

# Long-term stewardship at a remediated site: a study of land use controls used at Sydney Olympic Park, Australia

E. Laginestra<sup>1</sup> & J. Pym<sup>2</sup>

<sup>1</sup>*Sydney Olympic Park Authority, Australia*

<sup>2</sup>*Waste Service NSW (retired), Australia*

## Abstract

Long-term stewardship uses a number of mechanisms to ensure the sustainability of significant features at a site. Mechanisms include the use of physical and institutional controls, records management, monitoring programs and environmental management frameworks, such as adaptive management and risk assessment. Site stewardship has strong social goals that focus on long-term site health and equity as well as economic objectives.

Sydney Olympic Park, Australia, has resources worth conserving and vital information that should not be forgotten. Resources include heritage items and rare ecological habitats; vital information relates to our history and remediation. The land cleanup and conservation have provided improved “quality of life” for our neighbours and visitors, preserving valuable resources for the future and providing lessons about remediation success. However, ongoing management is crucial as contamination remains on-site and social responsibilities have been outlined in the Sydney Olympic Park Authority Act. The parklands are still evolving, a process that could take up to 100 years. Therefore controls put in place during and post remediation need monitoring to assess their effectiveness or restrictiveness under changing circumstances over a period of time.

This paper outlines the controls now in place at Sydney Olympic Park and tools used to form the basis of our long-term stewardship decisions; including information management, identification of the “spirit of place” and a strategic research program. As environmental management science is still young, we have highlighted uncertainties and where more information is required.

*Keywords: land use controls, long term stewardship, risk-based remediation.*



## 1 Introduction

Sydney Olympic Park is located in the geographic centre of Sydney, Australia. The park as it is today has been defined by its historical legacy, the physical and location aspects and the social requirements for recreational uses.

Agricultural, industrial and naval use over the past 200 years had left a degraded site of over 760 hectares in the middle of a very urbanised area. The range of contaminants included domestic and industrial wastes, building rubble and unexploded ordnance. The site had also been altered physically by resource extraction, landfilling and waterway channelisation.

The area had been identified for urban renewal in the 1970s and placed on a government priority list for remediation in 1991, due to its central location, proximity to transport routes and the size. In 1992 studies commenced to assess the extent of contamination and determine remediation requirements. The initial aims of the remediation were to restore the waterways and provide for the long term social, cultural and sporting requirements of the people of New South Wales. Supplementary environmental aims were added for the Sydney 2000 Olympic “Green Games” bid; including requirements for energy and water conservation, waste management, sustainable planning and construction and improvements to water, air and soil quality. A financial aim was included to ensure an adequate return from residential and commercial development.

These aims developed and supported the proposed end-uses of conservation and recreation, which in turn directed the approach taken during and post Olympic construction. However, throughout the remediation, adjustments to methods and decisions were required as new information became available. Change was managed by undertaking the remediation in stages, setting up multidisciplinary teams, and providing conceptual documents for guidance rather than solely relying on restrictive operational instructions. It is relevant to note that winning the right to host the 2000 Olympic and Paralympic Games, was seen as a suitable end-use rather than the main driver of remediation, although the inflexible time frame and public profile did provide impetus and innovation.

Another important sustainability concept that affected the remediation process was equity (Bruntland [1]). This concept was implemented in two important ways: no waste was to be removed to another site for someone else to deal with at another time or place (inter- and intra- generational equity); and protection of the environment would also protect the worker, ensuring that safety and other controls were taken seriously by all site workers.

Remediation and renewal of the site occurred from March 1992 (with the first value management meeting) until February 2001 (final validation report from the independent auditor). Details of the remediation stages and methods have been documented elsewhere (Laginestra [2], Pym [3]) but basically each remediation stage consisted of initial analyses to determine the extent and level of contamination, remediation and landscaping plus one year of chemical monitoring. An estimated \$137 million was spent on remediation (working out at over AU\$180,000 per hectare). A further \$10 million was spent on data



management, remediation effectiveness monitoring, education products and supporting a community reference group.

The obvious question to all this work is “Was the remediation worth the resources spent?” Instinctively the answer is yes. Exposure to toxicity was reduced, transport and aesthetics improved, important heritage and ecological features were preserved and 425 hectare of parklands, as well as residential areas and world-class venues for recreation and entertainment were provided. Also many “sustainable” activities were mainstreamed, intellectual capital developed and more than 10,000 jobs created in the area. The cleanup also snowballed remediation and development in neighbouring areas, as desirability for living in and visiting the district increased. Recent reports noted that the surrounding residential market was not affected by the property slow down last year partly due to the infrastructure and beautification of the Olympic site (Edwards [4]). However, for stronger economic comparisons between costs and benefits important social and environmental indicators need to be valued competently. Currently it appears that economic and social growth is occurring at the expense of natural environment (Gittins SMH 24/4/2002) and there is still considerable difference of opinion as to the most appropriate non-economic indicators.

Post remediation, the focus of research has changed from assessing effectiveness of cleanup methods to ensuring sustainability of key features. Sydney Olympic Park Authority (SOPA) now administers 665 hectares of commercial precinct and parklands, manages the nature reserve in the north for the National Park and Wildlife Service under a Memorandum of Understanding, and has handed over the sustainability showcase village of Newington to the local council of Auburn, whilst still maintaining landscaping of village frontage and entrances to the park.

## 2 Management focus and framework

Unrestricted use of the site is not currently permitted due to potential risks from waste remaining at the site and for the conservation of rare / endangered species and historical artefacts and buildings. As there were community concerns that the site would not be managed sustainably once the publicity of the Games quietened, community education was also an important management activity.

In the Brownfields literature (mainly from the USA), long-term stewardship and the resultant management control mechanisms are required where a “risk-based approach” for cleanup is used (US DoE [5], Ubinger [6]) as opposed to “total cleanup”. Controls are defined as measures that limit human exposure by restricting activity, use and access to properties with residual contamination (USEPA [7]) and are required when hazards are first discovered, during remediation and when residual hazard remains on-site. Although the legislative requirements vary between Australia and the USA (and within the USA), there are similarities in the requirements and effects of management controls.

Although the focus of risk and hazard is on remediated land, the concepts of stewardship and controls have already been used for conservation management (Sutherland [8]). For habitat preservation, the risk may include loss of species or



degradation of ecosystems with the desired outcome as protection of species or biodiversity. For both remediated land and conservation, the aim of a control is to reduce an identified risk by limiting or controlling behaviour.

The “risk-based” approach to remediation used at Sydney Olympic Park was unusual in Australia in 1992, but has grown in popularity world wide due to perceptions of improved cost-benefit and flexibility plus reduced invasiveness. However, limited data is available on the effectiveness of this approach due to the “newness” of the science. Thus long-term stewardship requires structural flexibility that can take changed understanding and conditions into account.

## 2.1 Changing conditions

Change is expected over the life of a site due to natural variation, better knowledge or methods, adjustments to legislation and management practices and changes to land use or demographics.

There was limited state government legislation for remediating contaminated land in 1992, which had been managed through the planning legislation. The Contaminated Land Management Act, Duty to Report and State Environmental Planning Policy 55 for managing contaminated land were implemented only during the late 1990s, developed largely with the help of the Sydney Olympic Park experience.

Many of today’s major environmental concerns were not an issue three decades ago; including global warming, loss of ozone layer, diminished freshwater supplies in first world countries, depletion of fisheries, persistent organic pollutants and endocrine active compounds. Expectations of improved communication and inclusiveness have increased as stakeholders demand understanding of the potential impacts and want input or control over decisions.

At Sydney Olympic Park, the original management focus during remediation was blockage of contaminant exposure pathways. Controls were put in place to protect workers and neighbours in the immediate term and provide a system that would manage the contamination safely in the longer term. A Sydney regional environmental plan (SREP 24) was passed regulating land use at the site, which enabled SOPA to prepare and adopt guidelines and strategies for management. Particular attention was paid to sustainable development and conservation.

Post Olympics, a new Act has been passed - the Sydney Olympic Park Authority Act 2001, SOPA has both gained (Bicentennial Park) and relinquished (Nature Reserve and Newington residential area) management of land and the research focus has shifted from assessing cleanup effectiveness to studying impacts on the controls in place and ensuring real site sustainability in the long term.

We are now at an interesting stage of management, not only as the remediation and conservation science is new, but the parklands are newly created, expecting only to become as envisaged over 50-100 years (Hassell [9]) and sustainability management frameworks are still being developed and assessed.



To understand the impacts of some of these changes and adapt our management controls, we needed to collect baseline information to comprehend natural variation and understand our catchment, legislation and stakeholder requirements. We also needed the capacity to handle and query this information.

## 2.2 Research program

SOPA has implemented new research programs to supplement remediation effectiveness and species conservation monitoring (Laginestra [10]). These include optimisation of bioremediation treatment, management action evaluations (eg fertiliser or pesticide application), weight-of-evidence environmental health assessment and endocrine disrupting activity studies. Research has been undertaken to examine changes in wetlands, sediments and algae and propose hypotheses for observations, as well as develop new methods and models for assessment and control.

Some of the models being developed look at possible scenarios including sea level rise, sediment accretion and subsidence and pollution transport. Methods of assessment being developed include vegetation monitoring using satellite imagery, hazard monitoring for interactive querying and fuzzy logic models for prioritising actions, monitoring control effectiveness and assessing hazard impact. Models not only include our site and neighbouring areas, but are assessed for portability to other regions. It is essential that adjoining properties are included in assessment to understand impacts on each other. Access and usage of park facilities will affect the actions and controls selected.

Data to populate or validate models and methods are stored and manipulated in the Ecology Databank, which has geographic information system (GIS) capability. Research is selected and prioritised strategically, based on relevance to management goals, length of time, innovation and ability build on current knowledge. Managers do not have to wait for final results from requested research projects before adjusting their actions or controls, as an adaptive management framework is being put in place and assessed (Laginestra [11]). Expectations, monitoring programs and adaptive actions are documented. Enforcement is expected to be handled through the operational plans.

## 2.3 Data management

SOPA developed a data management system, the Ecology Databank, with the objective to capture “intellectual capital” of work undertaken at our site and make this available to technical and non-technical audiences alike. We considered web shell (the look and feel of the interface), access / security, search requirements and the outputs required by management. Standard formats were used to help with future communication between systems (Hudson *et al.* [12]).

The databank can manage most data necessary to define the “scope” of the institutional control and easily allow access to supporting documentation. Decision-making has therefore become more transparent and open with access to the databank and the development of new decision-making models.



## 2.4 Communication

The success of remediation and ongoing management controls was largely dependent on our involvement with stakeholders. There was a lack of public outcry or adverse media attention prior to major events, including the Olympic Games, even though contamination can be an emotive issue. Workshops were arranged and newsletters distributed as managers prepared the remediation strategy in 1992. Expert advisory panels were convened to examine specific environmental issues (such as ecology, transport integration, water management and landscaping). In 1998 a community reference group was established with a specific charter to monitor and review the remediation strategy. However, it was not judged a success until it was perceived that all managers were free with information and discussed results openly (Simms [13]).

## 3 Selection and assessment of controls

Controls should be selected after outlining what is hoped to be achieved, then assessing the options available. Some examples of the main controls selected for use at Sydney Olympic Park are assessed in Table 1 using a “rational approach”, which has also been used in other industries for decision making, such as policy development (Hughes [14]). The steps include:

- Define the problem
- Outline proposed end-uses / outcomes (what you hope to achieve)
- Establish the evaluation criteria (how you judge the success of controls)
- Consider contexts - legislation, policy, catchment
- Look at the alternatives and assess whether they will meet requirements (an evaluation of risks, consequences and uncertainties)
- Implement, monitor, evaluate and maintain, then communicate.

The controls put in place during remediation, although often not clearly documented, appeared to be effective. Certainly the special state planning controls (SREP 24) allowed for rapid and effective management with an integrated approach. Adjustments to other controls were made from trial and error, rather than a controlled adaptive approach.

Current controls put in since the passing of the Sydney Olympic Park Authority Act 2001 have been based on an understanding of the site nature; with future long term concepts for park usage outlined in Parklands 2020, and the operational plan and risks documented in the Plan of Management. The Plan of Management has considered legislation and defined allowed activities for each precinct. This Plan also has a statement of evolution allowing for adjustment based on monitoring against selected indicators.

There are many excellent papers outlining the types of controls that can be used, but they all need ongoing effectiveness assessment for a number of reasons:

- Controls may provide protection from a number of risks, but in some cases have been swiftly put in place to address a single issue and may not be the optimum choice.



- Effectiveness may change with changing situations over time or with better information
- They may not be suitable to achieve desired future outcomes. This could be due to reduced effectiveness or over-prescriptiveness.

### 3.1 Legislation

When remediation first started (1992) there were limited suitable regulations that controlled cleanup. The planning laws did not permit some of the work and environmental laws in place were not suitable for control. Planning NSW were included on the initial committee and worked with remediators to develop suitable legislation throughout the project. The EPA issued “directives” to undertake work. In 1995 the Olympic Coordination Authority Act streamlined planning and development departments involved in the site into the one group and OCA became a building approval authority. Planning policy ensured development applications, subject to consent by the Minister for Urban Affairs and Planning, had to meet a number of regulatory conditions. During the remediation, both planning and environmental laws and policies were updated based on experiences at the Homebush Bay site. Validation reports (conducted by independent environmental auditors) at the completion of remediation were submitted to the occupiers, the NSW EPA and Planning NSW. There are still some issues with legislation, for example the Threatened Species Conservation (TSC) Act 1995 focuses on mono-species protection rather than biodiversity.

### 3.2 Approach to control selection

At Sydney Olympic Park key site information included:

- Waste was left in place for equity plus limited treatment methods were available. Waste transfer posed an unacceptable risk to the surrounding community
- Waste was not homogenous and ongoing treatment is occurring
- Land-uses were proposed or prohibited based on current site knowledge
  - There are rare, threatened and other species protected by international treaties
  - There are historic artefacts and stories
- We have boundaries with other developing areas and new residents and workers will have certain attitudes and expectations

This knowledge affected the types of controls that could be suitable. The key issues for control selection included the types of site features and end-uses; risks and consequences of incorrect selection; monitoring and maintenance required (resourcing, enforcement); length of time a control is needed or guaranteed to remain effective; the dominant forces in place (for example pre-load stress for leachate collection); and communication.



Table 1: Major controls in use at Sydney Olympic Park.

Issue	Aims	Context	Criteria	Controls			Concerns
				Physical	Instiutional	Maintenance &	
Contaminated land	<ul style="list-style-type: none"> <li>No waste transfer &amp; block exposure paths</li> </ul>	Limited legislation Limited guidelines Perceptions Boundary joins Catchment input Waste type	<p>Actions to:</p> <ul style="list-style-type: none"> <li>Obtain consent</li> <li>Block pathways</li> <li>Minimise access</li> <li>Notify governments &amp; community</li> <li>Ensure effectiveness</li> <li>Develop standards</li> </ul>	<ul style="list-style-type: none"> <li>Containment system, caps, safety gear decontam. shed</li> <li>Fencing &amp; signage</li> <li>Treatment methods*</li> </ul>	<ul style="list-style-type: none"> <li>Development applications &amp; retrospective legislation</li> <li>licence issue &amp; reporting</li> <li>Audits</li> <li>Deed restriction</li> <li>Health advisory bans</li> </ul>	<ul style="list-style-type: none"> <li>Guidance &amp; operational plan</li> <li>PD duty</li> <li>Monitoring plans</li> <li>Specification in briefs/ contracts /agreements</li> <li>Adaptive Mgt framework</li> </ul>	<ul style="list-style-type: none"> <li>Ownership/ legislation change</li> <li>Guarantee life of materials</li> <li>Changes to standards</li> <li>New treatment methods, changing conditions</li> </ul>
Understand site and define key features	<ul style="list-style-type: none"> <li>Conserve &amp; natural cultural heritage</li> </ul>	TSC Act -mono species protection Heritage orders Community interest International treaties	<ul style="list-style-type: none"> <li>Protect key species</li> <li>Enhance biodiversity</li> <li>Restore artefacts</li> <li>Sustain items under changing conditions</li> </ul>	<ul style="list-style-type: none"> <li>Fencing restricted access</li> </ul>	<ul style="list-style-type: none"> <li>Management plans</li> <li>MoU</li> <li>Signage</li> <li>Creation of reserves</li> <li>Landscaping standards</li> </ul>	<ul style="list-style-type: none"> <li>Predictive models</li> <li>Maps</li> <li>Research</li> <li>Monitoring and reporting field observations, inspections</li> </ul>	<ul style="list-style-type: none"> <li>Maps and plans not interactive</li> <li>Model uncertainties</li> <li>IP</li> <li>Management activity changes</li> <li>Conflicting activities</li> </ul>
Emerging "green" awareness	<ul style="list-style-type: none"> <li>Showcase ESD initiatives</li> <li>Ensure sustainability – triple bottom line</li> </ul>	Major event profile Intellectual capital Agenda 21 Social values Demographic change Surrounding development	<ul style="list-style-type: none"> <li>Integrate ESD</li> <li>Share knowledge</li> <li>Set standards</li> <li>Allow and prohibit actions based on risk</li> <li>Maintain valued items, sustain under changing conditions</li> </ul>	<ul style="list-style-type: none"> <li>Education &amp; outreach programs</li> </ul>	<ul style="list-style-type: none"> <li>SREP 24 – use zoning &amp; restrictions</li> <li>Single site legislation</li> <li>Environmental Mgt System</li> </ul>	<ul style="list-style-type: none"> <li>Checklists</li> <li>Multidiscipline teams</li> <li>Research</li> <li>Prioritisation methods and models</li> </ul>	<ul style="list-style-type: none"> <li>Policy enforcement: join-lines, park users neighbours</li> <li>Off-site effects</li> <li>Modifications to planning instruments</li> <li>Assigning value to benefits</li> </ul>

ESD = Ecologically Sustainable Development, IP = intellectual property MoU = Memorandum of Understanding PD = Position Description  
 Conditions issued on development applications and licences. Deed restrictions issued with handover of Newington Village to Local Council, although SREP 24 applies  
 \*Different treatments due to different waste types: most waste contained, some waste treated using bioremediation or thermal desorption plus base catalytic conversion



## 4 Summary

The remediation and redevelopment provided a lasting legacy from degraded land at a cost far less than initially estimated. The integration of consideration of the natural environment into the process resulted in a product of far greater value than originally envisaged. The Olympics provided a good opportunity to profile the work, drive collaboration, and show many “unachievable” initiatives can be not only done, but also mainstreamed.

Since the completion of works at the site environmental policies have been drafted to provide guidance on environmental management, sustainability and communication. Legislation on management of contaminated land and occupational health and safety have been upgraded. A guidance concept plan and an operational plan for the Parklands have been prepared to ensure sustainable management at the site. Site documents will still need review and adaptation to ensure the environmental showcasing at the site is not historic but adapting to changing situations. The site has been and will remain a “living laboratory” where intellectual capital has been developed and assumptions tested in the field. Site understanding helps select appropriate end-uses, data management is required for decision making, education and communication, and strategic research prioritises resources and assesses the effectiveness of controls.

What were seen as “sustainable” actions during cleanup have already changed in some cases. This occurred as undocumented wastes were found, better methods became available, scheduled chemicals list changed and endangered species were found. We cannot assume that if something is working well now it always will, nor can we assume that we will always manage all of the site.

Controls put in place appear successful and many areas of concern have been highlighted for monitoring. We still need to assign costs to many of the benefits so we can all talk the same language. We have initiated some projects to address this, including ecological footprint project and sensitivity testing of our models. Projects monitoring visitation and hazard using a fuzzy logic model help assess and select locations where new controls are needed or current controls adjusted. We will also monitor our ability to change and would like to gauge differences between Australian and international legislation to provide a global context for some of the institutional controls being discussed.

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