A Forest in the city for flood mitigation and much more

Une forêt dans la ville pour la gestion des crues et encore plus

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RÉSUMÉ

La ville de Wollongong en Australie, s'étale sur une bande de 7km de large, blottie entre l'océan et un escarpement à 350m d'altitude. L'escarpement et ses forêts forment une toile de fond très verdoyante. Cependant depuis les années 1820, quand les premiers colons s'établirent ici, de grandes étendues ont été défrichées créant des problèmes pour les cours d'eaux locaux. Les effets orographiques de l'escarpement sont bien connus et entrainent des pluies très intenses. En 1984, le sud de la ville reçut 804 mm en 48 heures. En 1990, un plan de prévention des risques d'inondations fut établi préconisant un certain nombre de bassins de rétention. En 1992, les plans techniques pour un de ces bassins sont en développement et se confrontent aux vues générales que le lit des bassins de rétention ne doit pas comprendre d'arbres. Cependant à cette époque certaines recherches montraient déjà les bénéfices d'inclure des arbres dans ces structures. Les arbres ont donc été préservés et d'autres ont même étaient plantés, résultant de nos jours en une dense forêt urbaine qui présentent de nombreux bénéfices sociaux, environnementaux et de prévention des risques d'inondation. Cette communication présente la base des décisions pour développer les plans techniques de ce bassin de rétention et aussi la diversité des bénéfices qui en ont résulté. Le domaine des connaissances pour déterminer les valeurs de ce genre de 'bassin-forêt' reste cependant inadéquat.

ABSTRACT

The City of Wollongong in Australia is a narrow strip (~ 7km wide) of land between the Ocean and a near vertical escarpment to a height of around 350m. The escarpment forms a green forested backdrop. However the initial settlement of the area from around 1820 on lead to extensive clearing of land and associate problems with streams and rivers.

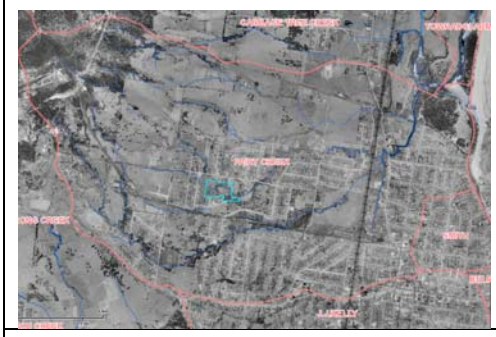
The orographic effect of the escarpment on rainfall intensity is well known with an area just south of the city having recorded 804mm in 48 hrs in 1984. In 1990 a Floodplain management study and plan put forward plans to construct flood mitigation measures which included a number of stormwater detention basins. In 1992 a design for one of these struggled with general practice at that time of excluding trees in such structures however research even then showed that there were multiple benefits in including trees within basins. The trees were kept and many more added, such that the area is now a dense urban forest, with multiple social, ecological and risk management benefits. This paper explores the basis of the original design decisions and the diverse range of benefits that resulted. There still remains inadequate knowledge regarding determining the value of some of these outcomes.

KEYWORDS

(Urban Forests, Flood Management, Multiple Use, Storage Basins)

1 SETTING

The Illawarra escarpment is a prominent coastal escarpment that fringes the western edge of the Illawarra region and the City of Wollongong in Australia. There are strong orographic effects that deliver extremely intense rainfall along this feature that results in very fast flash flooding relatively frequently. Flood mitigation options including the provision of storages have been implemented. Traditionally these have been barren sporting fields or grassed parks with an embankment. For several projects in the Fairy Cabbage Tree Creek catchment in the 1990's it was successfully argued to promote tree growth within these storages. This to some extent was driven primarily due to a tree planting local enthusiast awarded the Order of Australian Medal for his efforts in 2017.

	
	
1948	2016

It is clear that there has been a remarkable change in vegetation cover from 1948 to 2016, noting that the vast majority occurred post 1994.

2 INTRODUCTION

Flood mitigation by the provision of storages has long been a preferred traditional approach (at times questionable). Generally these were provided by way of sporting fields with an embankment to hold the flood volume for example. There being an active mind set to eliminate or at least not include trees.

In the implementation of the Fairy Cabbage Tree Creek Flood Mitigation Scheme, several storage basins were constructed with the specific inclusion of mass tree planting. The lead example of this is the Nyrang Park Basins. Since its construction (~1994) thousands of trees have been planted and maintained. Today it presents as a magnificent treed park.

The outcome some 26 years later is not only spectacular with regard to the aesthetics, but also in regard to re-establishing habitat for flora and fauna, re-connecting the community to nature, inspiring the ongoing development of community bushcare, mitigating urban heat island effects and buffering climate change impacts as well as the performance as infrastructure to reduce flood impacts and promoting improved ground water exchange.

This paper will go into the detail of the original design, the original struggle for approvals and the detail of the range of benefits over an equivalent open field detention basin nearby. It will also touch on the direction of ongoing Policy and likely Policy change into the future. This paper aims to explore the range of benefits of this approach over the tradition 'treeless' approach.

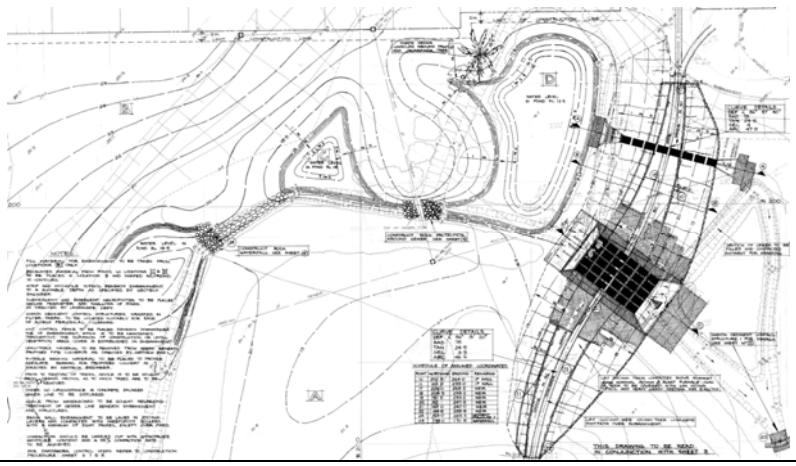
3 DETAILS OF THE PROJECT

The provision of a storage basin in Nyrang Park came as an outcome of the 1990 Fairy Cabbage Tree Creek Catchment Flood Mitigation Study and Plan. The aim being to protect downstream properties from flooding in a range of events but particularly the most frequent events.

3.1 Nyrang Basin

The Nyrang Park covers an area of around 4.2 hectares the basin provides a 3.5m High embankment across the watercourse with a three tier outlet configuration to provide a PMF capacity. The basin

provides a volume of around 48,000m3 in total, covering an area of around 1.5hectares.



Overview of Upper Nyrang Basin

The barren design plan was preferred by more traditional senior engineers. But wait there was a landscaping plan also.

3.1.1 Landscaping

Unlike most other Basins design and constructed in Wollongong at that time, Nyrang Basin's landscaping plan included extensive tree planting inside the basin volume extent. This was shaped by a much earlier concept document "The Keira Green Coorridor" (Davis 1992). Many of these early ideas tie in very tightly with current ideas around "Urban Forests". It was argued (by the more traditional camp) that as the tree trunks grow storage would be lost and the basin's performance compromised. The counter argument however showed that through available research at the time in fact the leaf area index of a fully well-structured forest provided sufficient storage on leaves and surfaces to more than offset the loss of open storage lost in the trunks. Not to mention the benefits of improved infiltration and moisture holding capacity of the leaf litter mulch and humus. Hence it was conceded that it would be allowed as a trial site. The resistance to the concept maintained for quite some time on other similar projects.

4 OUTCOMES OF THE PROJECT AFTER 20 YEARS

Nyrang Park during construction was stripped largely to the underlying clay material over extensive portions of the park. Even during construction as areas were completed the local resident was actively planting and maintaining trees. This to some extent actually aided in minimising sediment loss from the site, as the planting was accompanied by mulching.

4.1 Hydrologic Impacts

The basin has shown that it regularly stores significant quantities of flow thereby having an impact on reducing flows downstream over a range of storm events. Further with its now structured canopy and understorey the leaf area index is well beyond that of a singular tree, combined with the thick rich layer of leaf litter/mulch and aerated humus, the park has far greater moisture retention through canopy interception and infiltration (Bartens etal 2008). Studies on canopy interception have shown (Venkatraman, Ashwath 2016) this to be far more effective than initially understood. This is likely to be still under estimated for more complex vegetative structures. It is hoped that in the near future these aspects may be quantified specifically.

4.2 Environmental Impacts

Environmentally the park has transformed in the amazing ways. The vegetation has attracted all manner of bird life and other fauna, the increase in leaf litter and decomposing woody material has improved the soil condition and structure. The floor of the basin is rich dark fertile soil that is better aerated and has greater infiltration capacity. The clarity of the dry weather flows has improved. The vast majority of weed species have now disappeared by either been out competed by the native vegetation or due to reduced light penetration from the dense canopy . In addition this urban forest, reduces air pollution, reduces the urban heat island effect and stores carbon from the atmosphere. There is a very noticeable temperature difference when walking through the park on a hot day for example.

4.3 Economic Impacts

Although not a directly considered outcome of the project, the vastly reduced area requiring mowing has

had a direct impact on the cost of maintenance in the park. In addition, although the initial input managing and caring for trees was carried by the “tree planting’ resident, in the long term there has been little need for ongoing council involvement. The now natural regeneration of various tree species and the establishment of a canopy and understorey has kept the need for intervention of any sort to a minimum hence vastly reducing costs compared to other nearby open parks. The full economic impact analysis of the annual benefits of the park has not been undertaken but (Alexander, McDonald 2014).have estimated it to be around $10AUD per tree per year (in benefit).

4.4 Social Impacts

Nyrang Park has transformed from a poorly frequented and used, weed infested overgrown parcel of land to a truly majestic forested area, utilised daily by many of the adjoining residents who enjoy its health benefits. Access has been provisioned with a formal footpath and a number of less formal bush walking tracks. The active Land Care group provides the ability for many local residents to become involved, educated and aware of environmental issues in the park, and there are regularly arranged social outings, for example inviting nearby schools to participate. The peace and tranquillity of interacting with a dense compact slice of nature with its cooling air and soothing atmosphere is likely to have many other benefits to local residents.

5 NEED FOR FURTHER RESEARCH IN DEMONSTRATING THE VALUE AND STATUS OF URBAN TREES IN STORMWATER PROJECTS

Although this basin was constructed with at the time little comprehensive data relating to the benefits (or not) of a more naturalised approach to storm water mitigation planning, this situation continues some 25-30 years later. There still remains a vacuum of quality research and data that holistically addresses the overall impacts or benefits. This is not only identified as an issue in Australia, but globally recognised, and recently (European Union, 2014) produced significant policies under the EU Water Directive Policy document of Natural Water Retention Measures(NWRM), where it is stated:

“Despite the growing knowledge base on the positive role that NWRM can play in integrated water management, the need for a better knowledge base and exchange of good practices is recognised. More robust information, in particular on the effectiveness of NWRM under different conditions and on their (potential) additional benefits as compared to other measures, will facilitate the identification of contexts and conditions where NRWM may provide multiple benefits and be cost-effective, and hence may promote more widespread implementation of NWRM.”

Hence in the long term it may be worth considering a targeted project of monitoring to enable a more accurate estimate of overall benefits. This would aid authorities such as local councils implementing this type of infrastructure over the more traditional approaches.

In 2017, Council adopted an ‘urban greening strategy’ to achieve a reduced ecological footprint, improve sustainability of the urban environment, increased physical and mental well-being of residents and other benefits.. The authors of this paper argue that flood and stormwater managers have a key role to play in shaping the urban space and achieve a range of benefits that go well beyond flood mitigation, and need to link into broader concepts such as those contained within the philosophy of Urban Forests and NWRM’s for example, the value of which is only recently becoming more fully recognised (Alexander, McDonald 2014).

6 ACKNOWLEDGEMENT

The authors of this paper would like to acknowledge the almost unfathomable amount of dedication and hard work put into the public asset of Nyrang Park by local resident Reece Flaherty (OAM), without who’s efforts there would be little to write on this subject in this paper. Note in 2017 Reece was awarded the order of Australia Medal (Flaherty 2017) for service to conservation and the environment, a well deserved recognition of his efforts and contribution to his community. We congratulate and thank him for his ongoing tireless efforts.

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