Factors affecting the successful implementation of WSRD into the arterial road network : an Australian perspective

Facteurs limitant le développement des techniques douces de gestion des eaux pluviales sur le réseau de voiries principales : une perspective australienne

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RESUME

Malgré l'existence de différentes législations sur l'environnement et la gestion de la qualité de l'eau, l'industrie routière australienne, dans son ensemble, a accueilli favorablement la nécessité d'intégrer les techniques douces de gestion des eaux pluviales (WSRD) sur le réseau de voirie dans toute l'Australie afin de garantir la pérennité des axes principaux d'Australie. Avec la hausse des compétences et des connaissances des acteurs de l'industrie, la capacité à mettre efficacement en œuvre le principe WSRD dans un projet routier semble, maintenant, fortement dépendre des caractéristiques du site. Des charges en polluants hautement variables, des terrains contaminés, des sols de nature très diverse, des chaussées étroites et la présence de multiples structures souterraines sont souvent perçus comme autant d'obstacles s'opposant à une mise en œuvre efficace des techniques douces. Toutefois, une planification et une conception judicieuses permettent d'atteindre les objectifs visés.

ABSTRACT

Even though differing environmental legislative and water quality management frameworks exist, the Australian road industry as a whole has willingly embraced the need to incorporate water sensitive road design (WSRD) in road projects across Australia to ensure a more sustainable arterial road network. With skill levels and knowledge within the industry increasing, the ability to successfully implement WSRD into a road project appears to depend predominately on site characteristics. Highly variable pollutant loads, contaminated land, wide ranging soil types, often narrow road reserves and many underground services, have been identified as perceived impediments which can affect the successfully implementation of WSRD. However, these can be addressed with forward planning and clever design to provide treatment to meet objectives.

KEYWORDS/MOTS CLES

Australia ; legislative framework ; roads ; WSRD.

INTRODUCTION

A review of the implementation of Water Sensitive Road Design (WSRD) into the arterial road network within the main states of Australia was undertaken to identify key factors that helped to make it successful. The purpose of the review was to help VicRoads, the state road authority for Victoria, to identify if there were more efficient ways to facilitate the implementation of WSRD into its road projects. The study looked at two key areas which have the potential to affect implementation success : the statutory arrangements and a water quality management framework.

While most VicRoads projects now implement WSRD, a major hindrance was found to be the conflicting requirements between the environment, transport logistics, safety considerations for pedestrians and vehicles, design and construction, and ongoing maintenance. A study tour undertaken during 2006 found that these hindrances are also experienced by other road authorities around Australia including the Roads and Traffic Authority in New South Wales, Transport South Australia, Main Roads in Queensland and MainRoads in Western Australia, irrespective of differences in legislative frameworks or water quality management frameworks within the states.

METHODOLOGY

A review into the environmental legislation governing water quality protection in four mainland Australian states: Victoria, New South Wales, Queensland and Western Australia, was undertaken. This involved interviewing road authority staff responsible for WSRD in relation to issues associated with implementing WSRD into road projects and activities. Road projects include new major arterials, smaller inner urban or outer metropolitan and rural roads, widenings and duplications, intersection works and upgrades where actual construction works are being undertaken. Each road authorities water quality management framework and documents were also reviewed and their success discussed with environmental practitioners.

Water quality management frameworks include all facets of managing water during construction, operation, and maintenance, however this review focussed on the areas directly associated with WSRD. Figure 1 shows a map of Australia and the location of the capital cities and states.

RESULTS AND DISCUSSION

Australia maintains one of the most extensive road networks in the world. The Australian road network comprises more than 800,000 km of public roads, with funding shared by Federal, State and local governments. The states and territories own their own network and together with local government spend A$30 million/working day maintaining and reconstructing the total network (Austroads, 2005).

Each of the road authorities are governed by different external environmental legislation which, while predominately the responsibility of the individual states Environment Protection Authority, also involves other agencies, acts and regulations. Each road authority has also developed a water quality management framework to address how, during both construction and operation of the road network, the quality of the receiving waters is to be protected. Overall, all road authorities have included the need for incorporating WSRD elements into road projects.

Road Authorities

VicRoads – Victoria

The Victorian Roads Corporation (VicRoads) manages a road network comprising 22,320 km and 2,987 bridges across the state of Victoria. The *Transport Act* 1983, the *Road Safety Act* 1986 and the *Road Management Act* 2004 provide VicRoads with its powers and functions.

Key legislation aimed at protecting water quality are located within the Victorian Planning Provisions and Local Planning Policy Framework, *Water Act 1989*, *Environment Protection Act 1970* (the State Environment Protection Policy (*Waters of Victoria*) 2003 – in particular Clause 46 Urban Stormwater and Clause 57 Roads), *Planning and Environment Act 1989*, and referenced documents within these Acts such as the Urban Stormwater : Best Practice Environmental Management Guidelines (VSC, 1999).

Several key pieces of Victoria's legislative framework have been amended in recent years that direct the incorporation of Water Sensitive Road Design elements into developments (including WSRD on the road network). Based on work coming out of the Port Phillip Bay Environmental Study (CSIRO, 1996) in the 1990s, the framework focuses on the reduction of nitrogen loads to Port Phillip Bay. This objective is now a standard used to assess the implementation of WSRD across all of Victoria.

Map of Australia and the location of the capital cities and states
(Source: www.studyaustralia.com.au)

VicRoads has, in its new Environment Strategy 2005-2015, identified the need to incorporate WSRD into all its road projects wherever practicable and feasible. This is further supported by the organisation's Environment Policy and the development of a specific WSRD commitment statement as part of its new Water Sensitive Road Design Guidelines 2006 (VicRoads, 2006c) and WSRD Toolkit. The WSRD Guidelines provide direction on suitable treatment elements for road projects and the required construction and maintenance needs. However, this still does not guarantee success. Even where sufficient land would appear to be available, the success of

WSRD can still be affected by minimum road design requirements; road safety factors; and underground services within the road reserve. In Victoria, preferred WSRD elements for road projects are swales, buffer strips and biofiltration trenches. Wetlands have used in some cases on large highway projects and in many cases these wetlands have formed part of recreational facilities associated with the road reeve and adjoining land use, such as public open space.

Roads and Traffic Authority (RTA) – New South Wales

The Roads and Traffic Authority (RTA) of New South Wales (NSW) is responsible for 17,776 km of state roads, management of 3,105 km of national highways, nearly 2,962 km of regional local roads, and 4, 867 bridges, including major culverts.

The RTA's vision "A safe, sustainable and efficient road transport system" expects "positive environmental and urban design outcomes" with immediate results showing "impacts on the natural, cultural and built environment are minimised". Strategies to support this include "lead best practice infrastructure planning and road works".

Water quality management from roadworks and their use is an essential environmental responsibility of the RTA and is incorporated in the planning, design, construction and maintenance of the road network, as well as traffic management. The RTA's work in this area aims to " reduce and minimise the impact of roads and traffic on water quality" and is governed by a Water Policy and a Code of Practice for Water Management.

The RTA's Water Policy identifies a set of objectives for the management of water issues related to planning, design, construction, operation and maintenance. RTA's Water Policy seeks to ensure that the RTA, its contractors and sub-contractors, consistently apply the most appropriate water management practices. RTA's Water Policy objectives will be achieved by maintaining compliance with the environmental principles outlined in the RTA Code of Practice for Water Management - Road Development and Maintenance.

The RTA Code of Practice for Water Management - Road Development and Maintenance (CoP) has been prepared to promote understanding of water management throughout the RTA. It provides water management principles for RTA staff and contractors involved in activities that may impact on water flow patterns and water quality. The CoP was prepared as a result of NSW EPA's Regulation 21 of the Clean Waters Regulations 1972. It is intended to promote the understanding of water management including for construction and maintenance works (RTA, 1999a).

Stormwater Environment Improvement Program (SEIP)

The RTA works with local councils to prepare Stormwater Management Plans (SMPs) for each of the catchments, districts or local government areas in which the RTA has some responsibility for stormwater management. A SEIP comprises all actions that the RTA is responsible for implementing, or that the RTA should contribute to, under the SMPs. The SEIP focuses on supporting management actions by the RTA and councils that improve water quality by removing potential pollutants nearest to the source, and reviewing activities so that their environmental impact on stormwater is reduced (RTA website, 2006). Preferred WSRD elements for improving stormwater run-off and implemented in a road project or funded under the SEIP include the installation of gross pollution traps (GPTs) and oil and grease separators, re-establishing sedimentation basins, wetland construction and education programs.

Transport South Australia (Transport SA) – South Australia

Transport SA manages nearly 23,000 kms of South Australia's road network. This represents almost 25 per cent of the states total road network. It carries a large percentage of all traffic movement within the state, including most heavy freight

vehicles and represents one of the State's largest physical assets with a replacement value in excess of $6 billion.

Four Acts provide the legislative framework in regard to matters of surface water quantity/quality : *Environment Protection Act 1993*; the *Environment Protection (Water Quality) Policy 2003*, *Water Resources Act 1997*; *Local Government Act 1999*; and *Highways Act 1926*. The main agencies involved in the management of stormwater and surface water quality in South Australia are : Department of Water, Land and Biodiversity Conservation; Catchment Water Management Boards; Environment Protection Board; and local councils (Transport SA, 2002).

The *Environment Protection (Water Quality) Policy 2003* uses codes of practice or guidelines as a means of describing how a person undertaking a particular activity can comply with their general environmental duty. Specific requirements in these codes and guidelines may be enforceable. As a result of this legislation Transport SA produced the Protecting Waterways Manual (Transport SA, 2002) to minimise impacts on water quality.

Transport SA aims to minimise transport impacts on water quality by including treatment measures in the design of infrastructure projects. This includes measures such as WSRD elements to treat pollutants in runoff from operational use of the road where practicable and feasible (Transport SA website). The key types of WSRD elements incorporated include sediment/detention basins (some vegetated), gross pollutant traps, spill interception basins and wetlands.

MainRoads – Western Australia

MainRoads is the state owned road authority for Western Australia (WA). Under the *MainRoads Act 1930* Main Roads manages almost 17,800km of highways, freeways and other major roads. In July 2005 MainRoads was the first road management authority in Australia to achieve ISO14001 international standard for environmental management systems.

MainRoads Environment Policy aims to manage the State's road network to provide safe and efficient road access that will enhance community lifestyles and support economic prosperity, seeking to achieve balanced and sustainable outcomes for the community. Responsible environmental stewardship in developing and maintaining the road network is critical to MainRoads success.

MainRoads has standard environmental contract conditions and procedures in place that identify and manage projects where no significant environmental issues associated with the project. Other projects likely to have more significant environmental issues are subject to a more detailed impact assessment process, potentially including statutory assessment under State or Commonwealth legislation. For most projects with some level of significant environmental impact, any requirements are handled through preparation and implementation of Environmental Management Plans (EMPs) that are incorporated into contractual arrangements. Some projects require referral to regulatory agencies for possible assessment under State and Commonwealth environmental legislation, such as the Western Australian *Environmental Protection Act 1986* (WA.) or the *Environmental Protection and Biodiversity Conservation Act 1999* (Comm.).

Main Roads – Queensland

Main Roads Queensland is responsible for the management of 34,000 km of roads carrying approximately 80% of Queensland traffic. Main Roads have also developed a proactive Environment Management Policy and Strategy where they aim for sustainable road development through managing water during all phases of a roads construction and operation. Key acts influencing WSRD in road projects are the

Water Act 2000, *Transport Infrastructure Act 1994*, *Wild Rivers Act 2005* and the *Integrated Planning Act 1997*. Wetlands, sediment traps and swales are preferred WSRD elements used by Main Roads in many of its major road projects.

The *Environmental Protection Act 1994* is the primary environment legislations in Queensland with the Environmental Protection (Water) Policy 1997 and the *Environmental Protection (Water) Amendment Policy (No. 1) 2006 - Subordinate Legislation 2006 No. 30* setting the objectives and water quality values to be protected when undertaking projects. They have also developed the Queensland Water Quality Guidelines 2006, which are technical guidelines to help organisation such as Main Roads to address water quality issues.

Legislative framework

The EPA in all states manages the primary environmental legislation that directs the road authorities in their individual water quality management frameworks. Other agencies such as water resource, catchment or drainage managers also influence the extent to which road authorities have embraced the need to include WSRD into their project designs. Regardless of the agency responsible for water quality improvement the need to incorporate WSRD elements has been embraced with ongoing research into suitable, low maintenance elements (e.g. no watering of vegetation, minimal weed invasion issues, long life cycle expectations) a priority for all authorities.

Water quality management framework

Each road authority has developed internal water management frameworks with supporting guidelines, policies and strategies to guide all internal, construction, and maintenance staff of the need to address road operational pollution through the correct planning and design of projects.

All frameworks aim to increase the technical knowledge and capacity of staff within the organisation to ensure continued improvement in the construction, operation and maintenance of the road network and its impact on waterways.

Road surfaces can generate large amounts of runoff which needs to be managed successfully. Integrated water quality management frameworks have several key features in common which include the control of run-off and discharge; address potential impacts on the receiving environment and store or attenuate water during storm events.

Several of the road authorities are also undertaking R&D into various areas of WSRD including device effectiveness, element location (e.g. at source or catchment based), and road runoff pollutant levels. To date research tends to indicate that each site is unique and that there are various factors affecting the successful implementation of WSRD elements including rainfall, vehicles per day, type of vehicles (e.g. freight trucks versus passenger vehicles), and site constraints. This research is supported by industry groups such as Austroads, ARRB Group, the Cooperative Research Centre for Construction Innovation, Facility for Advancing Water Biofiltration (FaWB), Institute for Sustainable Water Resources (ISWR) and industry/academic partnerships around Australia.

Site characteristic affecting the implementation of WSRD

It was also found that large road projects, such as highways and city bypasses were able to successfully and fully incorporate WSRD into a design due to the availability of large road reserves and limited public access. Outer urban roads were generally able to incorporate WSRD elements however public access trails (e.g. pedestrian and cycle paths) can be a limiting factor. Many inner road projects were severally restricted by available land (land owned by the road authority) and underground services, with kerb to kerb pavement the usual results for upgrade and road widening projects. Ongoing

issues with maintenance of WSRD elements when roads are operational were also investigated, with the experience and knowledge of maintenance groups affecting their ability to properly maintain these water treatment features a common trait for all states. On-going interagency discussions are investigating the ability to "retrofit" inner urban projects addressing jurisdictional and maintenance responsibility concerns.

CONCLUSION

The Road Traffic Authority (RTA) assesses the need to implement WSRD against the downstream risk to the aquatic environment. Therefore, the more sensitive the environment, the greater the need and likelihood that WSRD elements will be incorporated into a project. Transport SA uses a risk management approach to the incorporation of WSRD into the road network, identifying highly sensitive water environments for protection from road runoff. Main Roads Queensland extensively uses sediment traps and detention basins to manage both pollutant and high rainfall of tropical urban environments.

MainRoads Western Australia includes aquifer recharge opportunities in their risk assessment approach when assessing road projects and retrofit options. This is done by identifying and evaluating highly sensitive aquatic ecosystems and the potential for impact from the road network. Due to the highly sandy soils around Perth and Western Australia infiltration treatment methods are being successfully used to not only filter stormwater but also to replenish the groundwater supplies. This has the added advantage of incorporating less drainage infrastructure in their projects.

In Victoria, VicRoads the legislative framework requires WSRD to be implemented wherever practicable and feasible and the organisation has fully embraced this by including the requirement for WSRD into its Environment Strategy and developing guidelines to direct a consistent approach across the state.

The risk assessment approach used by some states has the advantage of protecting highly vulnerable environments but has the potential to result in some projects being undertaken with minimal treatment of runoff because the receiving waterway is not considered sensitive enough. This approach may also rely heavily on annual operational budgets which are generally insufficient to allow more than one or two sites to be retrofitted annually. WSRD elements included in projects have agreed capital funding and allowing for specific site characteristics will ensure treatment is incorporated in nearly all new road projects. Additional funding can then be sourced to retrofit specific sites where highly sensitive ecosystems have been identified downstream of existing road networks.

Although the main Australian states incorporate WSRD into the road network under differing water quality management and legislative frameworks, policies and strategies, similar issues are being experienced by all organisations that have the potential to affect the successful outcome when implementing WSRD. Planning, design, construction and maintenance are all common themes, however none are insurmountable and the road authorities are continuing to work with the industry, institutions and agencies to develop standard designs, construction methodologies and maintenance standards to address these issues. Several key challenges to ensuring improved operation of the road network and minimising waterway impacts were identified by all states reviewed and include :

- Planning can often be undertaken a decade or more before a road is constructed with environmental and legislative requirements changing significantly over that time ;

- Variable planning requirements by different local authorities affecting an individual road project ;
- Working with competing multiple uses within road reserves, such as underground services (e.g. power, water, sewer, telecommunications), public access paths, wildlife corridors and remnant vegetation protection, as well as road design and safety considerations and
- Varying interpretation due to expertise and experience by service providers, including the experience of contractors in building WSRD elements and the level of understanding of maintenance requirements by the organisations and service providers.

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