EFFECTIVE CONTROL OF PROBLEMATIC WEED AND ALGAE IN SEWER OPEN CHANNEL SYSTEM

James Pither, *Senior Engineer Bulk Waste (Major Systems),* Gippsland Water
(Co-authors if any) Joe Chiocci, *Business Development Manager,* Chemiplas Australia

ABSTRACT

Gippsland Water operates a Regional Outfall System (ROS). Constructed in 1957 the outfall is comprised of underground pipeline and open earthen channel sections transporting wastewater. It travels approximately 85.6km from the Gippsland Water Factory at Maryvale to Gippsland Water's Dutson Downs treatment facility prior to exiting via the ocean outfall at Golden Beach. The ROS consists of 43km of pipeline between the water factory and Rosedale, followed by 42.6kms of predominantly open earthen channel from Rosedale to Dutson. The channel was designed for a maximum flow of 60ML/day. The length of the ocean outfall is 1.25km.

Over recent years during spring and summer the open earthen channel sections have experienced problematic weed growth along the base and internal embankment walls. This issue has evolved since the construction of the Gippsland Water Factory (GWF) in 2010, which was constructed for the purpose of pre-treating wastewater to the standard outlined under Gippsland Water's EPA licence. The improved treated wastewater quality being produced in combination with periods of warmer weather creates a favourable growing environment for both weed and algae. The combination of these two invasive species has led to large heavy mats of weed grass, intertwined with algae building up on bar screens along the channel. This contributes significantly to flow restriction and causes damming to take place, raising the channel level, increasing the risk of overflow into neighbouring farms at various sections and contributing to additional erosion of the channel. The formation of this matting has also increased the need for more frequent cleaning, monitoring, and introduces occupational health and safety risks for Gippsland Water personnel who are required to physically remove the heavy weed and algae material from the bar screens manually.

This paper details the steps Gippsland Water has implemented to mitigate these issues, of Occupational Health Safety and Environmental (OHSE) risks and potential overflows. A combination of strategies including targeted herbicidal weed control and mechanical excavation to physically remove weed grass have been used in the past. A subsequent addition of an inline dosed novel algaecide to control the algae and bio film present greatly reduced the dependency on the other strategies. The combination of these approaches mitigated the associated risks with the seasonal issue presenting a safer working environment for Gippsland Water personnel with no overflow environmental risks.

1.0 INTRODUCTION

Gippsland Water operates the Regional Outfall System (ROS) Channel which transports treated domestic and industrial wastewater to its Dutson Downs treatment facility and ocean outfall. The ROS channel typically transports approximately 30 ML of treated class C water per day, which includes 12 ML/day of residential effluent from surrounding towns and 15 to 18 ML/day of industrial effluent from Australian Paper (Integrated Pulp & Paper Mill located in Morwell). Prior to the commissioning of the Gippsland Water Factory, the Regional Outfall System received raw effluent, which contained higher solids load of paper pulp. The quality of this effluent and presence of paper pulp hindered any ability for weed and algae to form, while also lining the channel with an organic sludge barrier which limited any leaks.

The removal of solids in the wastewater and improvement in water quality since the commissioning of the GWF facility, has dramatically changed the operating conditions of the channel and arising operational issues. Over the last nine years Gippsland Water has seen an increased presence of algal growth and weed along all sections of the ROS channel predominantly during springtime each year. This is a likely consequence of the improved quality and clarity of the water due to the increased penetration of sunlight enhancing optimal growing conditions. A combined effort between the Gippsland Water environmental team and operational teams resulted in the successful identification of two aquatic weed species in the ROS channel. *Ruppia Megacarpa*, a perennial aquatic herb found in shallow brackish waters and *Potamgeon Crispus*, a submerged aquatic perennial curly leaf pondweed with stems up to 120cm long.

Recent microscopic analysis[1] of the algal mats present in the channel identified a mixture of filamentous types of green algae from the genus *Sirogonium, Ulothrix and Mougeotia* with the *Sirogonium* type as dominant. An example of the algae that can form in the channel is shown below from Spring 2021 at Peg 166 and Peg 54

The presence of algal blooms combined with the two weed species has created significant operational issues, as the biomass material clusters often weigh more than 30kgs, restrict flow capacity and create OHSE risks. Gippsland Water operators are responsible for maintaining 10 channel screens along the open channel section of the ROS channel, which under normal

conditions typically require cleaning twice per week. Due to the presence of the weed and algae and the speed at which these species grow, operations staff have been required to increase cleaning of the screens up to three times per day in many instances during these events removing 25-30 kgs of matter per event.

The channel has the capacity to adequately manage an average flow of approx. 30-34 ML/day, but the restrictions caused by weed and algae has seen reduced flow capacities of between 21-24ML/day. The significant reduction in flow rate reduces both the capacity and contingency of the system. Reduced capacity in the system increases the risk of an EPA reportable spill due to overtopping. Maintaining flows can only be achieved by removing the weed and algae present in the channel.

2.0 DISCUSSION

The ROS channel is a relatively unique system in that open channel sewer systems are no longer common in modern Australian wastewater networks. Gippsland Water's initial focus was to treat aquatic weed and algae via herbicidal treatments, with a backup option of mechanically removing of large mats of biomass with an excavator using a screening bucket. This had varying levels of success, and required a further investigative study into similar industries and other treatment options that exist in the industry. The following subsections outline the process followed whilst investigating the problems, the results of individual trials and possible applications of these treatments for others in the water industry.

2.1 Early Control Trials

As weed and algae continued to become an issue, several conventional methods were deployed to attempt to manage the problems.

These early weed/algae management techniques included the following:

- Completion of channel shuts to drain the channel to expose weed/algae to temperature extremes and;
- Chemically treat with Round Up or;
- Chemically treat with GenFarm Diquatt 200 Herbicide

These early trials were not very successful, with poor kill rates, particularly in areas were some standing waters remained (dilution of herbicides). The switch to a Diquatt herbicide resulted in increased kill rates of the aquatic weed, however dilution of chemical in the channel base still resulted in a low kill rate in this key area, and subsequently a fast return of overall biomass. On many occasions even with the herbicide treatments, channel levels continued to rise, and large mats of visual weed/algae mats were present resulting in the need to mechanically remove by the means of an excavator. Mechanical removal brought with it a range of its own issues, many due to the poor visibility of the water resulting in damage and removal of the clay liner, reducing asset life and potentially causing leaks as well as significant cost.

As both weed and algae problems continued to worsen, it became clear that the methods employed to date were not effective or sustainable.

Figure 2: Mechanical removal of weed & algae at ROS Channel - Peg 54 Bar Screen

Figure 1: 1 Day of weed removed from Peg 54

2.2 EarthTec® Algaecide

During the 2021/22 summer period Gippsland Water began experiencing severe algal blooms in the ROS Channel, at volumes that had not been experienced in the system before. Additionally, the presence of two different species of aquatic weed species in the system were compounding the issue resulting in increased channel levels, leaks and increased staff health and safety risks.

Gippsland Water commenced market research into algal management options in late 2021, receiving a proposal from Chemiplas for a noval algaecide treatment EarthTec®

EarthTec® is a patented highly dispersible, low pH algaecide designed for use in lakes, ponds, reservoirs, sedimentation basins, irrigation canals, treatment lagoons and other water systems. The active ingredient in EarthTec® is a highly biological active form of cupric ion (Cu++). Unlike other copper sulfate-based treatments, the copper in EarthTec® is already fully dissolved, and more importantly, the release of the cupric ion is controlled by biological demand instead of water conditions. These unique characteristics allow for the long-term control of algae and bacteria without overtreatment. EarthTec® can be applied in one location, and it will evenly disburse, even in stagnant conditions, throughout the body of water. The product is immediately bioavailable and toxic to algae. EarthTec® does not settle out and is not wasted. The residual EarthTec® stays in solution to prevent algae regrowth and is only consumed when met with biological demand.[2] A full environmental risk assessment was undertaken which validated the use of EarthTec® within this environment. EarthTec® is also used within the water sector by regional water corporations to manage algal and weed growth is storages and channel systems.

During the first season of application a temporary dosing setup was established at the Peg 29 open channel site with dosing commencing on 4 December 2021, with an initial dose of 2ppm, increasing to 3ppm on 5 December, 2021 and then reduced back down to 2ppm as algal presence

reduced. The initial trial ran to 12 January 2022 and continued at a reduced (<1ppm) rate in the form of a preventative dose until early February with algal presence having been removed. The measure of success being visual reduction in the presence of algal blooms, enhanced channel

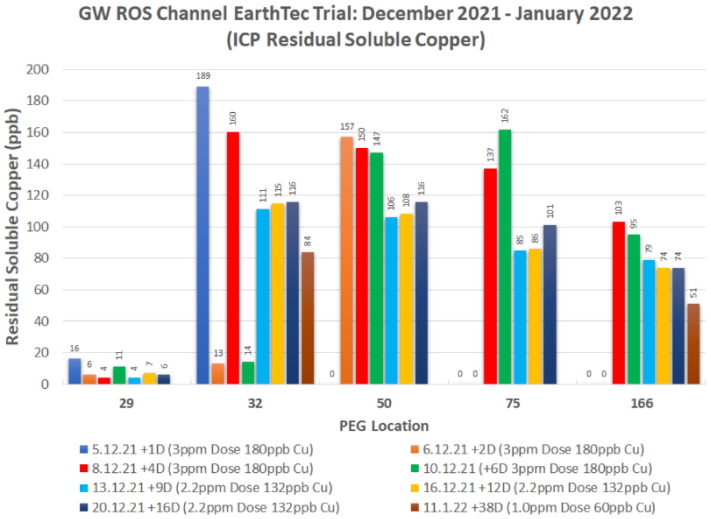

Figure 4:Residual Soluble Copper PEG over 2021/22 trial period

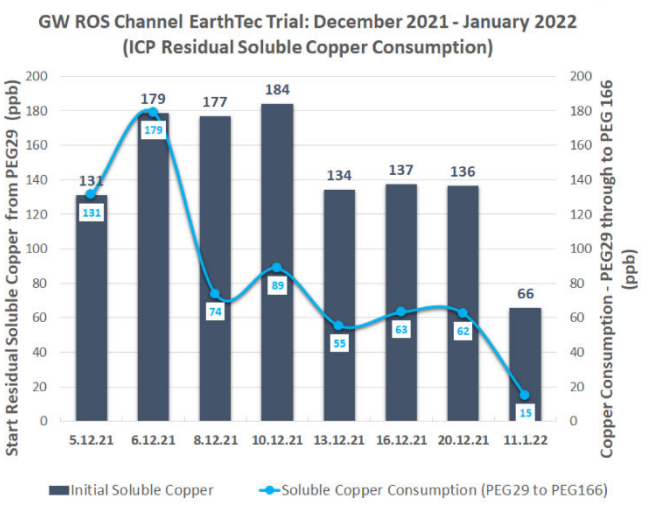

Figure 3: Residual Soluble Copper Consumption over the trial period

operating levels, operator feedback and downstream copper residuals. [3]

Outlined above in Figure 3 is an overview of residual soluble copper measured at various points across the channels 41.5km length. The results show that as the treatment continued, there was a steady reduction of copper residual along the channel indicating uptake from algal, grass and biofilm.

Figure 4 outlines a graphical representation of soluble copper consumption across the channel's length. The results show a consumption of about 50 -60 % of input soluble copper of EarthTec® from Peg 29 –Peg 166. Additionally, it shows that on 11 January 2022 sampled soluble copper dropped to only 22% soluble copper consumption indicating less uptake from remaining algae and biofilm due to the elimination of the biomass in the channel.

While the sampling results show a positive and successful initial trial, the visual reduction in algal blooms, reduction in channel levels and resounding positive feedback from operators who maintain the channel grills were the true indicators of success.

The 2021/22 initial trial of EarthTec® showed strong positive results regarding managing algae this isdespite commencing the treatments in a reactive setting, i.e., once algae had bloomed and was causing significant operational issues. Regarding the management of aquatic weed, the EarthTec® treatment was found not have a significant impact to weed levels, and other measures are required to manage this aspect. However, bio film breakdown by the EarthTec® treatment is likely to have had a positive impact in easier removal of weed that was anchored within this biofilm as opposed to the earthen base.

Figure 5: Peg 54 pre-treatment with Earthtec

Figure 6: Peg 54 post treatment with Earthtec (+ 12 days)

Figure 5 shows the extent of the weed and algal issue in November 2021 prior to the EarthTec® application. This clearly shows the extent of heavy algal mat and illustrate the high channel level due to the damming effects caused by the visible blockage on the screens. Figure 6 shows the same location after 12 days of EarthTec® application with significantly reduced algae and reduced damming effect lowering overall channel height and mitigating OHS risk due to the reduced biomass load on the screens.

Since the initial 2021/22 season application Gippsland Water have continued to use the EarthTec® product as part of an intergrated weed and algal control strategy. In Season 2022/23 a change in dose point was instigated where EarthTec® was dosed to a pipe section via injection quill at Rosedale storage approximately 3km prior to open channel section. With improved channel monitoring the dose employed in the 2022/23 season was lower than the initial season. A 1.5ppm dose was employed over the first three weeks to account for bio film within the pipe section up taking the product which accounted for some of the consumption prior to the start of the open channel section (PEG 13). After this the treatment dose was reduced with algal growth under control. Figures 7 & 8 demonstrate the soluble copper and copper consumption for this season including a breakdown of consumption within the pipe and open channel sections.

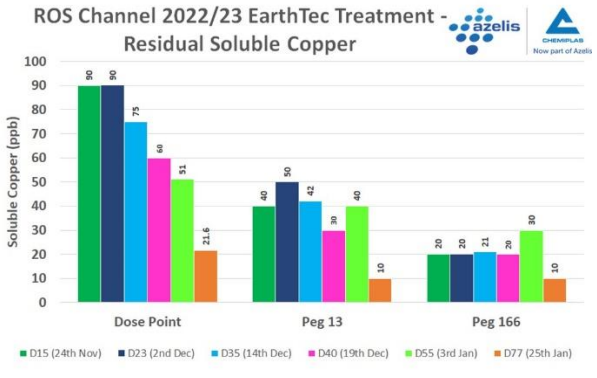

Figure 7: 2022/23 Soluble Copper

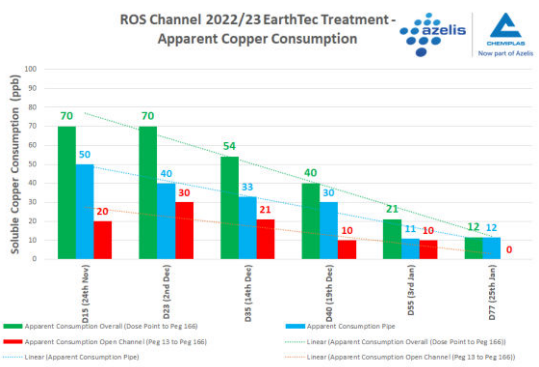

Figure 8: 2023/24 Soluble Copper Consumption

Further refinements of the algal control strategy have continued into the current 2023/24 season where EarthTec® application was commenced prior to the normal algal season in a preventative mode. This ensures a small residual copper amount is present to prevent algae from propagating in the first instance. This strategy is currently using a dose of 0.7-1.0ppm and algal presence has been close to zero.

2.3 Current Weed Management Trials – Magnacide H

With algae under control via EarthTec®, the focus shifted to determining other options for treatment of aquatic weed. Gippsland Water reached out to local raw water authority, Southern Rural Water for information about a successful herbicidal trial they had been running in their irrigation channels, using a herbicide called Magnacide H. Magnacide™ H Herbicide (active ingredient Acrolein). As Acrolein is a restricted contact herbicide a commercial operator's licence is required for use through Agriculture Victoria. A full environmental risk assessment was undertaken which validated the use of Acrolein in this environment as it is highly reactive and has a short half-life in water (4-5 hours) with treated water being able to be released within 72 hours or utilised for irrigation immediately. [4]

Gippsland Water commissioned Aquatic Weed Control Australia to complete a trial, with dosing commencing on 1 August 2023. A slug dosing application was determined most suitable, with a dose of 15ppm applied in two locations within the first 20km of open channel. Flows were held back at Longford storage (midway along the channel system) to allow testing for chemical residual. The residual testing revealed that with two doses at specific upstream locations, the chemical successfully impacted the entire length of channel from Peg 13 to Longford storage, with residuals of 1.6ppm being recorded at the inlet to the storage.

An ongoing sampling program for the week following was completed, to ensure the breakdown of the weed in the channel did not cause any adverse impacts to the Dutson lagoons. Subsequent reporting showed no significant increase in BOD, or any other parameters of concern.

Overall, the Magnacide H Trial was a great success, with strong and immediate results for removing aquatic weed. Outlined above in Figure 5 and Figure 6 are photos taken seven days apart in the same location, the first the day before the trial and the second nearly a week after. Following the treatment, the channel had a significant downstream flow increase, decrease in level, and decrease in amount of weed present on the siphon grills, all great indicators of early success.

Figure 6: Pre application of Magncide H

Figure 5: 7 Days Post application of Magancide H

3.0 CONCLUSION

Through a combined approach utilising EarthTec® to manage algal growth and Magnacide H to control aquatic weed, Gippsland Water has been able to control weed & algal issues in its Regional Outfall System. The results of the project show that through a process of trial and error, and collaboration with other water authorities, solutions to complex

operational problems can be identified and implemented. Benefits to the operation include reduction in associated manual handling OHSE risks, reduced overtopping discharge risks, reduced dependency on excavation equipment to manage weed and minimising potential damage to channel lining from excavators being used below the surface water, reduced labour hours inspecting the channel length, and reduced biomass going to Dutson Downs treatment facility.

4.0 ACKNOWLEDGEMENTS

Joe Chiocci – Chemiplas

5.0 REFERENCES

[1] Algal analysis provided by EnviroMicroBio – Building 5 (TAFE Gippsland) 225 Monash Rd, Newborough, Victoria 3825, 0434 210 610
[2] Description of Earthtec – https://www.earthsciencelabs.global/municipal-industry/
[3] -ALL EARTHTEC TECHNICAL INFORMATION SHOULD BE REFERENCED TO WEBSITE LISTED IN REFERENCE 2 (Joe.C)
[3] Description of Magnacide H - Magnacide® H | ADAMA Australia)
[4] Data collated and provided by Chemiplas via 3rd party laboratory water analysis of copper content using ICP method