Asset Management

water e-journal
Online Journal of the Australian Water Association

ISSN 2206-1991
Volume 4 No 1 2019
https://doi.org/10.21139/wej.2019.009

Applied Fluvial Geomorphology in the 21st Century

Embracing a Waterway Asset Management Approach

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KEYPOINTS

- Embracing *asset management* is an opportunity to realise value from investment in waterways
- Improving our approach with respect to managing physical form and function is a key part of this
- Improving our understanding of and data on the regions physical form and function is required
- A framework integrating physical form and function attributes with asset management is required

ABSTRACT

In 2016 Melbourne Water embarked on a transformation of how we manage our regions waterways and storm water quality treatment wetlands driven by the Victorian Government mandatory requirement[1] that: *commencing in 2020-21, all public sector agencies must conduct a three-yearly self-assessment of the level of asset management maturity within their organisation and state this in their annual report*. The implications of this 2016 mandate are that by 2020, Melbourne Water needs to have aligned our existing approach to managing waterways and storm water quality treatment wetlands with the requirements of the ISO 55000 Asset Management Standards.

Melbourne Water took this mandate as an opportunity to dedicate efforts to establish a waterway asset management approach. Melbourne Water has managed waterway and stormwater quality treatment wetlands for many years, but there is a difference between managing assets, often independently of one another; and embracing a comprehensive and systemised asset management approach.

This paper provides insight into the asset management approach to physical form and function being developed over the coming year. It is hoped that other organisations can benefit from the sharing of the knowledge being generated as Melbourne Water develops its waterway asset management capability and maturity.

Keywords: Waterway, asset management, physical form and function data, decision-making, return on investment

INTRODUCTION

Melbourne Water's Waterway Condition and Stormwater Quality programs are a significant part of our business, representing some $250M of investment in maintenance and capital improvement works over a typical 5-year cycle. The programs deliver a wide variety of social and environmental outcomes for the community of Melbourne. Being able to demonstrate a level of asset management maturity by 2020 will contribute significantly to Melbourne Water's overall compliance with the Victorian Government mandate.

The benefit of adopting a waterway asset management approach is realising value from our investment. This means we need to determine what the optimal management

[1] as stated in chapter 3.1.4, page 13 Department of Treasury and Finance (Vic.): Asset Management Accountability Framework (February 2016)

regimes for our waterway and stormwater quality treatment assets are so that we can balance the cost, risk, opportunities, and performance benefits to get the best return on our investment in ensuring our waterways support a range of social, cultural, environmental, and economic values. The Healthy Waterways Strategy and Waterways and Drainage Investment Plan provide the obligations and expectations upon Melbourne Water in regards to the service outcomes our waterway and stormwater quality treatment assets[2] need to be delivering.

By putting in place an asset management approach, Melbourne Water can take a holistic view of our asset portfolio and establish service objectives and performance standards to improve and better justify our investment decisions. This enables Melbourne Water to demonstrate how effective we are being in balancing cost and risk in achieving these outcomes.

Managing asset condition is the way in which we proactively influence the service delivery performance of our waterway and stormwater quality treatment assets. With respect to waterway assets in particular, a key focus of our asset management effort over the next year is to establish a robust, strategic approach to managing waterway physical form and function so that investment can be prioritised in the most effective manner to support the range of waterway conditions and values influenced by physical form and function.

Our understanding of physical form and function

Melbourne Water retains significant knowledge and data on waterway physical form and function however this does not cover the entire region and is not in a readily accessible or consistent format. This is limiting our ability to develop and apply a robust, strategic approach aligned with the requirements of the asset management standards. Melbourne Water therefore has an opportunity to enhance our understanding of the spatial distribution of different reach-scale fluvial processes, geomorphic behaviours and geomorphic conditions across our network of over 8000km of waterways in Port Phillip and Westernport and store and report on this information in an accessible and meaningful way. In parallel to this is the need to develop an asset management framework to support our decision-making regarding what this information means for determining the need for proactive intervention in managing physical form and function and in prioritising our investment in those interventions.

Improving our understanding of physical form and function is a fundamental aspect of being able to manage fluvial processes as either a value or a threat. Waterways of variable physical form (e.g. stream type or River Style™), in good geomorphic condition, and functioning within their expected range of behaviour are a value in their own right and should be protected.

Where waterway physical form is degraded, geomorphic condition is poor, and geomorphic behaviour is out of range, this can pose a threat to other waterway conditions and values. Ensuring fluvial processes that threaten the geomorphic condition and behaviour of the regions waterways are properly understood and managed appropriately, is vital for successful management of our waterway assets. If it is possible to understand where threatening processes occur, the severity of the processes, and the potential for them to impact, we would be able to strategically prioritise the interventions required to manage the threat, and as a result better protect waterway condition and values, and maintain hydraulic[3] function.

Asset management framework for physical form and function

ISO 55000:2014 defines asset management as: *the coordinated activity of an organisation to realise value from assets*. Waterway asset management therefore is the *coordinated activity of Melbourne Water to realise value from our waterway assets*, which involves leveraging Melbourne Water's asset management system, whose function is to establish the asset management policy and objectives and the processes to achieve those objectives.

The realisation of *value* from assets is the critical point of asset management. When thinking about physical form and function in this context, in order to realise value from our waterway assets, we need to balance the costs, risks, opportunities and performance benefits from managing the physical form and function of our waterway asset portfolio.

In order to achieve this balance, we need a framework that integrates the key elements of waterway geomorphic condition and behaviour that we know have the greatest benefit or impact on the ability of waterways to perform their

[2] ISO 55000:2014 defines an asset as an item, thing or entity that has potential or actual value to an organisation. In Asset management: Overview principles, and terminology, 3.2.1, p13.

[3] Drainage and flood conveyance

broad social and environmental service delivery function (i.e. support the values), so that we can make informed decisions regarding potential intervention and non-intervention. Such a framework will allow consideration of the cost and benefits of intervening and not intervening in different circumstances, the risk of intervening and not intervening, and the opportunity to explore different solutions to traditional in-stream works. The framework will therefore be critical in linking all the required elements together in a logical manner. This is illustrated in Figure 1.

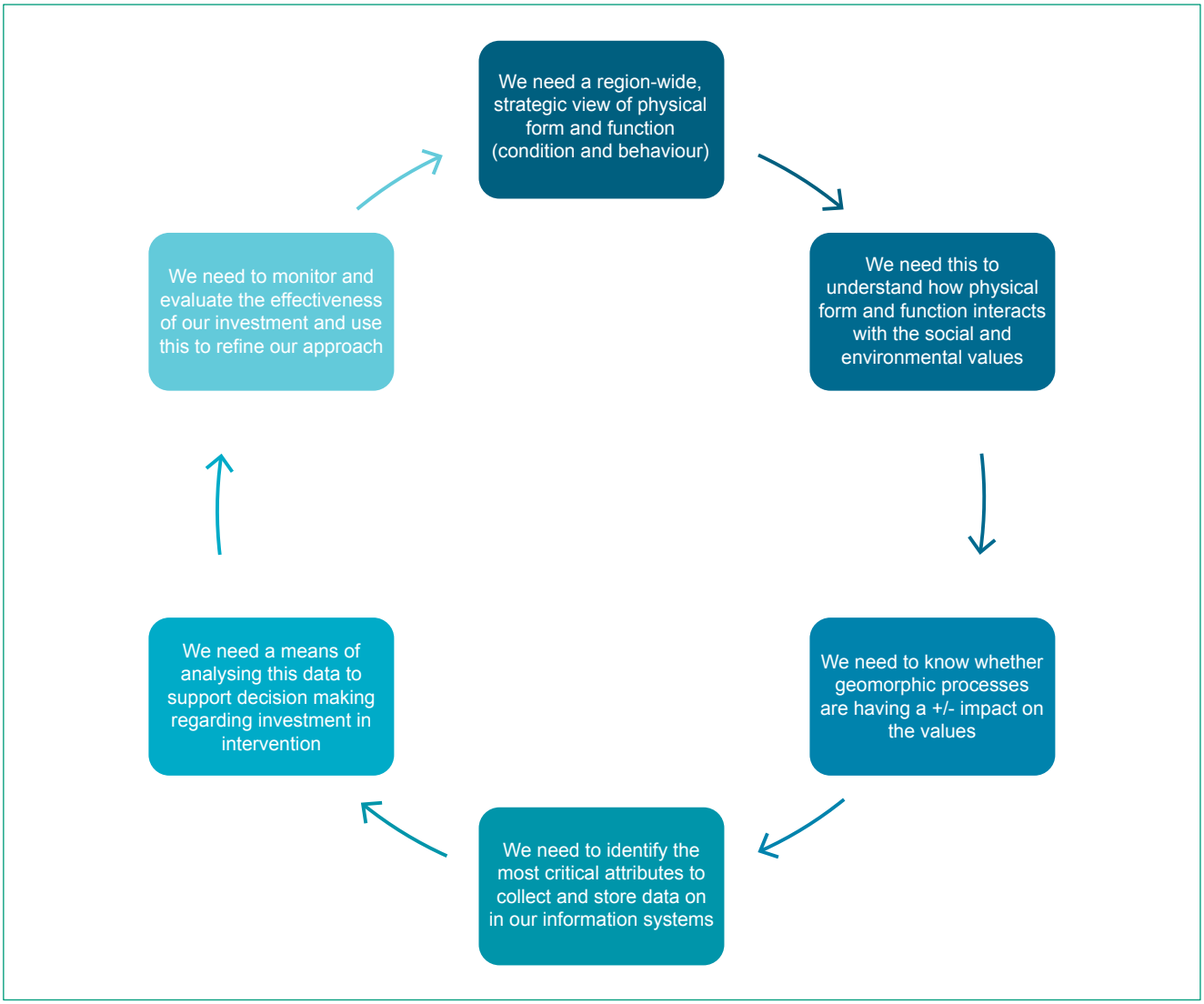

Figure 1: Key needs informing the development of the asset management framework

PROPOSED METHODOLOGY

The project will be completed during the 2018/2019 financial year and will progress through a series of phases aligned with the two themes of improving our understanding of, and developing an asset management framework for, physical form and function. The initial work will most likely be focused on a pilot catchment to fully test and refine the approach before roll out to the rest of the region.

Our understanding of physical form and function

Background data

The conceptual models developed in conjunction with the recent refresh of the Port Phillip and Westernport Healthy Waterways Strategy (2018) would be reviewed as the basis of determining the relationships between service outcomes, service objectives, the performance of physical form and function, critical attributes, failure modes, and the suite of potential management interventions.

Existing data sources including but not limited to the following will be utilised:

- Previous geomorphological investigations and waterway management plans
- Previous Index of Stream Condition data
- Region-wide geology, soil and land use data
- Region-wide topographical data
- Available flood / hydraulic capacity mapping of waterways

Knowledge gaps

The project will also need to provide information to fill the following knowledge gaps:

- The occurrence and location of reach-scale fluvial processes impacting on geomorphic condition and behaviour
- The type of fluvial processes occurring (e.g. incision, meander migration, channel widening, aggradation)
- What the stage and trajectory of the processes are (e.g. stage of incision, recovery, etc.)
- What the scale of impact is to date and its likely future trajectory
- What degree of risk is being posed to the waterway level(s) of service

Asset management framework for physical form and function

Specify service objectives

Melbourne's waterways support a wide range of values. Melbourne Water's management of a waterway's physical form aims to:

- Protect the key environmental values, for example, by preventing incision from destroying valley fill habitat upstream and/or washing sediment downstream and filling in pool and riffle habitats
- Protect social and cultural waterway values associated with accessing and enjoying waterways
- Maintain appropriate levels of hydraulic capacity (ensuring that waterways can carry the appropriate amount of floodwater)

In some locations these priorities may conflict or complement one another depending on the landscape context. To best manage Melbourne's waterways the service objectives for each reach of waterway should be specified. The service objectives might include providing different levels of quality, quantity and capacity for a combination of biodiversity, cultural values, amenity and flood mitigation. Specifying service objectives also helps to identify which waterways are more 'critical assets' based on the consequences should the waterway fail to support their specified service objectives. Such information can be used to prioritise intervention when the risk of physical form and function failing service objectives becomes intolerable. There are multiple ways in which waterways can fail to support their service objectives and these are typically explored through an exercise referred to as failure mode analysis.

Establish performance standards and measures

Once service objectives are specified, it is necessary to establish performance standards that describe the acceptable range of geomorphic condition and behaviour required to support the service objectives.

It is likely that a series of performance measures will be required, aligned to the critical attributes, so that data can be collected and analysed to determine whether the waterway's geomorphic condition and behaviour is satisfactory, when compared to the standards. Unsatisfactory performance flags the need to investigate and determine whether intervention is necessary. Knowing which of the attributes is underperforming guides identification of appropriate intervention options.

Determine critical attributes

The project will need to determine the most pragmatic combination of attributes that will best inform (i) our understanding of geomorphic condition, behaviour, likely rates of change and potential future trajectories; (ii) the relationship between waterway geomorphic condition and behaviour and the performance of the waterway in supporting its service objectives; (iii) the likelihood that the waterway fails to support these service objectives; and (iv) our resultant asset management decision making to determine how best to mitigate these risks.

Data on each of these attributes can then be collected or generated, stored, analysed and reported. The synthesis of data for these attributes as part of the project can be used to establish a baseline across the waterway network to facilitate future comparison.

Determine management regimes

The project requires that specific management regimes be recommended to maintain the critical attributes to ensure they achieve the performance standards required to support the service objectives specified across the waterway network.

Integration of spatial data with information systems

The service objectives, performance standards, attribute data and management regimes as applied to the region's waterway network should be configured in a way that enables them to be mapped in Melbourne Water's Geographical Information System (GIS) and uploaded into Melbourne Water's Asset Management Information System (AMIS: Maximo™). Integrating data in this way ensure its use by a wide range of users across the business.

EXPECTED RESULTS

Successful completion of this project will result in extensive spatial data for the region's waterway network of the:

- service objectives supported by physical form and function,
- applicable physical form and function performance standards for each waterway asset,
- most critical attributes of physical form and function
- applicable management regimes for physical form and function

This physical form and function data used in conjunction with the accompanying asset management framework will enable an asset management approach to be applied to the physical form and function of the regions waterway assets.

DISCUSSION

Melbourne Water need to improve our understanding of when and when not to intervene in physical form and function to ensure our waterways are achieving the optimal performance in supporting their service objectives. Sometimes not intervening is the best option both in terms of physical form and function and investment, because any investment in intervention requires ongoing monitoring and maintenance at a cost, so we need be certain that it's needed and is in the best interests of the waterways service objectives.

This project will develop a robust framework, supported by the latest geomorphic science that will enable a strategic approach to managing the physical form of waterway assets at the reach-scale, which is required in order to make effective decisions and realise value from our investment.

CONCLUSION

Integrating traditional waterway management approaches with the latest geomorphic science and aligning with the Asset Management Standards represents a unique challenge and opportunity. The challenge lies in the process of achieving the necessary integration (this project), whilst the opportunity lies in its ongoing implementation to assist Melbourne Water to make sound investment decisions to optimise the performance of our regions waterway assets in the delivery of the diversity of service objectives.

ACKNOWLEDGMENTS

This paper was much improved as a result of the enthusiastic and insightful comments of Geoff Vietz.

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GLOSSARY OF TERMS

Asset Management terminology has been used in this paper. Should the reader be interested in the formal definition of this terminology it is documented in: ISO55000:2014, *Asset Management: overview, principles and terminology*.

THE AUTHORS

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Leigh is a fluvial geomorphologist and has spent the past seventeen years working in waterway management in Victoria. Fourteen of these years have been at Melbourne Water where Leigh has worked across the business in various roles and has been involved in many aspects of strategy/plan and works program/project development and implementation. In his current role as Area Lead, Waterway Services, Leigh and his team are leading the adoption of an asset management approach for our natural and constructed waterways assets across the Port Phillip and Westernport region in accordance with ISO55000. Leigh has a love of the outdoors and enjoys various modes of exploration including running, mountain biking, surfing and kayaking. Other keen interests are of a lyrical and musical nature which Leigh combines with his song writing and playing acoustic guitar.

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