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Improving sustainability of local infrastructure using AUS-SPEC

Nandini Mehta[1]

[1] *AUS-SPEC Manager, NATSPEC Construction Information Systems Limited, Sydney, NSW*

[*] *Email: nmehta@natspec.com.au*

ABSTRACT: *Local government provides essential infrastructure and services that support local and regional communities. Integration of sustainable practices into the life cycle management of assets provides numerous benefits, including reduced water, energy and resource consumption and fewer emissions that contribute to climate change. A sustainable approach ensures that community liveability, environmental protection and economic prosperity are maintained over the long term for current and future generations.*

AUS-SPEC assists Local government to design, construct, maintain and operate, their assets by providing a range of specification Templates for buildings, roadworks, urban and open spaces and public utilities. This paper provides an overview of how Councils can use the AUS-SPEC system to document their requirements for sustainable infrastructure assets to meet the needs of their communities.

KEYWORDS: Asset, Asset management, Climate change, Construction, Design, Infrastructure, Integrated management, Local government, Maintenance, Procurement, Rating tools, Specification, Sustainability.

1 Introduction

AUS-SPEC is the Local Government specification system for the life cycle management of assets developed by IPWEA and updated by NATSPEC, a not-for-profit organisation owned by Government and industry bodies. NATSPEC provides a national master specification to the construction industry. AUS-SPEC is a national document system that enables consistency and a uniform approach to design decisions, construction and maintenance for buildings and minor civil works across Australia. They are suitable for documenting local roads, stormwater drainage, water and sewerage systems, urban and open spaces and community buildings.

Asset life cycle activities start with planning and end with disposal of an asset. To deliver and maintain a physical asset during its life cycle, asset management, life cycle strategies, financial planning and forecasting is carried out for an asset. Asset management advances the sustainability of infrastructure services. The AUS-SPEC documents have been developed following the principles of asset management as defined in the International Infrastructure Management Manual (IIMM).

2 Importance of sustainability for Local government infrastructure and buildings

Sustainability is about ensuring that the wellbeing of current and future generations of Australians is maintained or improved over time. [1]

Wellbeing is a combination of community liveability, environmental sustainability and economic prosperity. Sustainability is also the ability to maintain certain values, assets or capabilities over the long term.

Garry Bowditch, Director and CEO SMART Infrastructure facility, UOW states,

> *Infrastructure is not an engineering artefact but an agent of change, is it possible to imagine infrastructure systems that can meet the needs of double today's population with half of today's resources while providing twice the liveability?*
>
> *Effective infrastructure planning must be informed about the way suburbs and precincts change over time, and implications of that change on physical infrastructure. Land use within urban and regional areas and its impact on transport assets, demographics and*

population need to be accounted for in the planning process to achieve intended social and economic outcomes. [2]

Local government infrastructure assets must be sustained throughout their lifecycle. The delivery, maintenance and repair of roads, parks, public buildings and amenities is a major responsibility and challenges local government to provide these services in a financially sustainable manner, maintaining the financial capital and the infrastructure capital over the long term.

Ecological Sustainable Development (ESD) requires the effective integration of economic and environmental considerations in the decision-making processes. Environment Protection and Biodiversity Conservation Act 1999 and National strategy for ESD prepared by COAG in 1992 sets the standard for the design and development of sustainable buildings and infrastructure.

Following are the number of ESD opportunities in the design of buildings and infrastructure:

- Integrated design and process management.
- Social sustainability and occupant satisfaction.
- Indoor/outdoor environment quality.
- Energy management.
- Commissioning and operations.
- Transport.
- Ozone layer depletion.
- Choice of materials.
- Waste minimisation.
- Water use reduction.

These include not only the more familiar environmental factors such as energy and waste reduction, but also broader social factors such as accessibility by the whole community and provision of public space.

3 Integrating sustainability in the Procurement process

AUS-SPEC documents assist in defining the different stages of project delivery providing a clear project scope and a platform for quality design documentation for the selected procurement system. Requirements must be defined clearly and unambiguously and specified before proceeding with any procurement. This will ensure that prospective suppliers/contractors can offer to provide the goods, services, or works requested by the Local Government Councils.

Sustainable procurement can be aligned with the general stages of the procurement process to reduce the adverse environmental, social and economic impacts of purchased products and services throughout their life cycle. Specifications can be provided as either minimum or desirable requirements. Considering sustainability at an early stage of procurement decision-making process can identify opportunities to:

- avoid or reduce energy consumption.
- identify whether there is a more sustainable alternative readily available.
- rethink and revise specifications in order to improve sustainability outcomes.

3.1 Procurement for sustainable construction

The overall objective of good design is to ensure that buildings, infrastructure, public spaces and places are buildable, fit for purpose, resource efficient, sustainable, resilient, adaptable and attractive. Good design is synonymous with sustainable construction. [3]

Sustainable procurement can be defined as:

A process whereby organisations meet their needs for goods, services, works and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organisation, but also to society and the economy, while minimising damage to the environment. [4]

The impact of the Australian construction industry on the environment is substantial, and the need for sustainable procurement has become increasingly critical as illustrated in the following statistics:

2006–07, 43 777 000 tonnes of waste was generated, 38 per cent of which was from the construction and demolition stream. [5]

Buildings and their users are responsible for almost a quarter of Australia's greenhouse emissions. The energy embodied in existing building stock in Australia is equivalent to ten years of the nation's energy consumption. [6]

Buildings contribute significantly to human impacts on the environment consuming 32% of the world's resources, 12% of world's fresh water and up to 42% of world's energy. Buildings also produce 40% of waste going to landfill and 40% of greenhouse gas emissions. The operational phase of a building contributes between 70-90% of commercial building's total greenhouse gas emissions.

The focus of sustainable procurement is not just on asset delivery but also on the environmental impact of the asset throughout its life cycle, including avoiding unnecessary consumption as illustrated in Figure 1

Figure 1: Objectives of sustainable procurement in construction

More details on sustainable procurement are discussed in the NATSPEC TECHreport *TR06 Procurement – past and present*.

4 Sustainability requirements in specifications

Most aspects of sustainability relating to buildings and infrastructure are design decisions. The primary function of the specification is to give effect to design decisions. A specification addresses sustainability requirements by documenting products, materials and methods of construction that permit the implementation of ecological sustainable development (ESD). Most of the worksection *Templates* include ESD provisions through choice of materials, and energy and water conservation measures.

The ESD relevance of a specification depends on the selections, based on the informed decisions made by the specifier, for example, including integrated management, water sensitive urban design, stormwater harvesting, control of erosion and sedimentation, demolition for re-use, recycled materials, durable materials, maintenance cycles and levels of service. The AUS-SPEC system allows asset owners to balance the level of service provided with the maintenance and operations budget.

In order to produce an ESD specification, appropriate design decisions must first be made. A non-sustainable design cannot be transformed into a sustainable design just by specifying. It is, however, possible to improve on the environmental impact of any design through the specification by mandating low toxicity materials, energy and water efficient appliances, and so on. AUS-SPEC/NATSPEC, as a national master specification system, is not written as an exclusively ESD specification. It is a specification system that can be customised to give effect to ESD on specific projects. In summary, an

ESD specification focuses on:

- Giving effect to ESD design decisions not shown on the drawings.
- Specifying ESD appropriate materials and methods of construction.
- Specifying components and products that permit the implementation of ESD.
- Meeting mandatory ESD requirements to the extent that these can be handled through the specification process.

Asset maintenance strategies which address social and environmental factors provide significant savings in life cycle costs. The maintenance strategy will then bridge the development phase and the operation phase. Maintenance is an on-going process and the Plan, Do, Check and Act (PDCA) cycle provides a framework for life cycle maintenance as shown in Figure 2.

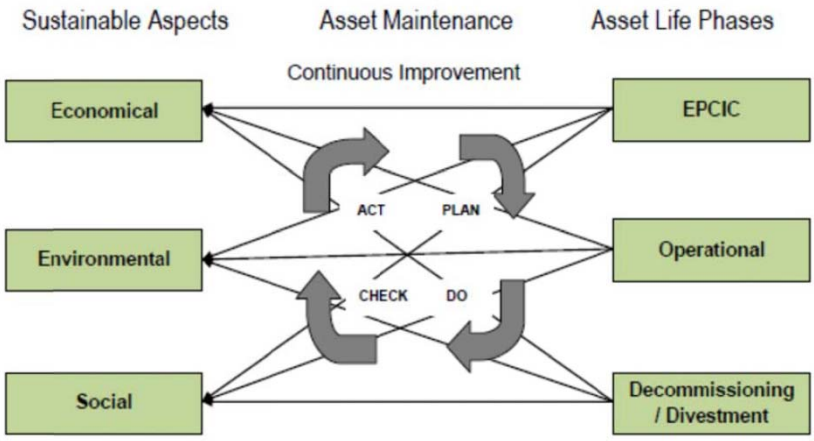

Figure 2 Continuous improvements in asset maintenance for sustainability [7]

EPCIC refers to Engineering, Procurement, Construction, Installation, and Commissioning.

5 Sustainability requirements in AUS-SPEC for infrastructure

AUS-SPEC addresses the sustainability issues by embedding these requirements in the design, construction and maintenance worksections to create specifications for infrastructure projects.

5.1 Planning and Design worksections

AUS-SPEC Design worksections form a basis for uniform design processes for civil infrastructure works. These worksections can be used for Council capital works as well as developmental works. The following sustainability requirements are included in AUS-SPEC worksections for consideration at the planning and design stage:

- Legislative requirements - Environment Protection and Biodiversity Conservation Act 1999
- Environmental impact statement (EIS), review of environmental factors (REF) and statement of environmental effects (SEE) and other state specific legislative requirements.
- Natural and built environment impact assessment.
- Social and economic impact assessment.
- Protection of trees.
- Identification and protection of sites of Aboriginal and heritage significance.
- Identification of natural hazard areas including bushfires and flood prone land.
- Identifying sensitive environments e.g. estuarine wetlands, rainforests etc.
- Cost benefit report, marine biology report and environment report for waterfront development.
- Protection of marine flora and fauna.
- Control of erosion and sedimentation.
- Flood control measures.
- Environmental considerations including construction materials, noise and light pollution, ecological footprint, environmental management report for construction.
- Climatic conditions, environmental considerations including moisture and temperature changes, specific location effects e.g. mine subsidence, freezing, snow and ice removal.
- Surface noise considerations.
- Salinity prevention.
- Water sensitive urban design (WSUD) principles.
- Water cycle management including stormwater harvesting and reuse, stormwater collection, storage, treatment and distribution and stormwater management.
- Minimise environmental impact by using trenchless technology.

5.2 Construction worksections

AUS-SPEC Construction worksections provide specifications for both Quality control, Integrated management systems and contracts associated with most Councils' engineering activities. The 0167 *Integrated management system* worksection is an umbrella worksection applicable for the documentation and operation of a system that collects the operating procedures of Work Health and Safety (WHS),

environmental requirements and quality requirements into a single integrated management system. The AUS-SPEC construction worksections include the following sustainability requirements:

- Environmental Management Plan and environmental assessment.
- Control of erosion and sedimentation.
- Dust control.
- Water erosion.
- Environmental impact statement.
- Weed management and control.
- Preservation and protection of trees.
- Treatment of cleared vegetation.
- Disposal of materials.
- Protection of environment and heritage areas.
- Protection of property and environment.
- Bushland restoration.
- Implementation and maintenance of environmental protection measures before disturbing the natural surface on site.
- Use of recycled materials for the construction of flexible and concrete pavements.
- Use of Reclaimed asphalt pavement.
- Use of Warm mix asphalt.

5.3 Maintenance worksections

The AUS-SPEC maintenance system is based on quality management, competitive principles and programmed maintenance. It recommends a proactive approach to asset maintenance as outlined in the National Sustainability Frameworks for Asset Management for Local Government, International Infrastructure Management Manual (IIMM) and the Australian Infrastructure Financial Management Guidelines (AIFMG). The system allows asset owners to balance the level of service provided with the maintenance and operations budget available, and prepare documentation for maintenance contracts. The AUS-SPEC maintenance system includes maintenance and operations of parks and recreations areas, buildings and facilities, road reserves and public utilities.

The AUS-SPEC maintenance worksections include the following sustainability requirements:

- Environmental Management Plan and additional Local or State requirements to promote conservation of the natural environment and cultural heritage.
- Environmental protection measures related to use of herbicide and chemicals.
- Minimisation of noise, smoke and other nuisances and green waste.
- Minimisation of disturbance and clearance of flora and fauna.
- Minimisation of dust generated from disturbed areas.
- Prevention of weed infestation, especially into undisturbed native flora areas.
- Minimisation of interruption or modification of natural or pre-existing drainage paths.
- Minimisation of removal or lopping of trees.
- Protection of soil and water from contamination.
- Minimisation and control soil erosion.
- Protection of native fauna habitats.
- Provision of appropriate tools and well maintained machinery.
- Protection of sites of cultural and natural heritage significance.
- Maintenance of the aesthetics of an area.
- Use of waste minimisation management techniques.
- Off-site green waste processing.

6 Sustainability requirements in AUS-SPEC for buildings

The AUS-SPEC Complete package includes the NATSPEC Building basic and the NATSPEC landscape package. The sustainability requirements for building works are covered by NATSPEC packages. The sustainability requirements for other infrastructure including, roadworks, urban and open spaces and public utilities are covered by AUS-SPEC. Together they provide a whole system for creating a sustainable specification.

The ways in which the specification can be used to implement specific ESD principles can be divided into a number of broad categories:

- Energy conservation and greenhouse gas reduction.
- Conservation of other consumables (like water).

- ESD appropriate materials e.g. materials with low volatile organic compounds (VOC) emissions.
- Quality environment, both inside and outside the building, using ESD principles.

NATSPEC does not impose ESD. Instead, it provides a framework in which clients and designers who wish to incorporate ESD principles and consider life cycle costs can do so, while also enabling appropriate choices to be made for clients whose priority is lowest initial cost. NATSPEC addresses the following ESD provisions in the NATSPEC TECHreport TR01 *Specifying ESD*:

- Energy conservation and greenhouse gas reduction
- Water conservation
- Materials
- Alternative construction methods
- Recycled and recyclable materials
- Ozone depleting substances
- Indoor air quality
- Outdoor air quality
- Lighting
- Noise and vibration

Other environmental concerns

As part of NATSPEC's broad scope, it specifies a number of other environmentally enhancing measures including:

- Termite management.
- Control of electromagnetic radiation.
- Remediation of soils.
- Corrosion resistance and durability.
- Vapour transmission.
- Weed management.
- Services commissioning.
- Maintenance.

The NATSPEC *Site management* worksection calls for the preparation of plans on waste and weed management, soil erosion and sediment control, and the incorporation of actions and follow-up monitoring of environmental issues. AUS-SPEC provides a number of TECHreports and TECHnotes in Appendix A with additional information on sustainability requirements and how NATSPEC addresses them in the specifications.

6.1 Specifying refurbishment with NATSPEC

> *Refurbishing presents an opportunity to reposition a building in the marketplace, improve environmental performance, reduce running costs and increase occupant comfort. Whether it is a minor, major or total upgrade, a well written specification can ensure the required quality level is achieved.*

NATSPEC TECHreport TR04 *NATSPEC for refurbishment, retrofitting and adaptive reuse* outlines how the NATSPEC specification system may be used for refurbishment, retrofit and adaptive re-use projects. Key upgrade options are summarised and refurbishment related items in worksections are highlighted.

7 Rating tools for infrastructure and buildings

Rating tools have been developed nationally to measure the various performance aspects of assets. The main approach to ratings tools is:

- A design based approach – where the performance is based on the analysis of the design features.
- An outcome based approach which measure the actual consumption of resources and environmental impacts of the asset in operation.

7.1 Rating tool for infrastructure

Infrastructure Sustainability (IS) rating tool: The Infrastructure Council of Australia (ISCA) has developed the IS rating tool to assess the sustainability of both new infrastructure and the operation and maintenance of existing infrastructure assets. The rating types offered are:

- Design rating – at the end of planning and design phase
- As-built rating – at the end of the construction phase
- Operation rating: after 24 months and revalidated after every five years.

Benefits of the IS rating tool include:

- Common national language for sustainability in infrastructure.
- Consistent application of evaluation of sustainability in the tendering process

- Scoping whole-of-life sustainability risks and costs.
- Encouraging innovation and continuous improvement.

7.2 Rating tools for buildings

NATSPEC TECHnotes DES 014 outlines some voluntary environmental rating schemes. The schemes include:

- NABERS
- Green Star

NATSPEC *TECHreport TR01 Specifying ESD* and various TECHnotes provide more information on the rating tools for buildings as listed in Appendix A.

8 Future challenges

8.1 Climate change

Climate change is the most significant sustainability challenge we face today and has significant potential to disrupt or damage existing and future infrastructure.

Following the recent release of the Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report, *Climate Change 2014: Impacts, Adaptation, and Vulnerability*, Alex Baitch, President, Engineers Australia, commented that *Australia has assets worth over $200 billion in coastal areas that support the livelihoods of 85% of the community, saying that as a nation, "we should be designing those assets to withstand the climate of the future not the climate of the past.[8]*

Some 560 Councils in Australia are responsible for the management of a range of assets worth $212 billion. Most of the assets have a life span of more than 50 years and will be affected by climate change. [9]

If sustainable practices are integrated into the life cycle of an asset, they provide numerous benefits to the environment, including reduced water, energy and resource consumption and fewer emissions that contribute to climate change.

According to the CSIRO report [10] on Climate change, the prospective impact on the built environment of climate change in Australia could be:

Buildings

- Increased fire and storm damage.
- Implications for building design and insurance in high risk areas.

Transport

- Road maintenance costs up by 30% by 2100.
- Inundation of road, rail and airport systems.

Water

- Inadequate stormwater capacity during floods.
- Reduced water supply

Energy

- Increased peak demand for air conditioning – possible black-outs.
- Reduced demand for heating.
- Reduced water supply for coal-fired power stations.

Emergency services

- Greater demand due to more extreme weather conditions.

8.2 Adaptation measures

The adaptation measures for climate change include:

- Structural measures including the analysis of infrastructure failures, regular infrastructure maintenance and retrofitting of existing assets.
- Non-structural measures including changes to contracts, planning instruments and policy, implementing disaster management planning.

The principal materials used in the construction of Council owned assets such as stormwater drains, roads and buildings are concrete, steel and bitumen. Climate change may increase salt concentration in the coastal environment due to gradual sea level rise or more frequent and severe storm surges, as a result concrete and steel structures may experience higher deterioration rates. This may deteriorate the asset condition and shorten the design life, affect the level of service and require alterations to the maintenance schedules.

9 Conclusion

AUS-SPEC provides a national documentation system that provides consistent and a uniform approach and enables sustainable aspects to

be embedded in the design decisions, construction and maintenance of community assets. AUS-SPEC specifications are a system of *Templates* and supporting information used by local government for the life cycle management of assets.

AUS-SPEC supports Councils in improving the sustainability of their infrastructure assets in the following ways:

- Social/People: AUS-SPEC covers design, construct and maintenance of infrastructure to serve the communities by providing roads, public utilities, urban and open spaces and buildings.
- Ecological/Environment: AUS-SPEC is concerned with life cycle management of infrastructure by looking at the whole-of-life, rather than the parts.
- Economic/Financial: AUS-SPEC is a national specification system which promotes standardisation and consistency across Council areas and is aligned to the National Sustainability framework, IIMM and AIFMG.

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Appendix A

Additional publications covering sustainability requirements in AUS-SPEC

TECHreports

- TR01 Specifying ESD
- TR03 Specifying design and construct – mechanical
- TR04 Using NATSPEC for refurbishment and adaptive reuse
- TR05 Selection and design of building IT systems
- TR06 Procurement: past and present

TECHnotes

- GEN 017 Using AUS-SPEC for asset management
- GEN 018 Using AUS-SPEC for asset maintenance
- GEN 020 Building commissioning
- DES 001 Slip resistance performance
- DES 002 Moisture content in timber
- DES 003 Fire hazard properties of insulation materials
- DES 004 Air, moisture and condensation
- DES 005 Preventing condensation on ducts and air handling
- DES 010 Atmospheric corrosivity categories for ferrous products
- DES 011 Rainwater harvesting
- DES 013 BCA Energy efficiency protocol and software for housing
- DES 014 Voluntary environmental rating schemes for buildings
- DES 015 BCA - NCC Volume One Energy efficiency provisions
- DES 016 BCA - NCC Volume Two Energy efficiency provisions
- DES 017 Selection of sealants
- DES 018 Bushfire protection
- DES 019 Pipe support spacing
- DES 020 Fire behaviour of building materials and assemblies
- DES 021 Site electricity supply
- DES 022 Microbial control
- DES 023 Mechanical services pipe and vessel insulation
- DES 024 Water sensitive urban design (WSUD)
- DES 025 Mechanical design and install HVAC checklist
- DES 026 Living walls and roofs
- DES 027 Impact sound insulation
- DES 028 Grass seeding and turfing
- DES 029 Native grass lawns
- DES 030 Seismic design actions on non-structural components
- DES 031 Specifying R-Values
- PRO 001 CCA (copper chrome arsenate) treated timber
- PRO 002 Mineral wool
- PRO 003 Warranties for steel protective paint coatings
- PRO 004 Ceramic tile and adhesive selection
- PRO 005 Formaldehyde - indoor air quality
- PRO 006 Glass types used in buildings