Floating wetland treatment systems in residential development: assessing the benefits for residents, local authorities, and developers

Les marais flottants pour le traitement des eaux pluviales dans un projet de développement résidentiel : évaluer les avantages pour les résidents, les autorités locales et les développeurs

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RÉSUMÉ

Parklakes 2 est un nouveau domaine résidentiel sur la Sunshine Coast dans le Queensland. Il était prévu, à l'origine, de traiter les eaux de ruissellement du développement grâce à un marais artificiel de 2,6 ha. Les coûts estimatifs de la construction de la zone humide étaient importants. En outre, les améliorations potentielles de la qualité de l'eau ne seraient pas effectives avant qu'environ 60% de la mise en place n'ait été achevée. Comme solution de rechange, Covey Associates, en collaboration avec l'Université de la Sunshine Coast et le Conseil local, a mis au point une nouvelle approche où le marais artificiel serait remplacé par un lac avec un système flottant de traitement de la zone humide de 2 100 m2 (FWTS). Une comparaison des coûts de construction des deux approches de traitement a été effectuée et il a été constaté que l'approche FWTS a permis d'économiser près de 1 million $ par rapport à la zone humide construite. En plus des économies de coûts, le système FWTS sera opérationnel lors de l'achèvement du premier stade du développement, ce qui offre plus d'avantages en termes de qualité de l'eau et des équipements pour les résidents. On sait qu'un plus grand nombre de plans d'eaux ouverts augmente la valeur des biens immobiliers et les avantages sociaux pour l'ensemble du développement, ce qui pourrait conduire à de nouvelles ventes plus profitables et accroître la valeur des propriétés. Le développement fait également l'objet d'une étude d'évaluation en cours sur la qualité des eaux pluviales.

ABSTRACT

Parklakes 2 is a new residential estate on the Sunshine Coast in Queensland, Australia. Runoff from the development was originally planned to be treated by a 2.6 ha constructed wetland. The estimated costs associated with the constructed wetland were significant. In addition, any potential water quality improvements would not be realised until approximately 60% of the estate was completed. As an alternative solution, Covey Associates, in collaboration with the University of the Sunshine Coast and the local Council, developed a novel approach where the constructed wetland would be replaced by a lake with a 2,100 m^2 floating wetland treatment system (FWTS). A construction cost comparison of the two treatment approaches was conducted and it was found that the FWTS approach yielded savings of almost $1 million compared to the constructed wetland. In addition to the cost savings, the FWTS will be operational by the first stage of the development, which provides greater water quality benefits, as well as higher amenity for residents. Increased open water areas are known to translate to higher property values and social benefits for the whole development which could potentially lead to further increased sales and property values. The development is also the subject of an on-going stormwater quality evaluation study.

KEYWORDS

Cost benefits, floating wetlands, greenfield development, maintenance, stormwater treatment

1 BACKGROUND

Parklakes 2 is a new master planned estate on the Sunshine Coast in Queensland consisting of over 400 residential lots, a retirement resort, and a 1,500 student private school. Planning for the development commenced in 2007, with approvals granted in 2014 and construction initiated on Stage 1 of the development in March 2015. Runoff from the development was originally planned to be treated by a 2.6 ha constructed wetland (Figure 1), which would also serve to manage the health of an urban lake that would receive runoff from the constructed wetland. Flows greater than four exceedances per year (EY, formerly known as a $Q_{3\text{-MONTH}}$) would be diverted around the wetland via pipe infrastructure and into a 400 m long concrete high flow bypass. Due to the large footprint and need to bypass flows above the 4 EY, estimated costs associated with the constructed wetland were significant.

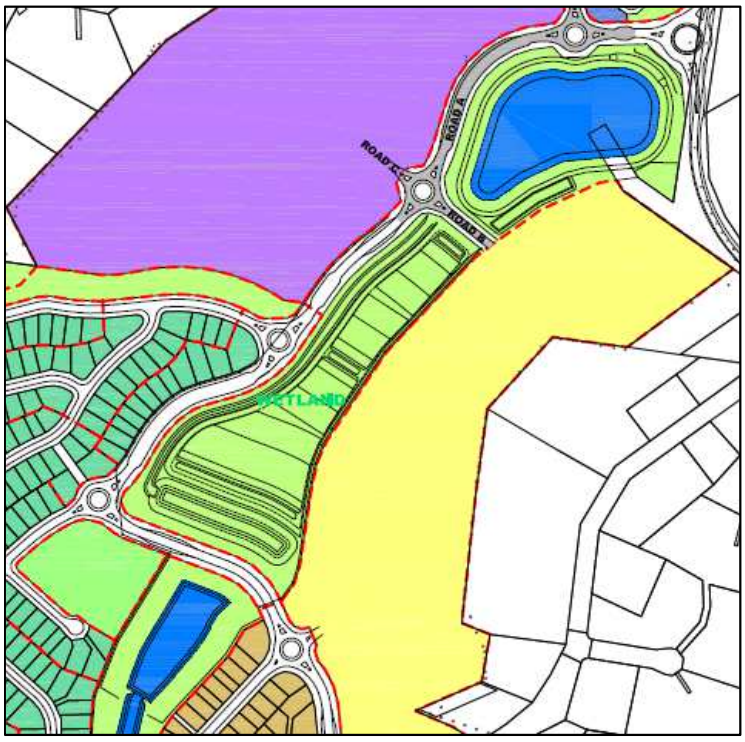

Figure 1 – Original Constructed Wetland Option for Parklakes 2

In addition to the cost implications, the constructed wetland would not be established (i.e. planted out) until approximately 60% of the dwellings in the development had been completed. This meant that much of the stormwater runoff that occurred during the construction phase would potentially receive lower treatment levels, limited to sediment removal only. If adopted, the constructed wetland would have been built out as a temporary sediment basin, with geofabric lined batters and rock lined overflow weirs. While functional, this approach provides little aesthetic value. Residents would not be able to realise any aesthetic benefit from the WSUD asset until after this phase is fully landscaped, which was estimated to be 3-5 years into the development.

2 ALTERNATIVE OPTIONS

Floating Wetland Treatment Systems (FWTS) mimic natual floating wetlands and have previously been used to in treating effluent, as well as providing habitat for aquatic species and waterfowl ((Burgess and Hirons, 1992; Kerr-Upal et al., 2000; Headley and Tanner, 2008; Sukias et al., 2011; Walker et al., 2014a). As the FWTS promote root growth into the water column, microbial biofilm are able to colonise the plant roots (Figure 2). The plant roots and root hairs (i.e. rhizomes) provide a significant surface area for biofilm growth, superior to that of constructed wetlands, where biofilm growth is limited to plant stalks (Walker et al., 2014a; Walker et al., 2014b).

The microbial biofilm is critical in the sequestration and removal of nutrients, particularly nitrogen species through denitrification / denitrification processes, from urban runoff (Borne et al., 2013; Winston et al., 2013). Phosphorus can be retained through binding processes that occur within the biofilm (e.g. adsorption) and uptake of orthophosphates is achieved by vascular macrophyte species.

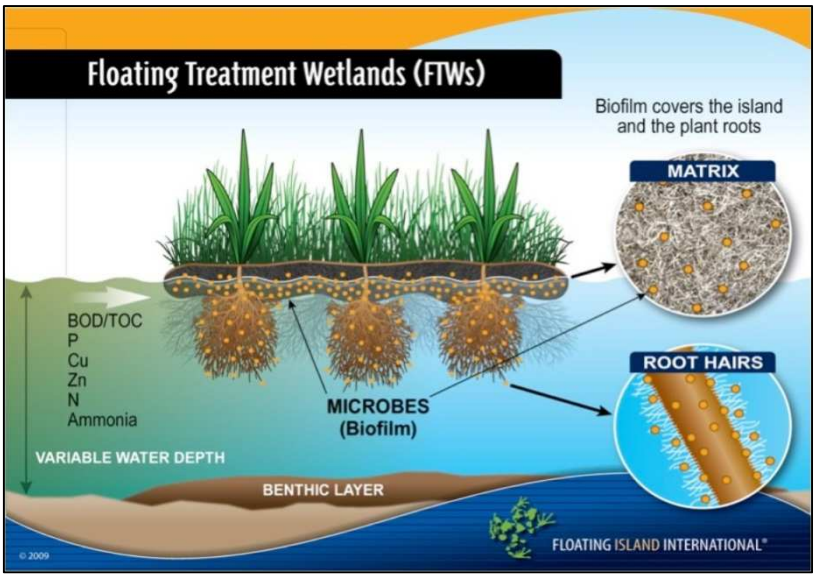

Figure 2 - Floating Wetland Schematic (source: www.floatingislandinternational.com)

Covey Associates developed an approach to use floating wetlands, in partnership with the University of the Sunshine Coast, as an alternative stormwater management strategy to constructed wetlands. This approach would yield an aesthetic benefit much earlier, as the wetlands could be established immediately. The use of the floating wetlands also yielded unexpected and significant cost savings. As part of the approach, a research study was developed in partnership with the University of the Sunshine Coast, where the 2.6ha constructed wetland would be replaced by a 2,100 m^2 floating wetland treatment system (Figure 3). This proposal was supported by the Sunshine Coast Council and as part of the collaborative planning process, a cost comparison between the FWTS and the constructed wetland approaches at Parklakes 2 was conducted. The FTWS option was also very attractive to Council as it aligned well with Council's Corporate Plan (SCC, 2015) to provide an enviable lifestyle and environment by maintaining and enhancing the region's natural assets, liveability and environmental credentials.

Figure 3 – Alternative Option: FWTS at Parklakes 2

3 OUTCOMES

The costs associated with the original constructed wetland option were estimated to be in excess of

$2.7 M, with a significant portion of this cost being attributed to the drainage structures associated with bypassing 4 EY events. The civil drainage infrastructure was estimated to cost $1.8 M, which was more than 65% of the total overall cost for this option. In addition, planting costs estimated at $550,000 were also expected with the 2.6 ha constructed wetland option.

The 2,100 m^2 FWTS approach enabled the majority of the civil infrastructure to be removed from the design. As the FWTS is an "online" treatment method it does not require flows to be diverted around the system. Further, the efficacy of treatment versus flow rate can now be assessed. The reduction in planting area from 2.6 ha to 2100 m^2 also yielded a significant cost saving to the project, as plant numbers decreased significantly from over 80,000 for the constructed wetland to only approximately 18,000 due to the reduced treatment footprint of the FTWS. Further, due to the smaller treatment area required, retaining walls bounding the eastern side of the wetland were no longer needed and were replaced with planted batters.

Additional cost savings will also be realised through reduced maintenance of the system. As the FWTS has a smaller footprint than the constructed wetlands, it inherently reduces the time spent on maintenance of the system. This was a major factor with Council's decision to move forward with this option. As Council will ultimately own this asset once the research project is complete, they will also be responsible for its maintenance. The detailed cost savings associated with the FWTS maintenance will be documented throughout the 4 year research timeframes.

4 SUMMARY

In adopting the FWTS as the stormwater management approach, a savings of approximately $1M in upfront construction costs was realised, when compared to the constructed wetland approach. In addition to the significant construction cost savings, the FWTS has been incorporated into the first stage of the development, which will ultimately provide an immediate aesthetic benefit for residents much earlier in the development, and it is anticipated that this will also benefit sales and property values. Furthermore, increased open water areas translate to higher property values and social benefits for the whole development.

FWTS offer a more flexible (and potentially more effective) approach to stormwater management that may boost development yield and property values while offering a more sustainable and aesthetically pleasing means of treating stormwater runoff. Being able to install FWTS at the beginning of the construction phase also offers multiple benefits including immediate stormwater treatment and increased amenity for residents.

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