WHAT PRICE STORMWATER MANAGEMENT

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ABSTRACT (200 WORDS MAXIMUM)

This paper has its origins in some internal work we have been doing, giving thought to the place of stormwater management in our business. It will focus in particular on the management of urban stormwater discharges. It presents some of the ideas we have developed about the evolution of urban stormwater management in New Zealand from the perspective of over 25 years of personal practise in the area.

The paper will challenge the place of the stormwater drainage mind-set in our current work environments and will also ask (and try to answer) some of the questions about what is meant by stormwater management. The paper will identify and discuss some of the common pitfalls practitioners experience with respect to the management of stormwater discharges in the urban environment and some potential means of avoiding those pitfalls.

The paper will present a range of experiences to stimulate thought and discussion amongst those who view it. Rather than to provide any definitive answers the intended outcome of this paper is to encourage each of us to think about what we need to achieve in our working environment and the priorities we need to focus on from a stormwater perspective. The paper originated as a paper to the 2013 Ingenium Conference on a Climate of Change, but has been adapted here for the 2013 Stormwater Conference.

KEYWORDS

Stormwater, Stormwater Management, Treatment, Low Impact Design

PRESENTER PROFILE

Allan Leahy is a stormwater engineer with nearly 30 years of experience in the stormwater industry in New Zealand in particular. Through that time he has been an active player in the evolution of stormwater from a largely engineering driven flood “control” activity into the multi-disciplinary activity it is now. He is currently the National Technical Specialist for Stormwater Management for MWH NZ Ltd, based in Auckland with work throughout much of the country and also internationally.

1 INTRODUCTION

This paper has originated from some work we have done internally within MWH on the changing role of the stormwater engineer, in particular as we define this role as it fits within the organisation. It represents the personal reflections of the author on the changes within the industry, his attempts to define the work he is involved in with stormwater management and considers whose technical domain stormwater management actually covers and who should lead this.

It has to be acknowledged here that in the words of an early mentor "stormwater is the Cinderella of the three waters". It is traditionally less well funded and is usually only a political issue for a short time after a major flood event. However, it has also become more of an issue for consideration during the consent processing phase of a new development, where the quality and volume aspects are examined in more detail.

The early to mid-1980's saw the start of stormwater management planning in urban areas in New Zealand. The first Stormwater Catchment Management Plans (CMPs) started being developed in New Zealand in the 1980's. These documents were about drainage and typically were based on (what we would now consider) simplified analysis of main stream systems through the urban areas. They were very much the engineers domain and focussed on the management (or in some people's terms the "control") of flood flows through urban areas.

2 EVOLUTION

2.1 DRAINAGE

Up to the mid 1980's, drainage and the engineer was king. We had simplified calculation methodologies using mostly empirical calculation techniques that allowed us to assess peak flows for simple systems, but the network effects in urban areas were not well understood or considered by most. Gauging and calibration of urban runoff calculations was more than a little adhoc (and arguably it still is). Indeed it was only in 1977 that the New Zealand Institution of Engineers (Auckland Branch) produced "A Guideline for the Procedure for Hydrological Design of Urban Stormwater Systems". This was as far as I am aware the first attempt to standardise urban stormwater calculations in the New Zealand context (though it was a bit before my time).

The 1980's saw the arrival of readily accessible computer aided modelling techniques. Personal computers started becoming available and affordable, with the ability to reasonably easily set up numerical models of drainage networks. While numerical modelling was in its infancy it represented a step change from the peak flow estimation techniques of the rational formula or other empirical flow calculations techniques. This change allowed for the consideration of network effects and the interaction of different branches with individual timings and land use effects being able to be considered.

At this time the outcomes sought were very much around how far did the flood area extend? What were the depths of flow? What size pipes or waterways were needed to pass the design flows? A number of our more structural flood management schemes with concrete channels were conceived during this period. The calculation outputs were limited to the main drainage systems or the main overland flowpaths. There really was limited ability to model the whole of the network and it's multitude of interactions between primary and secondary systems, pipes and open channels, as well as flood plain storage effects.

2.2 NUMERICAL MODELLING

The arrival of computer modelling techniques and tools provided engineers and land use planners with the tools to start to make land use decisions based on predicted effects with some degree of science behind them. These first tools were more than a little simplified by current standards. They allowed for the development and routing of flow hydrographs down reasonably simple systems, but certainly lacked the sophistication of modern systems.

As computers have become increasingly powerful and available so have the numerical models that we use on them. Now of course we are routinely looking at models which include linked pipe systems, overland flowpaths, 2D and 1D components. It is not that long ago that we only had the ability to model simple 1-D cross-sections, maybe taking into account the different roughness of the wider flood plain to the main channel, if we were lucky.

As the ability to model more complex systems has increased so too has the amount of information needed to be gathered for the models increased. However, the problems of getting meaningful and calibrated data from these models still remains, but is often hidden behind the complexity of the modelling systems employed.

Models used to be run (and often written) by engineers who were process driven and by necessity had to understand the hydrology and hydraulics behind the calculations as well as the basic calculation systems themselves. Now modelling is much more standardised and commercial and is often delegated to less experienced people to carry out, as with our computer aided drafting work. The risk of course is that the understanding of what is going on behind the scenes of the model is lost. How often have you heard "… but the model says…". The challenge for managers is to retain that understanding while still providing a cost effective service. We now have modellers involved in stormwater management. Modelling is no longer solely the realm of the engineer. Modelling is also becoming an end in itself rather than a means to an end from an engineering perspective.

Computer models have given us an unprecedented ability to examine the effects of different hydrological and hydraulic management techniques on our drainage systems at previously unheard of detail. However their use and interpretation still needs to be tempered by the application of solid experience and cynical oversight.

Perhaps an area of stormwater modelling still in its infancy is the modelling of contaminant loads. While we do have some models for the modelling of contaminant loading they are still pretty simplified in their modelling of contaminant generation, transportation and the fate of the contaminants. Perhaps this is to do with the still evolving state of the science in these areas? Or perhaps it is the lack of hard data on this subject?

2.3 WATER QUALITY

The quality of urban stormwater discharges started being highlighted in New Zealand via the Auckland Regional Council in the 1980's. There was solid experience demonstrating that Auckland's quiescent upper harbour environments were being adversely affected by contaminants carried within stormwater discharges. This mechanism is now accepted throughout the country, though the degree of its relevance is not perhaps always fully understood.

While a lot more is known in this area now than in the 1980's, it is still an area where we still have a lot to learn. Not just on the generation and transportation of contaminants but also of their fates in different receiving environments.

With the emphasis on the quality of the water in stormwater discharges, another professional area has come to prominence in stormwater management, that of the sciences. Stormwater management now needs input from a range of scientists from freshwater to estuarine to marine ecologists to physical chemists to water quality scientists to microbiologists and likely many others.

Attempts at addressing stormwater quality started with targeting the suspended solids on the basis that the majority of contaminants able to be reasonably easily addressed were bound to this material. Current evolution is taking us away from a purely suspended solids approach to addressing the particular contaminants of concern in given situations, bearing in mind that in this context temperature can be a contaminant.

The identification of the contaminants has of course then lead to the need to reduce the contaminant load. This has led to the development of stormwater treatment devices.

2.4 STORMWATER TREATMENT

In New Zealand the old Auckland Regional Council's TP10 Design Guidelines for Stormwater Treatment Devices published in 1992 (second edition in 2003) was the ground breaker in this area. While it relied on overseas experience it provided a local (Auckland) context to the treatment. It targeted suspended sediments and provided design methodologies for largely engineers to follow to design Best Practical Options for stormwater treatment devices. It included ponds, wetlands, sand filters, coarse sediment traps, rain gardens, swales, bio filtration. While this has become to a greater or lesser extent adopted around the country it was targeted at the sediments bound contaminants that were a particular concern in the Auckland environments.

In Christchurch where the issues were slightly different a separate publication came out around 2003, the Christchurch City Council's Waterways and Wetlands Guidelines. While this also targeted contaminants it was intended for a geography with quite different rainfall characteristics, ground conditions and receiving environments. In Christchurch the contamination of groundwater systems and retention of more 'natural' drainage systems in the flat topography was a key differentiator to the Auckland scenario.

In more recent times a number of other regional councils and the NZTA have published their own guidelines, these rely heavily on those earlier publications, in particular TP10.

With the requirements for stormwater treatment entrepreneurs have also come into stormwater management. There are now a number of proprietary treatment devices on the market, all promising to achieve many outcomes, with mixed success. Of course with the inclusion of commercial drivers and the need to sell product, the marketers are also involved. The need to understand the product outcomes and ability of various devices to achieve these outcomes gets more difficult to determine.

The other aspect that has come to the fore in the use of devices in particular the so-called soft engineering devices is the link with achieving better amenity. Often there is a need on Greenfields development sites to install pond or wetlands and generate more benefit from them than just engineering outcomes. This has led to the involvement of urban designers and landscape architects and parks people to also be involved in the stormwater management process.

While these treatment systems have done a lot to reduce contaminant loads to the receiving environments there are still questions on whether they have done enough, and strong evidence (arguably proof) that they have not addressed the degradation of the stream environments.

2.5 AQUATIC ECOSYSTEM PROTECTION

The next evolution of stormwater management was the protection of the stream systems. The key impact on them was the change to the hydrological regime through the introduction of impervious surfaces and the engineered drainage systems efficiently delivering stormwater runoff to them. Even the detention systems that have been so painstakingly designed to reduce peak flows were not helping in this respect. New approach was needed.

In New Zealand this started with what was then termed Conservation Design and has now become known as Low Impact Design, or Low Impact Urban Design and Development. In other countries this may be known as Stormwater Sensitive Urban Design, Integrated Water Management or Water Sensitive Urban Design or Sustainable Urban Drainage. It represents a different way of thinking about stormwater and the traditional 'efficient' engineering approaches to drainage.

This is really about looking holistically at stormwater runoff and trying to mimic natural systems. It goes against traditional engineering approaches of efficiencies, as nature is not efficient in engineering terms. It takes stormwater management back to a source.

2.6 LOW IMPACT DESIGN

As discussed above Low Impact Design and its variants are about a holistic approach to managing stormwater runoff. It is (the current) culmination of a relatively recent evolution of the stormwater industry in New Zealand, with direct parallels overseas.

Low Impact Design starts at the regulatory level in setting the framework for managing effects and managing the areas where development may or may not proceed. It operates at a catchment level where particular sensitivities and opportunities can be identified as part of developing wider solutions whether they be on types of development, types of land use or mitigation strategies or devices. It operates on a development level, where the format of a development and its mitigation of stormwater effects is finalised. Then it operates on a site level where the mitigation on a particular site is designed. This may then also extend to individual device design.

There are a range of tools and publications about Low Impact Design, the first in New Zealand being the old Auckland Regional Council's TP 124 "Low Impact Design Manual for the Auckland Region".

The key though (in the context of this paper) is that Low Impact Design has now taken stormwater management into being a truly multidisciplinary function. It is no longer the domain of the engineer, the land use planner or the numerical modeller. Nor is it just about creating amenities for the community or just about urban design. It is also not just about the streams or estuarine receiving environments. It is a holistic approach that requires an understanding of all of the above and the inclusion of specialists in all of the above areas working collaboratively.

3 PITFALLS

3.1 GENERAL

The typical pitfalls encountered in stormwater management could be the subject of a paper on its own. For this paper a selection of some of the key pitfalls are discussed.

3.2 DRAINAGE MINDSET

There is still (unfortunately largely in the engineering community) a mind-set that stormwater drainage is the answer. This mind-set needs to evolve.

Drainage is a vital part of stormwater management and achieving the amenity and protection criteria for our communities is essential. However it is now only one of the outcomes we need to achieve with stormwater design. Hence the evolution of the use of the term Stormwater Management. Educating practitioners on this difference is essential to achieving better outcomes for our communities, the environment and the next generations.

3.3 DEFINITION OF OUTCOMES

Clearly understanding the particular situation and defining the outcomes to be achieved is the essential first step in achieving those outcomes. The approach adopted in the final solution needs to be derived from a clear understanding of the effects to be managed and the outcomes being sought.

Too often in stormwater management and design (both at the macro and micro scale), the outcomes are derived without first defining what it is that needs to be achieved in the particular situation. Clear definition of issues, options and constraints will minimise this issue.

3.4 PHILOSOPHICALLY DRIVEN OUTCOMES

Often stormwater management outcomes are driven by philosophy rather than by an understanding of an application's particular situation. This is related to the above item of defining the situation and what needs to be achieved before developing the solution.

For example, Low Impact Design is often touted as being the solution, when the problem to be solved and the constraints on the solution sets are not even known. While Low Impact Design is a very important tool in our stormwater management tool box there are scenarios where other techniques may take precedence. Is treatment actually an issue in the particular situation? Is the volume of runoff an issue? Or is it an amenity issue that may be addressed in some other way?

3.5 MUTLIDISCIPLINARY APPROACH

Good stormwater outcomes now need to be driven by a truly multidisciplinary approach. The purely engineering driven approach is no longer adequate, nor is the approach of just looking at amenity or an existing environmental or regulatory consideration.

Often the organisational structures of those involved in defining the solution sets do not encourage the successful application of a multidisciplinary approach but it is vital to successful solutions for our existing and future communities that a multidisciplinary approach is adopted. This means that the imperatives of each of the parties, whether they are interested in (in no particular order) development, stormwater engineering, transportation engineering, structural engineering, parks and recreational, heritage, environmental imperatives (freshwater, estuarine, coastal as well as terrestrial), landscaping, urban design, community interest, tangata whenua, regulatory need to be considered.

3.6 COST VS VALUE

This pitfall warrants a conference all on its own. It is really easy to define the lowest cost for some inputs but it is much more difficult to define the best value. Both those who buy and those who sell in this context need however to very aware of the differences and continually strive to achieve best value, despite the systems they are working within. Sometimes the best value does cost a bit more.

3.7 PROPRIETARY DEVICES

This is also related to the above item of cost vs. value. Proprietary devices have a very important part to play in stormwater management, however, the selection of appropriate devices needs an understanding both of the problem to be solved and the capability of particular devices. Salesmen do not always have the ability nor the information to make those calls for designers. Their job is to sell their employers product.

3.8 MAINTENANCE

Once again this is a topic for a conference all on its own but understanding and implementing the appropriate maintenance requirements of stormwater management techniques is essential to their success. This applies to both structural and non-structural techniques and is not limited to engineering interpretations. Once again the multidisciplinary approach applies. A lack of understanding of who needs to do what and when has led to the failure of many applications. A supermarket owner or a member of a Body Corporate will not be as aware of maintenance requirements on treatment devices as will say a local authority operations team, it is not their core business.

3.9 EFFORT

This paper has specifically avoided discussion on cost. However it is not possible to avoid a short discussion on effort (which may well be related to cost). As our requirements to achieve more out of our stormwater management in the last few decades has evolved, so has the effort needed to achieve those outcomes.

A number of the systems being implemented are still in the developmental phase as are the maintenance requirements of them. Standard details are still being developed. Multidisciplinary approaches also take more effort than unilateral approaches.

As such more effort needs to be put into the development of successful stormwater management approaches to achieve the best value.

4 CONCLUSIONS

This paper has presented a potted history of the development of stormwater management in New Zealand over the career of the author. It has highlighted where we have come from and gives some insights into where we are going to. It has discussed some of the key pitfalls as seen by the author.

Hopefully it gives food for thought and provides the readers with some insights into how they can continue to achieve better stormwater outcomes over the coming decades.

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Thanks to all those who have both wittingly and unwittingly mentored me over my career to date. I have learnt so much from so many. Thanks also to those who will continue to teach me over the remainder of my career, I still have so much to learn.

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