TECHNICAL MEMORANDUM

DATE:	08/04/21	REFERENCE:	Surf PD
TO:	Jarrod Ryan	EMAIL:.	jarrod@huntdesign.com.au
FROM:	Butch Uechtritz	EMAIL:	butch@innovate-enviro.com
	Jo Thomas		jo.thomas@turbid.com.au
SUBJECT:	Surf PD Water Treatment Strategy		

1. INTRODUCTION

Turbid Water Solutions was asked to provide a strategy for the treatment of water on the proposed Surf PD development in Port Douglas Queensland. Identified water sources include the stormwater runoff from the catchment during rainfall events that will lead into a proposed reservoir and the other being from the extraction of water from a proposed bore and/or spring.

The stormwater treatment is to ensure any discharges from site will have minimal impact on the receiving Mowbray River system and provide potential re-use options on site for water sustainability outcomes.

The bore/spring water will be utilised to supply the aquatic facilities proposed with the development. A treatment system will be required to treat this water to a standard ensuring minimal health risks to users of the facilities.

The following memorandum will look at the two sources separately and provide a strategy to deal with each.

2. Stormwater Treatment

The stormwater treatment will be integrated between the construction phase and the operational phase of the development to give the greatest chance of minimising impacts on the receiving environment.

Turbid Water Solutions has pioneered the use of High Efficiency Sediment (HES) basins in Australia. These types of sediment basins have been stipulated as best practice with the International Erosion Control Association (IECA) sediment control guidelines and seen as a solution by many councils and the Department of Environment and Science (DES) alike to comply with the QLD State Planning Policy (SPP) and satisfy the "general environmental duty" condition under the Environmental Protection Act to manage construction phase sediment loading.

We propose that the HES basin will be part of a permanent integrated system to manage both sediment and nutrients to satisfy both the construction and operational phases of the developments water quality objectives.

Construction phase:

The HES basin will act as the primary system for water treatment during the construction phase of the development. All run off will be directed to a single inflow point of the HES basin for automated dosing of water treatment products. Indicative location of the HES basin is given below in Figure 1. Actual location will be determined as part of the Erosion and Sediment Control plan developed later.

Figure 1 indicative location of the HES basin

Typical layout of a HES basin is given below in Figure 2. The HES basin will be sized to ensure a minimum of 80% of the annual runoff will be discharged with no greater than 50mg/L in Total Suspended Solids (TSS) and pH in the range of 6.5 to 8.5 to coincide with the water quality objectives of the QLD SPP.

An automated dosing unit will be sized in accordance with the designed inflow rates and dose rates of the treatment product required. Jar testing of various treatment products will be carried out to determine the effective product and dose rate to effectively settle the solids out within the timeframe required.

Automated dosing the appropriate treatment product will result in significant sediment removal and deposition in the forebay section of the HES basin. With this sediment removal, there will be significant nutrient removal as well- particulate Nitrogen and Phosphorous in particular. It is proposed that the captured sediment in the HES basin be recycled back into the topsoil being utilised for landscaping purposes on site.

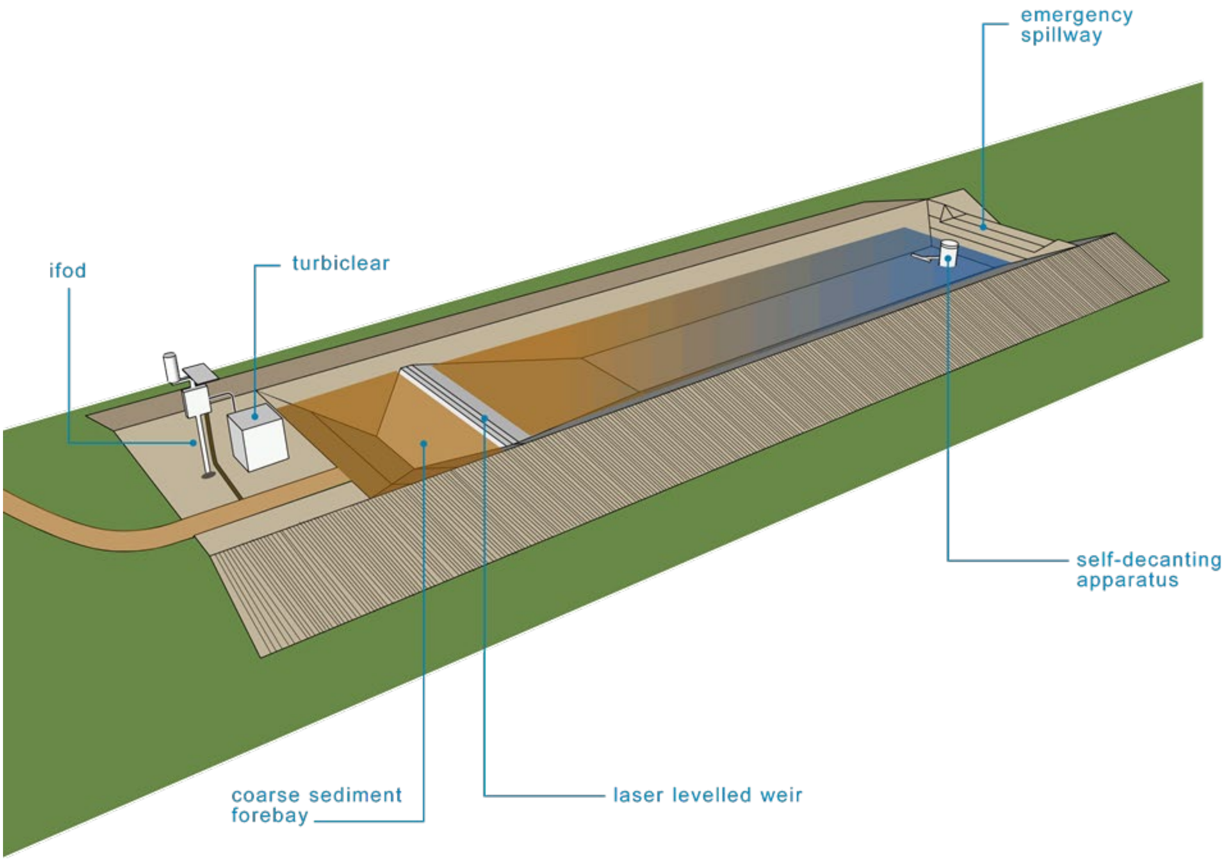

Figure 2 Typical HES basin layout

Operational phase

Once construction phase impacts are negated (sediment loads are minimal) the HES basin will be augmented to cater for predominantly nutrient removal. The automated dosing unit will be utilised only at times necessary for extensive sediment removal of any stormwater runoff.

We propose to install Constructed Floating Wetlands (CFWs) as the primary nutrient control during the operational phase of this development. The CFW technology has been proven to be successful at removing high loads of nutrients as well as lower loads of sediment.

CFWs are an innovative water treatment device that uses biomimicry to remove pollution from water. They function like hydroponic systems where the plant roots grow down into the water to access nutrients. The exposed plant roots create an effective filter for suspended solids and also provide a very large surface area for growth of microbial biofilm as can be seen in Figure 3 below.

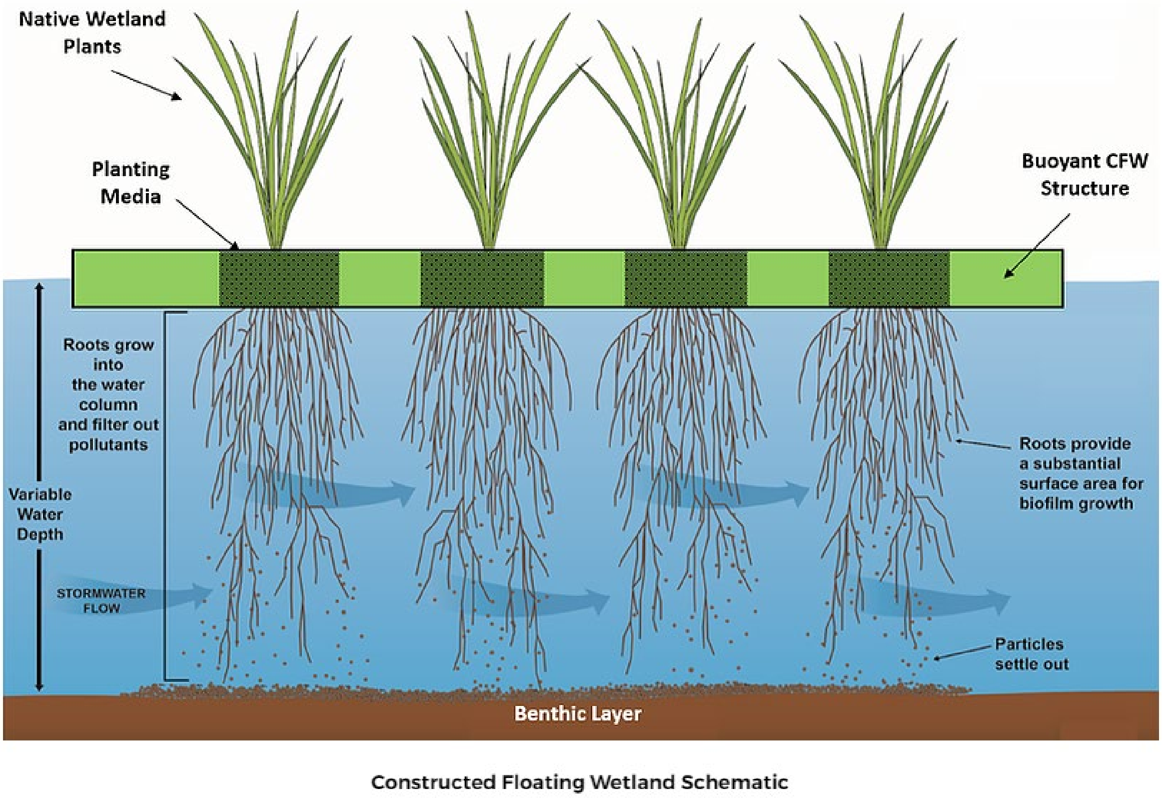

Figure 3 CFW schematic

As well as providing high water treatment performance, CFWs can also:

- Reduce algae growth
- Provide habitat for a variety of animals- birds and fish
- Provide a food source for microorganisms, fish and other aquatic biota
- Enhance visual amenity of water bodies
- Reduce water temperatures under the modules
- Inhibit wind and wave energy, protecting shorelines from erosion

See proposed CFW system in Appendix A.

3. Bore/Spring Water Treatment

The operational and makeup water for this facility will be a mixture of council supplied potable water and bore/spring water as available. The overview of the process to treat the bore/spring water to an acceptable standard for use on site is provided in Figure 4.

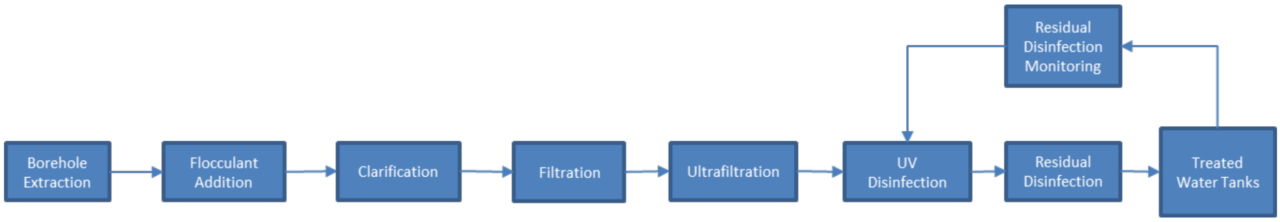

Figure 4 Preliminary Process Block Diagram - Borehole Treatment

The water quality from the bore/spring has not currently been quantified therefore the process adopted has the capacity to remove sediment, metals, and micro-organisms.

The preliminary process has the following units included in the design.

Borehole Extraction

Water will be extracted from the bore with an appropriately sized pump based on borehole extraction performance testing and site facility requirements. This water will be transferred to a buffer tank directly before the treatment system.

Flocculant Addition

Dependant on the contaminants and the water chemistry, the water will be treated with a flocculant to assist in the removal of any particles. The requirement for and selection of the appropriate flocculant will be dependant on water testing, however, it is envisaged if required aluminium chlorohydrate will be utilised.

Clarification & Filtration

A series of clarification and filtration modules will be used within the design dependant on particle size distributions and settling rates. The requirement will be to ensure that the turbidity is no greater than 5NTU to ensure effective UV treatment.

UV Disinfection

The first stage of disinfection will be using UV treatment with a log reduction of 4 for cryptosporidium and 3 for bacteria. The UV units will be the first stage to ensure the tubes are not coated with oxidised material from the addition of chlorine. The disinfection with UV is particularly effective with protozoa as demonstrated in Figure 5. The requirement for inclusion of the UV treatment process will be determined against the WSAA Health Based Targets for Drinking Water Safety.

Log Inactivation	*Fluence* required (mW.s/cm^2)		
	Giardia	Viruses	*Cryptosporidium*
1	2.1	58	2.5
2	5.2	100	5.8
3	11	143	12
4	NA	186	NA

Figure 5 UPEPA Fluence Values for Inactivation with UV Light

Residual Disinfection

As the disinfection with UV provides no residual protection, the use of a chlorine product will be required. Additionally, the use of a chlorine product is much more effective against viruses and bacteria than UV treatment as shown in Figure 6. The chlorine dosing will either be undertaken with sodium hypochlorite or chlorine gas, depending on capacity required of the dosing system.

Log Inactivation	Required *Ct* (mg.min/L)					
	Temperature (°C)			Temperature (°C)		
	5	15	25	5	15	25
Giardia[a]		pH ≤ 6			pH 8	
1	39	19	10	72	41	20
2	77	39	19	144	81	41
3	116	58	29	216	122	61
Viruses		6 < pH < 9			pH 10	
2	4	2	1	30	15	7
3	6	3	1	44	22	11
4	8	4	2	60	30	15

[a] Required *Ct* values for disinfection of *Giardia* by chlorine depend on the chlorine concentration; the values shown are for 2 mg/L as Cl_2. The values for 1 mg/L as Cl_2 are approximately 10% less than those shown.

Figure 6 USEPA Disinfection Requirement by Free Chlorine

Treated Water Tanks and Residual Monitoring

After the treatment process the water will be stored in tanks of sufficient capacity to ensure adequate residence time for the effectiveness of the disinfection with chlorine. If these tanks are used for additional storage capacity, a residual chlorine monitoring system will used to recirculate the water back through the disinfection system as required. This operation will be to ensure the continued removal of micro-organisms in the water.

APPENDIX A

CONSTRUCTED FLOATING WETLAND