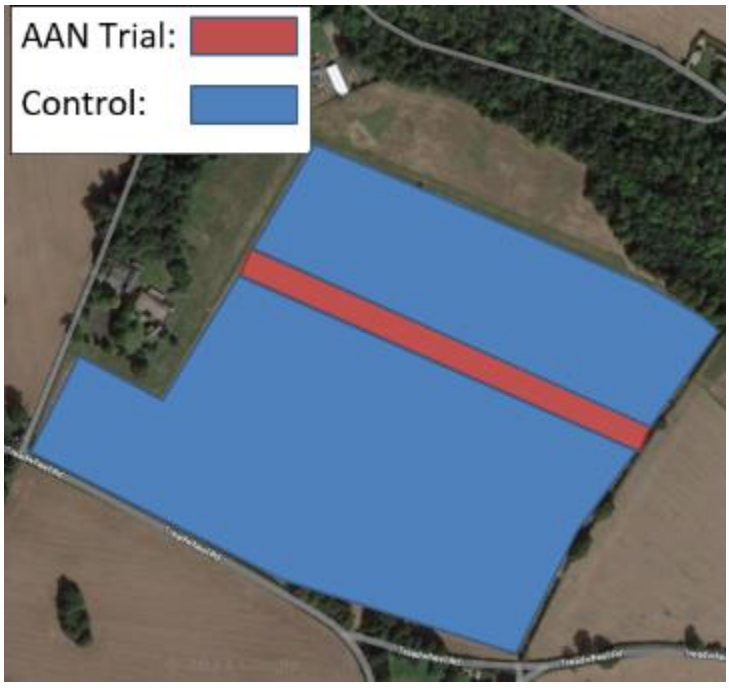


Table 1: Nutrient applications on the trial plots 2021-22:

AAN Trial **Total N: 321kgN/ha (inc AAN) *155kg artificial N/ha***	Normal Fertiliser Regime **Total N: 295kg N/ha**
SNS index 5 (using the 131kg/ha N in the soil from AAN sample)	SNS Index 1 (AAN SNS index 4) disregarded in the fertiliser program
75kgN/ha **215kg / ha** of Ammonium Nitrate granular fertiliser Feb 5th.	75kgN/ha **215kg / ha** of Ammonium Nitrate granular fertiliser Feb 5th.
40 Kg N/ha **137.5kg / ha** of Sulphur Gold granular fertiliser late March	80 Kg N/ha **275kg / ha** of Sulphur Gold granular fertiliser late March
40 Kg N/ha **137.5kg / ha** of Sulphur Gold granular fertiliser April	80 Kg N/ha **231kg / ha** of Ammonium Nitrate granular fertiliser Map
	60 Kg N/ha **174kg / ha** of Ammonium Nitrate granular fertiliser April

Table 2: Nutrient applications on the trial plots 2022-23:

AAN Trial **Total N: 343kgN/ha (inc AAN) *212kg artificial N/ha***	Normal Fertiliser Regime **Total N: 313kg N/ha**
SNS index 4 (using the 131kg/ha N in the soil from AAN sample)	SNS Index 2 (AAN SNS index 4) disregarded in the fertiliser program
69kgN/ha **200kg / ha** of Ammonium Nitrate granular fertiliser Feb 5th.	69kgN/ha **200kg / ha** of Ammonium Nitrate granular fertiliser Feb 5th.
50 Kg N/ha **145kg / ha** of Ammonium Nitrate granular fertiliser late March	100 Kg N/ha **290kg / ha** of Ammonium Nitrate granular fertiliser late March
50 Kg N/ha **145kg / ha** of Ammonium Nitrate granular fertiliser April	100 Kg N/ha **290kg / ha** of Ammonium Nitrate granular fertiliser April
36 Kg N/ha **200L / ha** of Omex Protein Plus late May.	36 Kg N/ha **200L / ha** of Omex Protein Plus late May.
7 Kg N/ha **20L / ha** of Efficient N28	7 Kg N/ha **20L / ha** of Efficient N28

Methodology:

Soil Sampling:

Soil mineral nitrogen sampling was carried out in February prior to any organic manure applications to set a baseline of nitrate levels within the soil. SMN samples were repeated after harvest and again in late February each year.

Visual Differences:

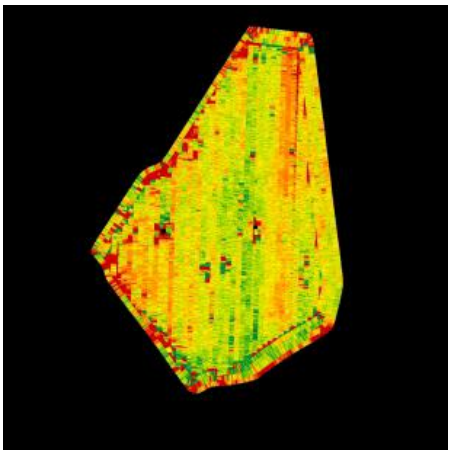
Site visits were made throughout the growing season to determine any differences in wheat growth.

Tissue Samples:

Tissue samples were taken each month March-June to measure any potential nutrition deficiencies in the plants.

Yield and Grain Analysis:

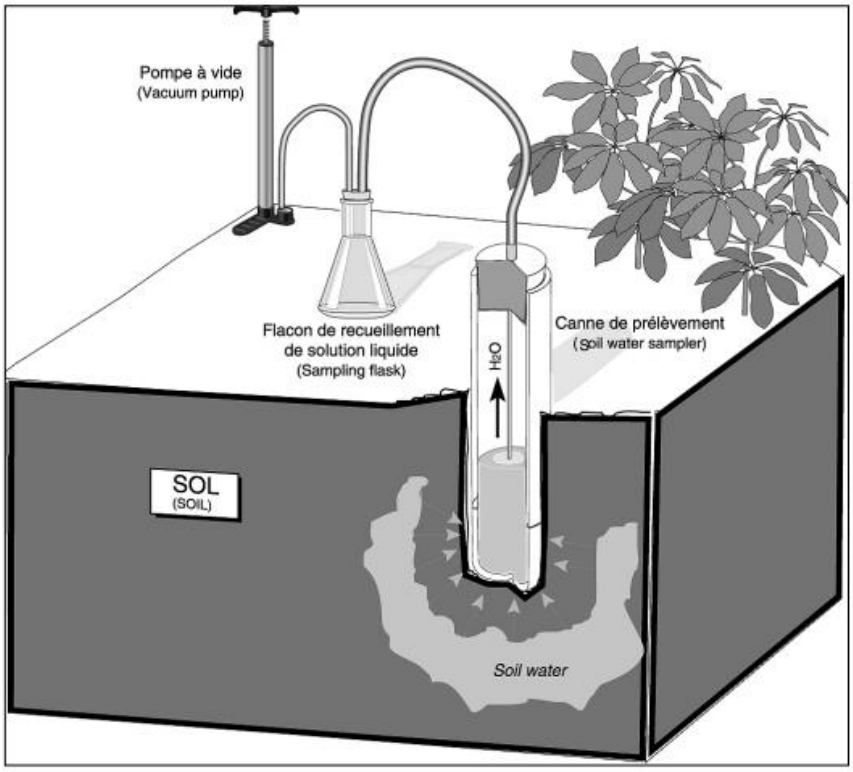
Yield data gathered at the point of harvest and grain analysis for protein content.



NDVI Sat Imagery:

Weekly images have been taken and analyzed to try and determine if clear differences in the NDVI could be seen during the growing season.

Porous Pots:



Ten porous pots were installed in each treatment, giving a total of twenty porous pots across the trial. Porous pots were sampled once every two weeks from the beginning of October through to the end of February. The water samples gathered from the porous pots were analyzed as fresh samples for nitrate levels (mg/l) which provided an excellent indication of the potential nitrate leaching through the soil profile.

Table 3: Year 1, SMN (Soil Mineral Nitrogen) Results 2021-2022:

Field Reference	Feb 2022 SMN (kgN/ha)	August 2022 SMN (kgN/ha)	Feb 2023 SMN kgN/ha)
AAN Trial	61.7	95	82.4
Control	84.7	98	75.6
Average	**73.2**	**96.5**	**79**

Table 4: Year 2, SMN (Soil Mineral Nitrogen) Results 2022-2023:

Field Reference	Feb 2023 SMN (kgN/ha)	August 2023 SMN (kgN/ha)
AAN Trial	71.7	44
Control	53.4	77
Average	**62.55**	**60.5**

Year 1 showed little differenced between the SMN results measured within the two plots across the growing season. However, there was a more obvious difference in August 2023 with a 33kgN/ha difference between the field average (control) and the trial plot (100kg/ha AN). The difference in application between the two plots was 100kgN/ha, so potentially a 1/3 of this addition has been left in the soil.

Table 5: Year 1, Tissue Sample Results 2022:

SAMPLE	Average N Content in plant N:S Ratio % **05/04/2022**	Average N Content in plant N:S Ratio % **05/05/2022**	Average N Content in plant N:S Ratio % **06/06/2022**	Combined Average N:S Ratio %
Control 1	2.67	1.86	1.7	2.07
Control 2	3.12	1.78	1.48	2.12
Trial 1	2.57	1.55	1.36	1.82
Trial 2	2.8	1.45	1.54	1.93

Table 6: Year 2, Tissue Sample Results 2023:

SAMPLE	Average N Content in plant N:S Ratio % 03/05**/2023**	Average N Content in plant N:S Ratio % 2**5/05/2023**	Average N Content in plant N:S Ratio % **14/06/2023**	Combined Average N:S Ratio %
Control 1	2.3	1.61	1.19	1.7
Control 2	2.37	1.56	1.28	1.73
Trial 1	1.96	1.41	1.03	1.46
Trial 2	2.12	1.11	1.1	1.44

There has been a clear difference in the NS ration between the field average and the control plots over the past two years. The average difference across the season was a 17% reduction in the trial plots vs the control plots. This will be contributing to a reduced greening effect in the flag leaf and ultimately grain yield and protein.

Table 7: Year 1 (2022), Yield t/ha:

YEAR	CONTROL	TRIAL	AVERAGE
2022	11.7	10.7	11.2

Table 8: Year 1 (2022), Protein (%):

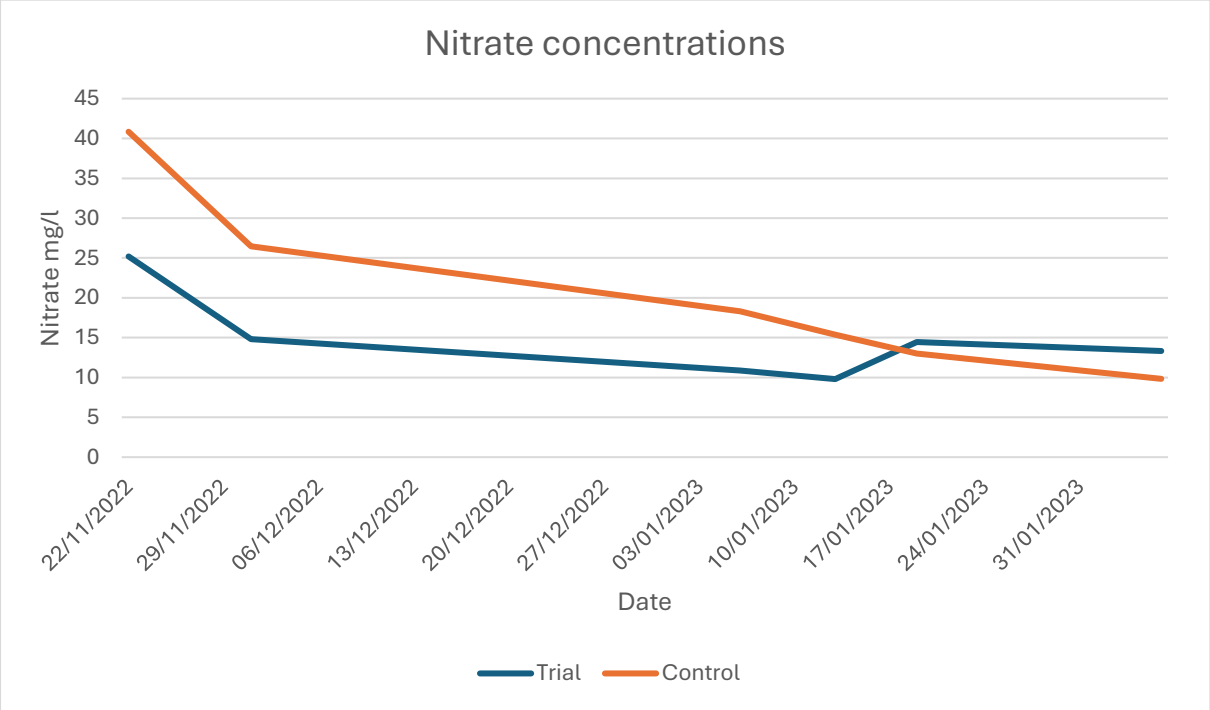
Year	Control 1	Control 2	Trial 1	Trial 2
2022	12.32	12.4	9.79	9.75

Table 9: Year 2 (2023), Yield t/ha:

Year 1, Porous Pot Results Nov 2022 – Feb 2023:

Control		Trial	
Date of Sample	**Nitrate (mg/L)**	**Date of Sample**	**Nitrate (mg/L)**
22/11/2022	40.84	22/11/2022	25.19
01/12/2022	26.48	01/12/2022	14.83
06/01/2023	18.3	06/01/2023	10.87
13/01/2023	15.38	13/01/2023	9.8
19/01/2023	12.99	19/01/2023	14.47
06/02/2023	9.82	06/02/2023	13.34

Figure 1. Graph showing porous pot leachate results for year 1, 2022-2023

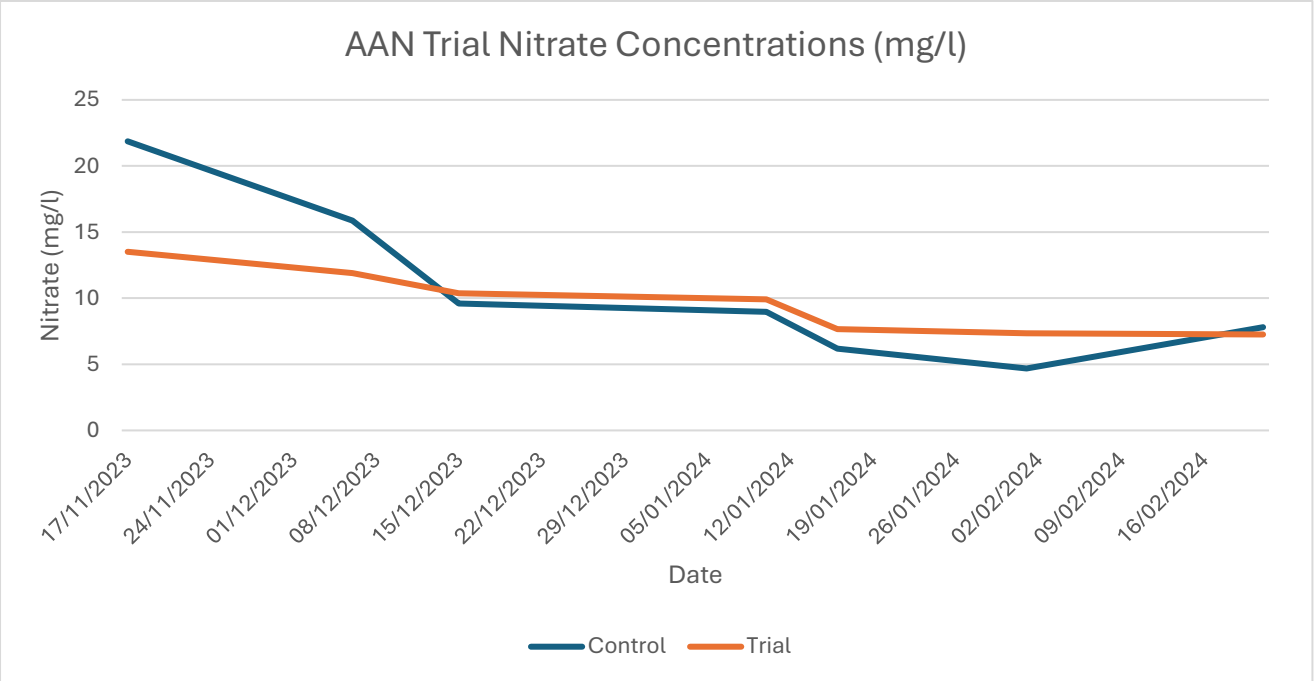


The porous pot results from 2022-23 demonstrate a significant reduction in nitrate leaching in the trial plot compared to the field average (control). This as would be expected given the 140kgN/ha reduction between the two plots. The average leachate concentration was 18% lower in the trial plot compared with the field average (control).

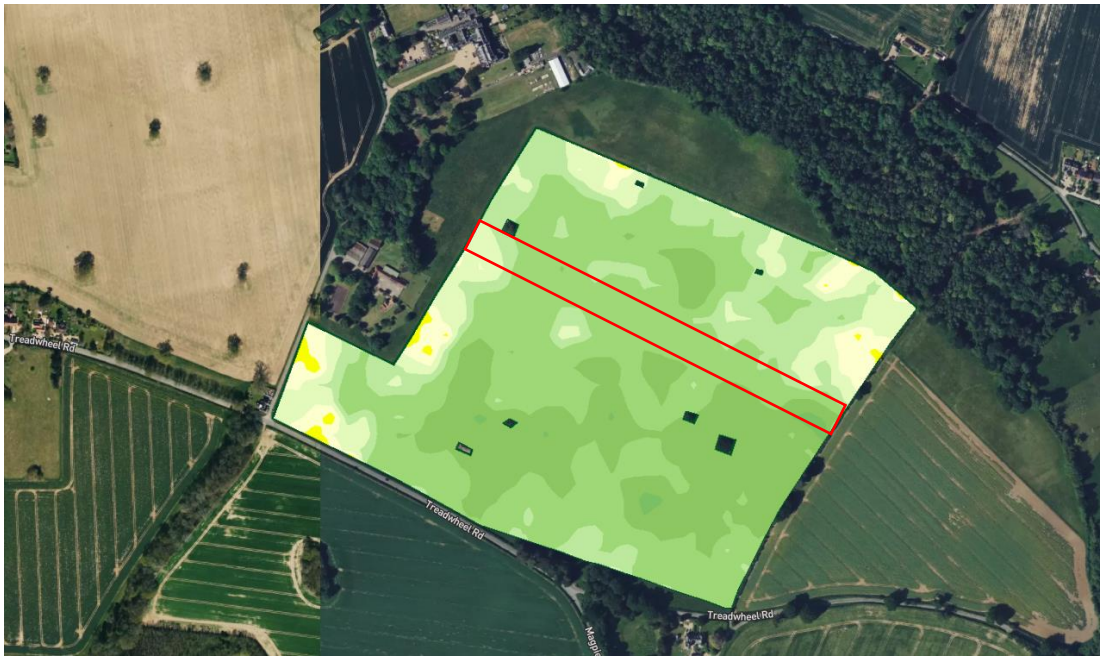
Year 2, Porous Pot Results Nov 2023 – Feb 2024:

Control		Trial	
Date of Sample	**Nitrate (mg/L)**	**Date of Sample**	**Nitrate (mg/L)**
17/11/2023	21.86	17/11/2023	13.51
06/12/2023	15.87	06/12/2023	11.9
15/12/2023	9.6	15/12/2023	10.38
10/01/2024	8.95	10/01/2024	9.91
16/01/2024	6.17	16/01/2024	7.66
01/02/2024	4.68	01/02/2024	7.35
21/02/2024	7.81	21/02/2024	7.2

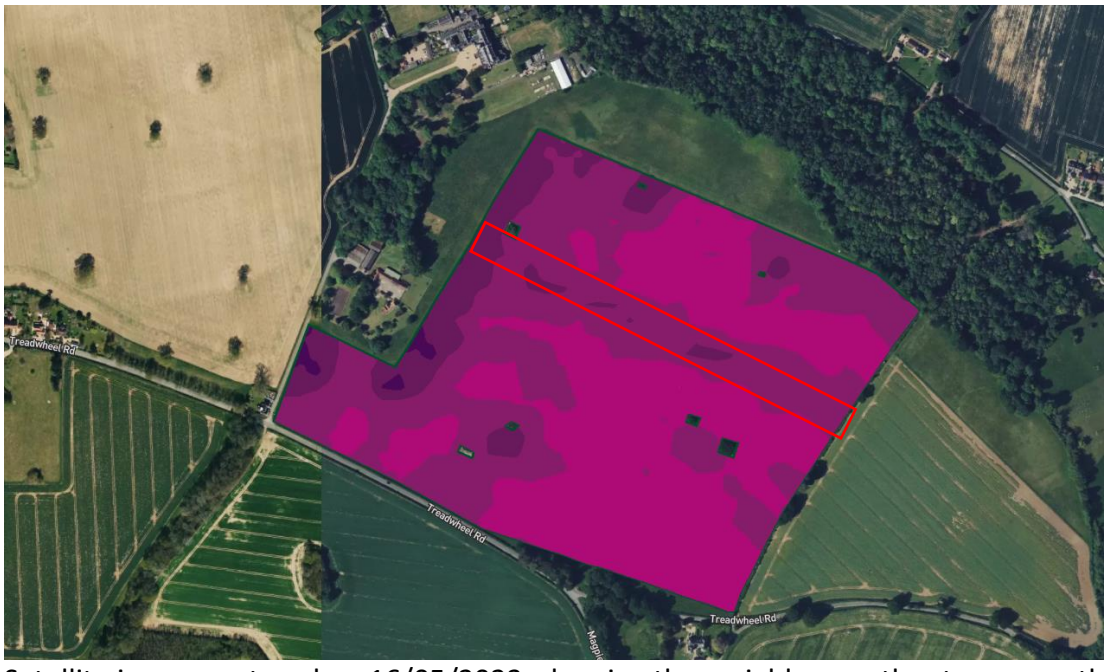
Figure 2. Graph showing porous pot leachate results for year 2 2023-2024



The porous pot results from 2023-24 demonstrate an insignificant reduction in nitrate leaching in the trial plot compared to the field average (control). The average leachate concentration was 4% higher in the trial plot compared with the field average (control).



Satellite image captured on 01/03/2023, showing the variable growth rates across the trial field. The red rectangle indicates the AAN Trial area. The rest of the field serves as the control. Although there are patches across the field, the trial tramline appears to have no patches of higher growth compared to the control. The trial's growth rate at this stage is very comparable to the control but is noticeable on the image.



Satellite image captured on 16/05/2023, showing the variable growth rates across the trial field. The red rectangle indicates the AAN Trial area. The rest of the field serves as the control. At this stage the trial is quite noticeable and is growing slower during the final greening stage than the control. This is significant for the results as this final stage is important for protein production and final weights.

Conclusions:

Over the past 2 years we have been able to put to the test AAN analysis as an alternative to a standard SMN sampling approach. The data gathered is to be taken with caution due to the lack of replicates. However, the trial is now in its second year and there has been some useful information that has come out of it so far.

On paper, reducing the nitrogen levels so drastically had an expected damaging effect on the crops yield and quality. Nitrogen levels recorded from the tissue samples were slightly lower in the trial plots compared to the rest of the field (table 3). However, they were not much lower, and the same trend can be seen with the porous pot results from December onwards. These minor differences suggest that the additional nitrogen added to the rest of the field has not had a significant greening effect.
SMN figures from August 2023 do show a significant difference between the trial plot and the field average. A good demonstration of the inefficiency high nitrogen inputs can be at getting into the plant, grain and ultimately protein.

Once the grain and yield data is collated, this can be confirmed. If this is the case, then it makes a strong case for the reduction of Nitrogen based on AAN results. Contrastingly, the SMN data shows a much higher Nitrogen level in the Control.

When the differences in the potential nitrate leaching is considered, the utilizing AAN analysis becomes more appealing to Portsmouth Water.

Any questions then please contact Stephen Woodley (stephen@swoodleycropservices.co.uk)