Water Quality and Surface Water Management Techniques

Background Paper for the Subsurface Drainage Return on Investment Trial

This paper is an activity conducted within the Subsurface Drainage Return on Investment Trial an Investment by the Grains Research and Development Corporation.

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1. Introduction

Subsurface drainage systems have long been used to combat waterlogging in agricultural landscapes. The buried pipe sits to the depth of the clay layer within the subsoil, the layer at which perched water becomes trapped in the root zone of the crop, leading to reduced crop growth and soil health. Subsurface drainage supports the effective drainage of excess water away from the root zone, and typically discharges the drained water through open ended pipe.

In the South Coast of Western Australia, growers of the Esperance and Albany Port Zones have been participating in a three-year demonstration trial to better understand the efficacy and return on investment of subsurface drains in broadacre agricultural systems. This project, the Subsurface Drainage Return on Investment Trial, is an investment by the Grains Research and Development Corporation and is guided by a technical advisory group (TAG) consisting of growers, advisors and experts within the port zones.

Following the commencement of the trial in 2021, the Esperance TAG saw a critical gap in knowledge pertaining to the relationship between water quality and varying water management techniques on farm. Particularly, the TAG sought to investigate whether water discharged from the subsurface drainage system was of better quality to that of surface water flowing across the paddock as runoff.

Both runoff, and water discharged from a subsurface drainage system, must eventually be captured, transmitted or evaporated. Transmitted water exiting the property boundary can have significant implications for the health of the natural environment and agricultural productivity, and the quality of this water is often poorly understood, yet highly influential in maintaining healthy waterways and downstream receiving bodies. Similarly, water that is captured for use on farm, such as stock water or irrigation, must be of acceptable quality, such that animal and human health is not threatened.

This paper is a synopsis of the activities undertaken by the Esperance TAG to investigate the water quality of both runoff and discharged water exiting from the subsurface drainage systems of the two Esperance demonstration trial sites. The paper seeks to provide a preliminary assessment of the results of this investigation and provide recommendations for further studies and research.

2. Location & Methodology

The Esperance subsurface drainage demonstration sites were established in the high rainfall agricultural zones of Neridup and Dalyup (Figure 1).

Figure 1. Trial Locations of the Subsurface Drainage Return on Investment Trial in the Esperance Port Zone, Google Earth 2022.

Climate

The average rainfall for the Esperance region is 621mm, with the Neridup and Dalyup catchments receiving slightly less annual rainfall on average of (~554mm and 557mm respectively) (Bureau of Meteorology, 2023).

In 2021, Neridup's total annual rainfall was above average reaching 630.7mm (decile 8-9), whilst Dalyup received a below average annual rainfall of 573.2mm (decile 4-7) although, most of this fell between April – November leading to an above average (decile 8-9) growing season for both sites (Figures 6 & 7) This increased rainfall can be largely attributed to the arrival of La Nina in late 2020, bringing increased rains across Australia (Bureau of Meteorology, 2020).

In 2022, with La Nina encouraging high rainfall for the South Coast, both Neridup and Dalyup recorded decile 10 annual and growing season rainfalls, reaching 677mm and 732mm respectively (Bureau of Meteorology, 2020). An Environmental Scorecard produced by the Australian National University and Australia's Terrestrial Ecosystem Research Network (TERN) 2022 was identified as the highest year of inundation across the South Coast NRM region (Walpole to Cape Arid) since the year 2000 (Australian National University, 2023).

The arrival of El Nino, coupled with a negatively charged Indian Ocean Dipole, led to drying conditions for the South Coast in 2023, dropping Neridup's annual rainfall to 487.2mm (decile 2-3) and Dalyup's' to a very below average rainfall (decile 1) to 479.4mm, more than 200mm less than the previous year (CSIRO, 2023). Much of 2023s rainfall was received during the growing season however, with Neridup experiencing an average growing season rainfall (decile 4-7) and Dalyup a below average (decile 2-3) (Bureau of Meteorology, 2024).

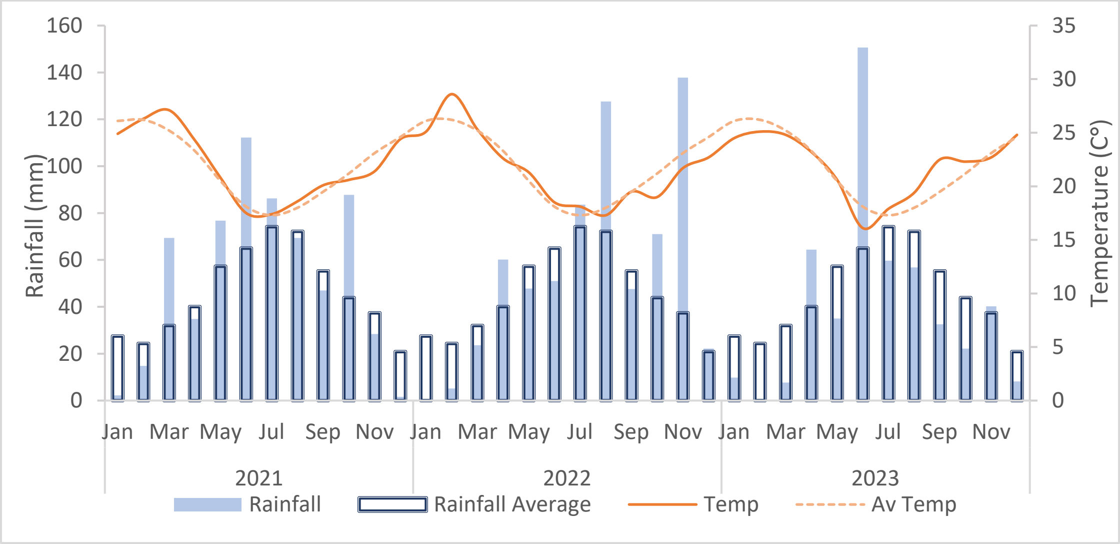

Figure 2. Monthly Climate Data for Neridup, Esperance 2021 - 2023. Sourced, Bureau of Meteorology, 2023.

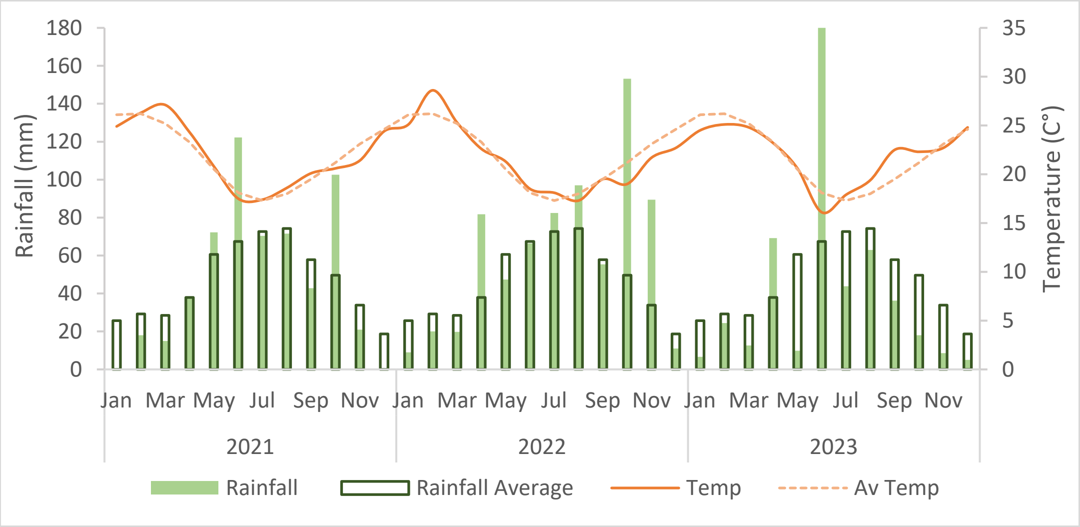

Figure 3. Monthly Climate Data for Dalyup, Esperance 2021 - 2023. Sourced, Bureau of Meteorology, 2023.

Trial Design

Both trials' subsurface drainage systems were designed to discharge perched water into existing surface water management infrastructure. At the Neridup trial, water is discharged from the pipe into an on-farm dam, which overflows into an open drain intersecting the paddock (Figure 4).

Similarly, the Dalyup trial discharges its perched water into a shallow/trafficable drain that indirectly flows towards a natural wetland, off the property (Figure 5). Neither site currently utilises any excess water from either subsurface drainage systems or runoff, for farm operations.

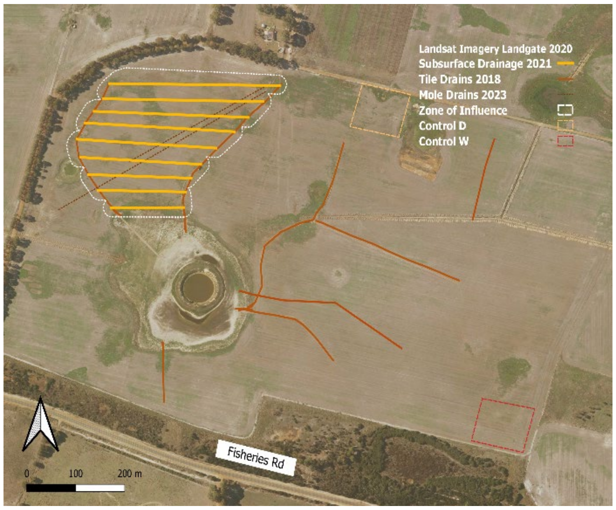

Figure 4. Neridup Subsurface Drainage Trial Design.

Figure 5. Dalyup Subsurface Drainage Trial Design.

Sampling Methodology

This activity was included into the project ad hoc, arising from the Esperance TAG identifying an opportunity to value add to the trials primary monitoring regime. Through discretionary funding, and co-contributions from the trial's landholders, the project was able to deliver a rudimentary investigation into the water quality of runoff and discharged water in addition to the delivery of the main project activities.

As an additional activity, the investigation was designed to deliver a preliminary assessment of the water quality, such that the trial landholders could understand the need for continued monitoring of their discharged water, and to guide further research into the influences of discharged water on downstream environments. The sampling methodology was therefore not rigorously designed and would not meet the Australian Standards for freshwater sampling (AS/NZS5667.1:1998) that would be required of a full study and technical report.

Water sampling was conducted throughout the three-year trial period, annually. Samples were collected by the TAG during in high rainfall events, considered 15mm and above in less than a 24-hour period. This was necessary to ensure sufficient runoff of surface water and flushing of the drainage system prior to sampling. Subsurface water samples were taken from the exit point of the subsurface drainage system, while surface water samples were taken from natural runoff points in the paddock.

Samples were tested for major nutrients, including Nitrogen, Phosphorus, Total Suspended Solids and Base Neutral Pesticides (BNP's). The samples were analysed by ARL Laboratories in Perth, WA.

3. Results and Findings

This report utilises the tolerance limits determined by the Australian and New Zealand Environmental and Conservation Council (ANZEEC) for evaluating water quality. Water that is intended to be used for agricultural activities, and particularly irrigation in cropping systems, is summarized in the ANZECC's, "Australian and New Zealand Guidelines for Fresh and Marine Water Quality: Primary Industries – Rationale and Background Information," (ANZECC, 2000a). For freshwater environments, tolerance limits are referenced from the ANZECC's main body of work, the "Australian and New Zealand Guidelines for Fresh and Marine Water Quality," (ANZECC, 2000b). Where water quality guidelines have been reviewed and updated, tolerance limits are determined from the ANZECC's 2018 default guideline values search engine (ANZECC, 2018).

It is important to note that the ANZECC considers the tolerance limits for both agricultural use and freshwater systems as general guidelines only and recommends that local tolerance limits are used in preference over the ANZECC's where available. In lieu of locally available data, this paper acknowledges the generalisation of the ANZECC's guidelines and uses the tolerance limits as reference limits only, noting that local limits would provide a more robust analysis of the water quality results.

The establishment of localised tolerance limits for the Neridup Creek and Dalyup River catchments forms a recommendation of this paper.

Nitrogen

For a healthy cropping system, the ideal levels of nitrogen within the soil, should balance with the levels of nitrogen taken up by crops throughout the growth cycle. However, when too much nitrogen enters a cropping system, the excess can leach into surface water systems and have impacts on crop and waterway health (ANZECC, 2000a).

The most available forms of nitrogen to plants are nitrate and ammonia. Whilst ammonia is rapidly absorbed by soils, nitrate is soluble, and relatively stable enabling it to leach into groundwater systems far more readily than other forms of nitrogen. Because of this, nitrate is considered to pose the greatest threat to the health of waterways, and animals or humans in drinking water (ANZECC, 2000a).

The ANZECC guidelines have set acceptable limits for Total Nitrogen (TN) for use on farm between 25 – 125 mg/L (ANZECC, 2000a). TN acceptable limits for freshwater ecosystems are significantly lower at 0.35mg/L (ANZECC, 2000b).

Neridup

TN is within the limits for use on farm on all sample occasions but does exceed the lower tolerance range of 25mg/L in the discharged samples of 2021 and 2023, reaching concentrations of 30mg/L and 37mg/L in the respective years (Table 1). TN exceeds the limits for freshwater systems on all sample occasions for both discharge and runoff and in all years, discharged water had greater concentrations of TN than runoff (Table 1).

The ANZECC determined a tolerance limit of 0.9mg/L for both Ammonia and Nitrate in freshwater environments. In 2021 and 2023, Ammonia is present in concentrations above 0.9mg/L in runoff samples, whilst Nitrate concentrations are exceeding guidelines in the discharged samples (Table 1).

In 2022, both Ammonia and Nitrate concentrations are inversed such that Ammonia presents in greater concentrations in the discharged samples, whilst Nitrate is highest in concentration in the runoff samples (Table 1). In all sample years, both Ammonia and Nitrate exceeded the tolerance limit for freshwater environments. The results for these forms of Nitrogen display a relationship between Ammonia and Nitrate within the nitrogen cycle. Whilst Ammonia is most concentrated in runoff, Nitrate is most concentrated in the discharged water, as seen in 2021 and 2023. And the same rule applies when Ammonia is most concentrated in the discharged water, then Nitrate is most concentrated in the runoff.

The concentration of Nitrate in the discharged water is far higher than the concentration of Ammonia in the runoff water in 2021 and 2023 (Nitrate was 30mg/L and 37mg/L respectively whilst Ammonia was only 6.1mg/L and 9.9mg/L). But in 2022, this difference in concentrations is significantly lessened, whilst Ammonia in the discharged water was 6.4mg/L whilst Nitrate in the runoff was 8mg/L.

There are no tolerance limits for Ammonia for use on farm, however, concentration limits of nitrate for use as stock water must be less than 400 mg/L, of which all samples from all years are within.

Table 1. Nitrogen presence in runoff and discharged water samples at the Neridup Subsurface Drainage Trial Site

Nutrient		**2021**		**2022**		**2023**	
NITROGEN'S	UNITS	RUNOFF	DISCHARGE	RUNOFF	DISCHARGE	RUNOFF	DISCHARGE
Ammonia-N	mg/L	6.1	0.03	0.02	6.4	9.9	0.04
Nitrate-N	mg/L	0.05	30	8	< 0.01	1.7	37
NOx-N	mg/L	0.06	30	8.1	< 0.01	1.9	37
Total Kjeldahl Nitrogen	mg/L			1.1	14	13	<0.2
Total Nitrogen	mg/L	16	30	9.2	14	15	37

Dalyup

TN in Dalyup was well below acceptable limits for use on farm but exceeded freshwater tolerance limits on all sample occasions (Table 2).

As with Neridup, ammonia and nitrate again display an inverse relationship; where ammonia is highest in runoff samples, nitrate concentrations are highest in the discharged samples in both 2022 and 2023.

Ammonia only exceeds the freshwater tolerance limit of 0.9mg/L, in one runoff sample, recording 6.2mg/L in 2023. Dalyup demonstrated the same Ammonia/Nitrate relationship as Neridup, so that as Ammonia was highest in the runoff samples in 2023, Nitrate was highest in the discharged water, with a concentration of 14mg/L (Table 2). Nitrate also exceeded 0.9mg/L in 2022, recording 16mg/L in the discharged water in 2022 as well. Dalyup also demonstrated a significant difference in concentrations between ammonia and nitrate, such that whilst Nitrate reached 16mg/L in the discharged water, Ammonia was only 0.17mg/L in 2022.

This inverse presence between runoff and discharged samples, and the difference is concentrations between ammonia and nitrate is present in all sample years at both the Dalyup and Neridup sites, except for the 2022 samples in Neridup. It is unclear, why the significant differences between ammonia and nitrate concentrations are not observed in this sample. Additionally, Neridup 2022 is the only sample occasion where ammonia is present in greater concentrations in the discharged sample, and nitrate is inversely highest in the runoff sample (Table 1).

Table 2. Nitrogen presence in runoff and discharged water samples at the Dalyup Subsurface Drainage Trial Site

NUTRIENT		**2022**		**2023**	
NITROGENS	UNITS	RUNOFF	DISCHARGE	RUNOFF	DISCHARGE
Ammonia-N	mg/L	0.17	0.07	6.2	0.06
Nitrate-N	mg/L	< 0.01	16	<0.01	14
NOx-N	mg/L	< 0.01	17	<0.01	14
Total Kjeldahl Nitrogen	mg/L	5.1	< 0.2	13	2
Total Nitrogen	mg/L	5.1	17	13	16

Phosphorus

Phosphorus is also an essential nutrient to crop health and vigour. However, widely considered a limiting nutrient to environmental waterways, excess phosphorus can drive rapid algal blooms leading to eutrophication of waterways, or potential build up and clogging of agricultural equipment, such as subsurface tile pipes (ANZECC, 2000a).

Phosphorus is measured in total phosphorus (TP), and the portion of phosphorus that is dissolved and readily available to plants, known as Filterable Reactive Phosphorus (FRP) (Australian Water Quality Centre, ND). The ANZECC guidelines set TP limits for use in agricultural system at 0.8 – 12 mg/L, and 0.01mg/L in freshwater systems (ANZECC, 2000a; ANZECC, 2000b).

Neridup

In all sample years, TP has the greatest concentration in runoff, well over ten times the amount observed in the discharged samples (Table 3). FRP is present in almost identical concentrations to TP in the runoff samples but does display slightly lower concentrations than TP in the discharged water (Table 3).

TP concentrations are within the acceptable limit for use on farm, but all samples, including both runoff and discharge, far exceed the tolerance limits for freshwater systems. The acceptable limit for FRP in freshwater systems is 0.005mg/L which is exceeded on all sample occasions except in the discharged sample of 2021 (Table 3) (ANZECC, 2000b).

Table 3. Phosphorus presence in runoff and discharged water samples at the Neridup Subsurface Drainage Trial Site

NUTRIENT		**2021**		**2022**		**2023**	
PHOSPHORUS	UNITS	RUNOFF	DISCHARGE	RUNOFF	DISCHARGE	RUNOFF	DISCHARGE
Total Phosphorus	mg/L	4	0.32	2	0.08	4.7	0.12
Filterable Reactive Phosphorus	mg/L	3.7	< 0.01	2	0.02	4.8	0.08

Dalyup

TP and FRP are also present in very similar concentrations in Dalyup, in both runoff and discharged samples. The most significant difference between these forms of phosphorus is observed in 2022's discharge sample, where TP was 0.26mg/L whilst FRP was only 0.02mg/L (Table 4).

Both forms of phosphorus were well within acceptable limits for use on farm but exceeded tolerance limits for freshwater systems.

Table 4. Phosphorus presence in runoff and discharged water samples at the Dalyup Subsurface Drainage Trial Site

NUTRIENT		**2022**		**2023**	
PHOSPHORUS	UNITS	RUNOFF	DISCHARGE	RUNOFF	DISCHARGE
Total Phosphorus	mg/L	*1.7*	*0.26*	*2.9*	*0.09*
FRP	mg/L	*1.7*	*0.02*	*2.3*	*0.09*

Total Suspended Solids

Total suspended solids (TSS) refer to solid particulates suspended in the water column, including silt and clay particles, or forms of plankton. High concentrations of TSS within a water source can scatter light, preventing penetration to aquatic organisms and inhibiting growth (ANZECC, 2000b). There are currently no guidelines for acceptable limits of TSS for agricultural use, but TSS concentrations have been examined for the aquaculture industry because of its significant threat to fish and other aquatic species. The ANZECC guidelines have determined a tolerance limit of <40 mg/L TSS in freshwater environments (ANZECC, 2000b).

Based on the tolerance limits for aquaculture, both the Neridup and Dalyup trial sites exceed the tolerance limit of 40mg/L on one occasion in 2022, where both sites recorded significantly high concentrations of TSS (130mg/L and 240mg/L respectively) (Table 5). Whilst Neridup recorded this peak TSS in its runoff sample, Dalyup's spike was observed in the discharged water. There was no meaningful difference observed between runoff and discharged water across trials and sampling years.

Table 5. Total Suspended Solids presence across the Neridup and Dalyup Subsurface Drainage Trial Sites.

NUTRIENT		2021		2022		2023	
TOTAL SUSPENDED SOLIDS	UNITS	RUNOFF	DISCHARGE	RUNOFF	DISCHARGE	RUNOFF	DISCHARGE
Neridup	mg/L	*7*	*20*	*130*	*24*	*6*	*7*
Dalyup	mg/L	-	-	*8*	*240*	*10*	*<5*

Base Neutral Pesticides

Five base neutral pesticides were detected across the Neridup and Dalyup trials; Atrazine, Diuron, Propazine, Propiconazole and Simazine. Excluding Diuron, all pesticides are a triazine herbicide, commonly used for pre and post emergent weed control (Attilio N, Vommaro M.L, Amico D, Sprovieri F, Pirrone N, Tagarelli N & Giglio A, 2023). These four BNPs are soluble and stable in soils and water, their slow biodegradation makes them persistent in groundwater systems, and they have been linked to threats to human and animal health as endocrine disruptors (Klementova, S., & Keltnerova, L. 2015).

Diuron is also a pre and post emergent herbicide, that particularly targets broadleaved and grass weeds, and is widely used in agriculture and in some aquatic systems (Australian Pesticides and Veterinary Medicines Authority, ND). Diuron is persistent in soils and water (both surface and ground) and is considered a threat to animal and human health as it produces a highly toxic and extremely persistent product as it breakdowns within the soil (Giacomazzi S, Cochet N, 2004).

Tolerance limits for BNPs are poorly understood, and the ANZEEC guidelines currently only have recommended and interim trigger values for Atrazine, Diuron and Simazine for freshwater systems which are 0.013mg/L, 0.0002mg/L and 0.0032mg/L respectively (ANZECC, 2000b).

Neridup

The runoff sample of 2021 was the only sample occasion that recorded concentrations of Atrazine, Diuron, Propazine and Simazine (Table 6). These BNPs were not observed during any other sample occasion, however, Propiconazole was detected in the discharged sample in 2022. Concentrations of Atrazine, Diuron and Simazine were above their tolerance limits, but not significantly higher. There are no ANZECC limits for Propiconazole.

Table 6. Base Neutral Pesticides presence at the Neridup Subsurface Drainage Trial Site

NUTRIENT		**2021**		**2022**		**2023**	
BNPs	UNITS	RUNOFF	DISCHARGE	RUNOFF	DISCHARGE	RUNOFF	DISCHARGE
Atrazine	mg/L	0.014	0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Diuron	mg/L	0.0011	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Propazine	mg/L	0.0002	<0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Propiconazole	mg/L	< 0.0004	<0.0004	< 0.0004	0.016	< 0.0004	< 0.0004
Simazine	mg/L	0.0086	0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001

Dalyup

Atrazine was the only BNP to be detected at the Dalyup trial site, with the highest reading in the discharged sample of 2022 at 0.0004 mg/L, which is still below the tolerance limit for Atrazine of 0.013mg/L (Table 7).

Table 7. Base Neutral Pesticides presence at the Dalyup Subsurface Drainage Trial Site

NUTRIENT		**2022**		**2023**	
BNPs	UNITS	RUNOFF	DISCHARGE	RUNOFF	DISCHARGE
Atrazine	mg/L	< 0.0001	0.0004	< 0.0001	< 0.0001

4. Discussion

In general, all major water quality parameters were not present in high enough concentrations to be considered a threat to water quality for use on farm as stock or irrigation water. This was not the case for freshwater tolerance limits, which were exceeded on most sample occasions across all nutrients at both the Neridup and Dalyup trial sites.

Overall, TN was highest in discharged water samples. Ammonia remained highest in runoff samples, in inverse concentrations to nitrate. These results reflect the nitrogen cycle, where, as nitrogen is applied to the crop, it breaks down into its particulates, and ammonia is quickly absorbed by the crop leaving behind the more stable nitrate in the subsoil (ANZECC, 2000a). The difference in concentrations between ammonia and nitrate could be a result of excess nitrate remaining in the subsoil and leading to nutrient loading over time or be reflective of ammonia being used by the crop more readily than nitrate.

The high concentrations of nitrate and total nitrogen in the discharged water samples is indicative of rapid leaching of nitrates on sandy soils. Nitrates from nitrogen fertiliser are readily leached from all soils, but leaching is particularly rapid on sands (Department of Primary Industries and Regional Development, 2014). Generally, nitrogen loss through drainage increases as the N rate increases, especially at N rates greater than the economic optimum. Understanding how much nitrogen is not being absorbed by the crop and leaching, could represent significant cost and time savings for farmers, and improved fertilisers practices that support healthy waterways.

Whilst TN was highest in discharged water samples, TP was highest in runoff, ten times that of discharged concentrations. This relationship may indicate that TP is not successfully reaching the root zone of the crop. As phosphorus is either dissolved and leached down into sandy soils or it runs across the surface when the soil profile fills up with water. Understanding phosphorus application practises on farm could provide insight into this observation. TP concentrations in the discharged samples are not a concern for risk of eutrophication and if kept low over the life of a subsurface drainage system, would not likely cause algal growth in the pipe leading to blockages. However, the high concentration of TP in runoff is of concern, and the end point where runoff is being captured, whether on farm or in the surrounding environment should be investigated to understand the risk of eutrophication.

Guidance is limited for TSS, and the levels observed in this report do not pose any water quality implications for use on farm, or in natural waterways in the short term. However, continued high loads of TSS entering water bodies could limit light availability in the water column and contribute to anoxic environments or eutrophication. Additionally, the ANZECC has observed real threats to fish health that should be considered. Settling ponds of discharged water or captured runoff prior to entry into a dam or natural waterway would ensure that TSS is managed appropriately over the long term.

The limited presence of BNPs in all samples of this investigation is a positive observation. It is possible that pesticide application on both trial farms is not having a leaching affect into surface water or the subsurface drainage systems. Pesticide regimes are highly intuitive to individual farming systems, so an understanding of each farms pesticide regime would be useful in drawing any further conclusions from the results.

There are clear differences between nutrient concentrations in the runoff and discharged samples throughout the sample period, even presenting inverse relationships between nutrients, such as TN and TP, across runoff and discharged water over time. These differences demonstrate some credibility to the hypothesis that in relation to phosphorus discharged water from a subsurface drainage system may be of improved quality to that of surface water runoff.

5. Recommendations

This paper recommends that a full study into the water quality differences between surface water runoff and water discharged from a subsurface drainage system be conducted. The results of this investigation show clear differences between runoff and discharged water and provide strong grounds for further research into this relationship. A study should be designed using a rigorous monitoring regime, following the Australian standards for surface water sampling AUS/NZS 5667.11:1998.

The study should include a greater number of farms, with varying management practise and surface water management techniques. It should incorporate farm management data, primarily fertilizer and pesticide regimes, and crop growth stages, to better understand the relationship between on farm practises and water quality.

The inclusion of this data, as well as a greater number of farms, would help growers and advisors to make more strategic management decisions about when to apply nutrients or pesticides, to maximise efficacy, realise cost and time savings and minimise excess nutrients leached into surface water.

Further, the study should pay particular attention to the environmental impacts of water exiting a farm and entering a natural waterway. In almost all cases, water sampled far exceeded the tolerance limits of freshwater environments, posing significant potential threats to the health of natural systems. Particularly, the threat of eutrophication is of primary concern, and is shown to be a real possibility with the high levels of phosphorus present in runoff samples. In determining the environmental impact of water entering waterways from the farm, it will be critical to understand the effects of short-term influx (concentration) versus the long-term compounding effects (load) of continued excess nutrients or sedimentation.

The use of settling ponds for discharged water before it exits the farm boundary is recommended to manage TSS and BNPs. Settling ponds are directly designed to remove TSS from the water column, by slowing the flow of water down, and allowing solids to settle to the bottom of the pond or silt trap. Settling ponds and other dams are generally shallow, and therefore, the exposure to sunlight will also help to break down BNPs, particularly Atrazine. Additionally, artificial wetlands can be used as biological filters, that can remove bacteria, pesticides, nitrogen, phosphorus, and fertilisers as water passes through them (University of Western Australia, 2014). The design and management of settling ponds, artificial wetlands and other surface water management techniques should always be guided by a trusted drainage expert.

Finally, this paper recommends that locally regionally specific tolerance limits that are sensitive to the farming systems and natural environments of the Esperance sandplain be developed. Limits should be developed through collaboration with experts, government departments, and organisations to collate knowledge based on shared understanding of local water bodies and farming systems. This would create synergy between farming operations and conservation efforts across catchments in the Esperance region. Both the Dalyup and Neridup trials sit within the Ramsar catchments of Lake Gore and Lake Warden respectively, and sharing data and learnings between this report and subsequent research with the Ramsar TAG could help to create co-benefits for both farms within the catchments and the wetland systems.

6. Conclusion

The Esperance Subsurface Drainage Technical Advisory Group sought to investigate if there were differences in water quality between surface water runoff and water discharged from a subsurface drainage system on farm. The investigation was administered as an ad-hoc activity to the subsurface drainage return on investment trial, an investment by the Grains Research and Development Corporation. The activity measured Nitrogen, Phosphorus, Total Suspended Solids and Base Neutral Pesticides across two trials sites in the Esperance region. Results of the investigation concur that there are significant differences between nutrient presence in runoff and subsurface drainage discharge, of which, these differences appear to be highly dependent on farming regimes.

Water quality was observed in terms of its suitability for use on farm as stock or irrigation water, or as discharge into natural fresh waterways. Whilst the results of this investigation determined that the water quality of runoff and discharge were of no threat to animal or crop health and therefore were suitable for use on farm, in almost all sample occasions across all water quality parameters, tolerance limits for freshwater systems were exceeded. Further research is recommended based on the results of this investigation. A robust study, into the relationship between fertiliser regimes and water quality of runoff and discharged water samples across a broader range of farm systems will provide critical knowledge to guide farm management practices for healthy cropping systems and natural waterways. The development of localised tolerance limits will support this outcome.

7. Acknowledgements

South Coast Natural Resource Management would like to thank the members of the Subsurface Drainage Technical Advisory Group, the project landholders, and all others who provide advice and support for the delivery of this project activity.

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