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Western Zoo
Waste Management Plan
Construction and Operational Phases

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Sydney Zoo
3 Wills Avenue
Waverley NSW 2041

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Western Zoo

Waste Management Plan

Construction and Operational Phases

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1 INTRODUCTION

1.1 Project Background

Sydney Zoo is seeking approval under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the construction of a zoo (Sydney Zoo) in the local government area (LGA) of Blacktown City Council (Council) within the Bungarribee Precinct in the Western Sydney Parklands.

The project was declared to be State Significant Development (SSD). Assessment and approval is being pursued in accordance with the EP&A Act. The Secretary's Environmental Assessment Requirements (SEARs) for the project have been issued and set out the environmental assessment requirements for the project.

This Construction and Operation Waste Management Plan (WMP) has been prepared by SLR Consulting Australia Pty Ltd (SLR) to address the relevant SEARs in relation to the preparation of the EIS for the Project.

1.2 The Project

The proposed development of Sydney Zoo will include.

- Animal exhibits across several enclosures of varying design for a range of native and exotic animals.
- Back-of-house buildings for exhibits.
- Main entrance building comprising entry/exit, and gift shop.
- Restaurant and café.
- Kiosks and amenities.
- Show arena.
- Picnic areas and gardens.
- Wetlands and waterways.
- Service building containing:
 - Administration areas;
 - Curatorial and food preparation areas; and
 - Veterinarian space.
- Service yard with maintenance shelter.
- Main car park for approximately 800 vehicles, with an overflow car park for approximately 490 vehicles, access via an internal road connecting to the Great Western Highway.
- Bus parking.

Construction of the project is expected to take approximately 8 to 12 months to complete.

Further detail is provided in **Section 4**.

1.3 Secretary's Environmental Assessment Requirements

A Request for SEARs relating to the form and content of the EIS was submitted to the NSW Department of Planning and Environment (NSW DP&E) in August 2015. The SEARs were subsequently issued by the DP&E on 16 September 2015 (SSD 7228).

Table 1 presents the key waste management issues to be addressed in the EIS, and identifies where each requirement is addressed in this WMP.

Table 1 SEARs for the Proposed Development

Waste Management	Relevant Section
Department of Planning and Environment	
Identification of the quantity and type of waste that would be handled, stored, processed or disposed of at the site.	Table 5, Section 5.4 Table 13, Section 6.5
A description of the waste processing and recycling measures, timeframes for processing and recycling and the quality control measures that would be implemented.	Whole of document, Section 5.5 – 5.8, Section 6.6 – 6.9
Details of the potential impacts associated with treating, storing, using and disposing of any waste and waste products.	Section 2, Section 5 and 6 Refer to Air Quality Report, Soil and Water Report, and Biosecurity Report
Environmental Protection Agency	
Waste management in the context of the waste management hierarchy.	Section 2, Section 5.5 – 5.6, Section 6.6 – 6.7
Waste management: <ul style="list-style-type: none"> ▪ Groundwater (example depth and any likely impact to groundwater) ▪ Any fill materials and illegally dumped waste ▪ Potential impacts from demolished buildings and infrastructure 	Refer to Groundwater Report Section 5.2, Section 5.9 and 5.11, Section 6.11 – 6.12
The EIS should identify the nature and scope of clinical and related waste likely to be generated during operation of the zoo and the measures proposed to handle, store, transport and dispose of those wastes.	Section 6.9.5
The EIS should identify how the proponent will ensure compliance with any relevant trackable waste requirements of Part 4 of the Protection of the Operations (Waste) Regulation 2014 in relation to clinical and related waste generated in the course of zoo operations.	Section 6.12
Blacktown City Council	
Identify all waste streams both incoming and outgoing from the premises in accordance with the EPA's Waste Classification Guidelines.	Table 5 and Table 13
Provide details regarding the source, quantity and types of all wastes that will be generated, accepted, handled, processed or treated.	Table 5, Section 5.4 Table 13, Section 6.5
Provide details regarding the proposed transportation, receipt and handling of waste generated.	Section 5.7 – 5.8, Section 6.8 – 6.10
Detail the extent of any waste that is to be stockpiled including: <ul style="list-style-type: none"> ▪ Estimated average and maximum amount of materials to be stored at any one time. ▪ Stockpile heights. ▪ The approximate locations of these stockpiles. ▪ Proposed containment of materials and stockpiles. ▪ Fire management and odour from any green waste stockpiles. 	Section 5.7 and Section 6.8 Refer to Air Quality Report and Soil and Water Report.

Additionally, qualitative information regarding wastewater management for the development has been addressed in **Section 6.5.4**). An assessment of the estimated emissions arising from the handling, storage, treatment, processing and reprocessing of waste at the site is available in the Air Quality Report.

1.4 Scope

This WMP applies to the construction and on-going operation of the proposed development. The minimum standards of this WMP must be implemented during all stages of the development, and may be subject to review upon expansion or changes in operational procedures.

- See page 11 for the Construction WMP.
- See page 23 for the Operational WMP.

1.5 Objectives

The principal objective of this WMP is to identify all potential wastes likely to be generated at the site during development and operational phases of the Project, including a description of how waste would be handled, processed and disposed of (or re-used/recycled), in accordance with SEARs.

The specific objectives of this WMP are as follows:

- To encourage the minimisation of waste production and maximisation of resource recovery.
- To ensure the appropriate management of contaminated/hazardous waste.
- To ensure the appropriate management of medical/clinical or related waste (including cytotoxic wastes).
- To identify procedures and chain of custody records for waste management.
- To assist in ensuring that any environmental impacts during the operational life of development comply with the development consent conditions and the conditions of other relevant regulatory authorities as outlined in the SEARs.

2 BETTER PRACTICE FOR WASTE MANAGEMENT AND RECYCLING

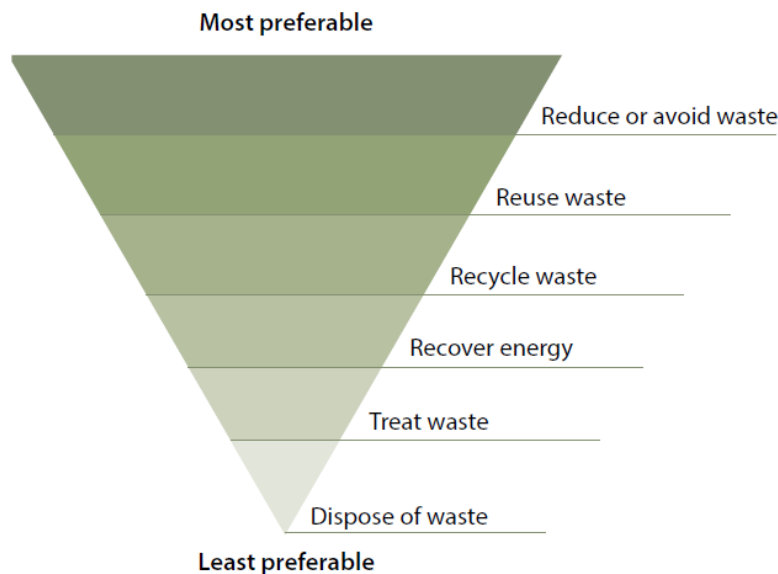
2.1 Waste Management Hierarchy

Where appropriate, this WMP aims to meet the principles of the waste management hierarchy, by promoting waste as a resource through the following in order of preference:

- Waste avoidance through prevention or reduction of waste generation. Waste avoidance is best achieved through better design and purchasing choices.
- Waste reuse, without substantially changing the form of waste.
- Waste recycling through the treatment of waste that is no longer usable in its current form to produce new products.
- Energy recovery through thermal treatment of residual waste materials and from green waste processing.
- Waste disposal, in a manner that causes the least harm to the natural environment.

The waste hierarchy pictured below demonstrates a classification of waste management options in order of their environmental impacts, as established under the Waste Avoidance and Resource Recovery Act 2001.

Figure 1 Waste Hierarchy



Source: NSW Waste Avoidance and Resource Recovery Strategy 2014-21 (EPA 2014)

2.2 Benefits of Implementing Better Practice for Waste Management and Recycling

- Enhanced social and environmental reputation of an organisation.
- Reduced costs associated with waste disposal.
- Benefits to all stakeholders and the wider community.
- Improved environmental, health and safety, and biosecurity outcomes.

3 WASTE LEGISLATION AND GUIDANCE

The legislation and guidance outlined in **Table 2** below should be referred to during the construction and operational phases of the development.

Table 2 Waste Legislation and Guidance

Legislation	Objectives
Waste Avoidance and Resource Recovery Act 2001	To promote extended producer responsibility in place of industry waste reduction plans with specific objectives including: <ul style="list-style-type: none"> To encourage efficient use of resources. To minimise the consumption of natural resources and the final disposal of waste by encouraging the avoidance of waste and the reuse and recycling of waste. To ensure that industry shares with the community the responsibility for reducing and dealing with waste. To ensure the efficient funding of waste and resource management planning, programs and service delivery.
Protection of the Environment Operations Act (POEO) 1997 & Amendment Act 2011	Administered by the NSW Environmental Protection Authority (EPA) to enable the Government to establish instruments for setting environmental standards, goals, protocols and guidelines. <i>Important Note: The owner of a premises, the employer or any person carrying on the activity which causes a pollution incident is to immediately notify the relevant authorities when material harm to the environment is caused or threatened.</i> A list of each relevant authority is provided in the POEO Amendment Act and will be noted in the site's incident register.
POEO (Waste) Regulation 2014	Contains provisions relating to the waste levy, waste tracking and management requirements for certain waste types, payment schemes for councils, consumer packaging recycling and other miscellaneous provisions.
EPA's Waste Classification Guidelines (Part 1) 2014	To assist waste generators to effectively classify, manage, treat and dispose of waste to ensure the environmental and human health risks associated with waste are managed appropriately and in accordance with the POEO Act and its associated regulations.
Secretary's Environmental Assessment Requirements (SEARs) and State Environmental Planning Policies (SEPPs)	Including: <ul style="list-style-type: none"> SEPP (Western Sydney Parklands) 2009 SEPP (State and Regional Development) 2011 SEPP (Infrastructure) 2007 SEPP No. 55 – Remediation of Land
Blacktown Development Control Plan (BDCP 2015)	Part G "Site Waste Management and Minimisation" provides information on how to prepare a WMP and advice on minimising waste during demolition and construction. It requires source separation of materials at site and states that a WMP must demonstrate diversion of waste going to landfill.
EPA's Waste Avoidance and Resource Recovery (WARR) Strategy 2014-21	A key component of the State Government's vision for the environmental and economic future of the state that will be supported financially by the <i>Waste Less, Recycle More</i> funding initiative providing long-term targets for key result areas.
Waste Management Guidelines for Health Care Facilities, NSW Ministry of Health	These guidelines were developed to assist health care facilities with key strategies for waste management in relation to medical waste / clinical and related waste streams.
NSW EPA's Better Practice Guidelines for Waste Management and Recycling in Commercial and Industrial Facilities 2012	The Better Practice Guidelines (EPA 2012) encourages efficient waste minimisation and resource recovery for commercial and industrial facilities and is used as a benchmark document when assessing waste production rates within Australia and details a range of waste management provisions.
Building Code of Australia (BCA) and relevant Australian Standards (AS)	The BCA (and AS) have the aim of achieving nationally consistent, minimum necessary standards of relevant health and safety, amenity and sustainability objectives efficiently.
Australian Packaging Covenant (APC)	Planned retail for the site should be encouraged to establish an Action Plan to demonstrate their contribution to the achievement of the APC's goals.

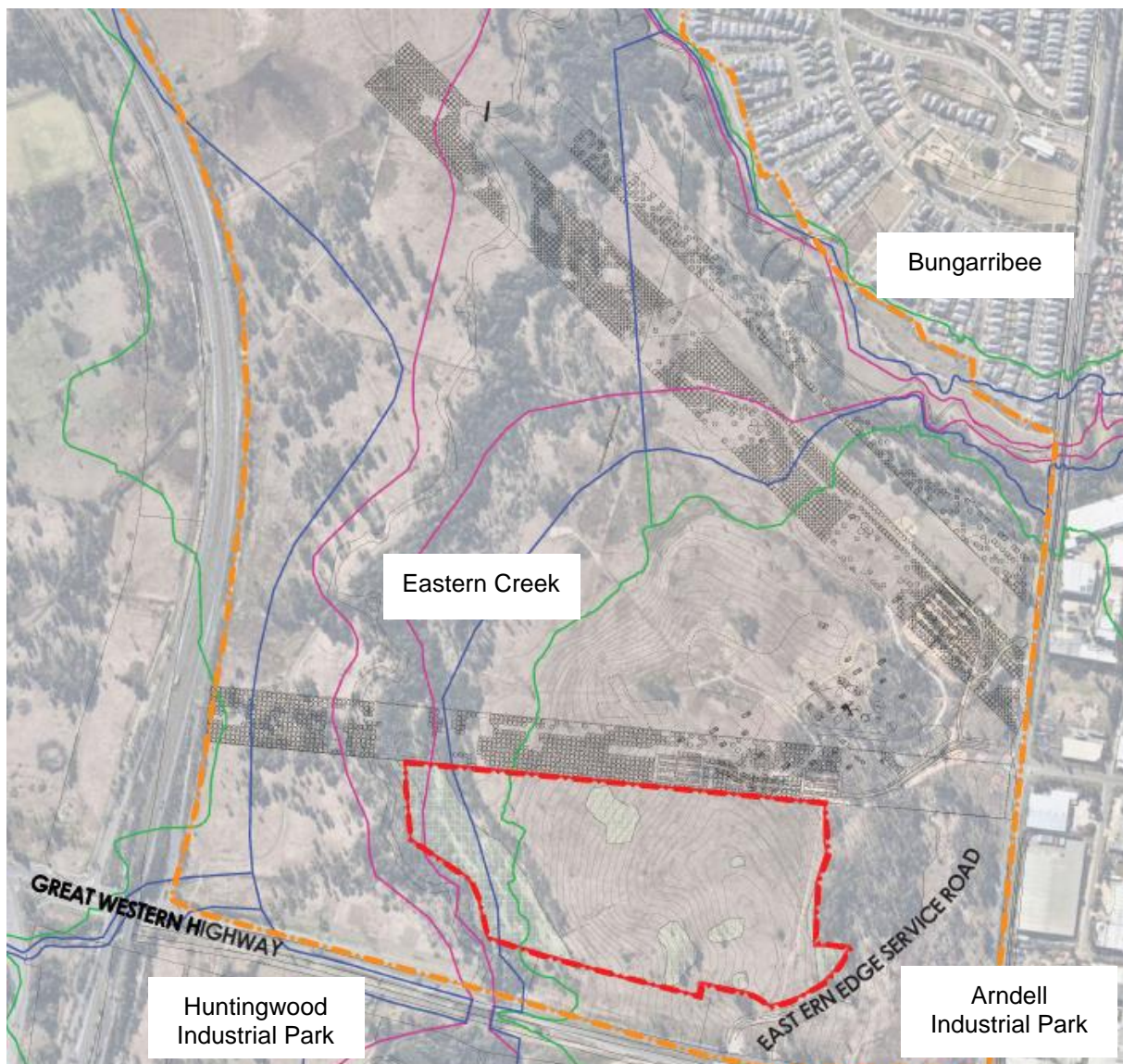
4 PROJECT DESCRIPTION

4.1 Subject Site

The subject site is located approximately 33 km west of the Sydney CBD and approximately 15 km east of Penrith. It is situated within the Bungarribee Precinct of the Western Sydney Parklands in close proximity to the Great Western Highway, M4 Western Motorway and Westlink M7. The proposed development site comprises approximately 16.5 ha and is accessible via the Great Western Highway which is setback approximately 75 m from the site's southern boundary.

The existing site is vacant and largely cleared of significant vegetation. There is some elevation towards the centre of the site but it slopes overall to the west. Access is currently provided by a restricted access gate to the highway and by an access gate off Doonside Road. Residential areas are situated greater than 600 m to the north in the suburb of Bungarribee. Industrial buildings are situated to the east to south, with open land and Eastern Creek situated to the west.

Figure 2 Site Location



Source: Aspect Studios December 2015

The Western Sydney Parkland Trust (WSPT) manages the Western Sydney Parklands area (a total land area of 210 ha). The Parklands Plan of Management 2010 and the Master Plan for the Bungarribee Super Park released in early 2015 both identify an opportunity for the southern portion of the park to cater for increased recreation and tourism.

4.2 Proposed Zoological Park Layout

The key characteristics of the site are:

- 30-35 exhibits with back-of-house buildings.
- Up to 60 animal species across several enclosures of varying design.
- An aquarium with up to 12 tanks (and filters) of an average of 10 m³ water volume.
- A nocturnal house with artificial sunlight during the night to reverse the diurnal cycle of the animals.
- An estimated 1,314 m of linear pathways, including lighting.
- Show arena, picnic areas, wetlands, waterways and gardens.
- 2 kiosks with food display and associated refrigeration.
- An 800 seat restaurant and café with food display, refrigeration and capacity for a la carte cooking (fryers, grills etc), built around an “African waterhole” housing hippos and elephants.
- A service building containing administration, curatorial and food preparation areas and veterinarian space.
- Amenities sufficient for servicing a peak in park capacity of 5,000 people.
- A service yard and maintenance shelter.
- An entry and exit pavilion including a gift shop.
- Car parking for 1,284 spaces and bus parking.

Estimated areas for service and customer buildings and also public areas are provided in **Table 3** and **Table 4** overleaf.

Table 3 Estimated Building Areas

Building Type	Floor Area (m ²)	Breakdown into Activity Areas (m ²)
Entry Building including Gift Shop	920	Registers, information desk, self-serve ticket units, retail, cash office, staff room, stock room
Kiosk	68	East and west kiosks
Café / Restaurant	929	Kitchen, dining, loading dock, back-of-house. amenities and future expansion areas
Services Building including:	1,130	
- Curatorial and Food Preparation	522	Offices, hot desks / cool room, storage area
- Administration / Offices	380	Entry foyer and meeting room, offices, lockers, showers and toilets, lunch/tea common area 70 m ² , outside courtyard
- Veterinary Centre	204	Reception, two treatment rooms, operating theatre, holding facilities, offices and staff room
Amenity Blocks	68	Eastern and western amenity blocks
Sub-total	3,115	
The Aquarium	343	-
Reptile / Insect Habitat	350	-
The Nocturnal House	350	-
Total Back of House (BOH)	2,906	Building 7 to 20
Sub-total	3,949	
Total Building Area	7,064	

Table 4 Estimated Public Place Areas

Building Type	Area (m ²)
Play Area / Picnic Area East	2,103
Picnic Area Central	505
Picnic Area West 1	550
Picnic Area West 2	500
Arena	1,250
Car Parking (including overflow)	40,324
Pathway	6,089 (1,314 linear metres)
Service Yard	95.8

See **Figure 3** overleaf for a conceptual plan of the zoo.

Figure 3 Zoo Masterplan



Source: Aspect Studios (L03 Revision A)

4.3 Operational Hours

The proposed operational hours for the zoo are Monday to Sunday, 9 am to 6 pm.

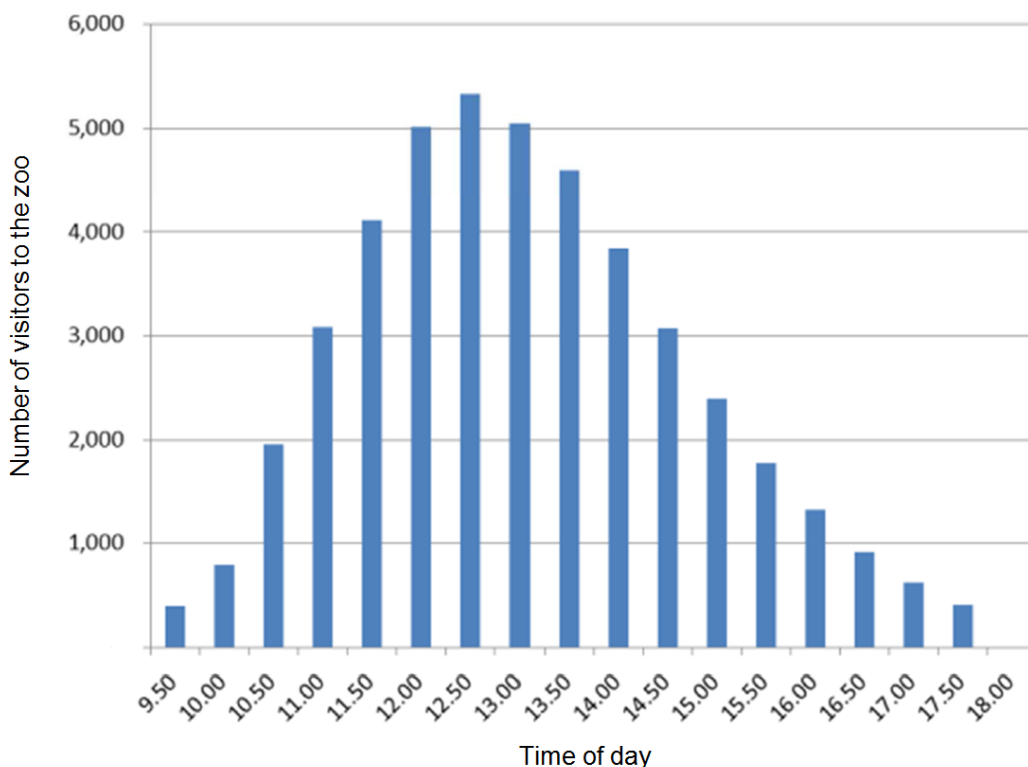
4.4 Anticipated Visitation Rates

Visitation rates for the zoo are expected to be between 500,000 and 800,000 visitors per annum.

Visitation will not be uniform throughout the year, peak days and then quiet intervening periods are likely to be experienced. Busiest periods are anticipated for the four weeks of school holidays in January (with the first two weeks likely to experience the highest visitation rates) and also around Easter, with visitation rates expected to be in the range of 80,000 to 128,000 over a 4 week period, with an average of about 3,400 to 5,500 visitors per day and a maximum of about 6,000 to 8,000 visitors per day.

Daily visitor flows have been modelled to estimate parking requirements and also facility and amenity requirements. The modelling outcomes are summarised below in **Figure 4** and show that the zoo expects daily peaks in visitation rates between 12 noon and 1 pm of approximately 1,700 people on a standard weekend day, and up to 5,500 people on a peak day.

Figure 4 Estimated Peak Day Visitation Rates



5 CONSTRUCTION WASTE MANAGEMENT

Site preparatory and construction phases of developments have the greatest potential for waste minimisation.

Key site preparatory and construction activities at the development site include:

- bulk excavation to create waterways, level areas and build up other areas of the site;
- site infrastructure development including access roads, parking areas, pathways, power supply, water supply, sewage supply, reticulation, etc;
- construction of site facilities, buildings, structures and roofing;
- construction of animal housing and fenced areas, aquariums and tunnels;
- refurbishment works for all buildings; and
- landscaping and reticulation works.

5.1 Targets for Resource Recovery

The performance of each construction project will contribute to the overall NSW State recycling and resource recovery performance, the target for which is 80% by 2021 for the construction and demolition (C&D) sector (see NSW Waste Avoidance and Resource Recovery Strategy 2014-21).

Waste minimisation measures that can be implemented to assist in achieving this resource recovery target are provided in the following sections. Waste audits will determine the actual percentage of wastes that were recycled and disposed of at landfill during the Project.

5.2 Waste Streams and Classifications

The site preparatory and construction phases of the development will generate the following broad waste streams:

- excavation material for reuse at site including sandstone, rock and soil (potentially contaminated soils);
- green waste;
- construction wastes;
- plant maintenance waste;
- packaging waste;
- work compound (on-site employee) waste; and
- waste water.

It is understood that no demolition activities will be required at the site prior to development works being undertaken and all excavated materials (soil and rock) will be reused at the site. In addition, approximately 15,500 m³ of imported fill materials will be required to be placed at the site.

Potential waste types along with their waste classification are provided in **Table 5**. All wastes generated during the project must be properly assessed, classified and managed in accordance with the EPA's guidelines to ensure the appropriate treatment, transport and disposal of wastes.

Table 5 Potential Waste Generation with Classifications

Waste Types	NSW Classification	Proposed Reuse / Recycling / Disposal Method
Site Preparatory / Construction		
Green waste	General solid (non-putrescible) waste	Reuse / recycling on-site or off-site recycling
Excavated material (VEMN, EMN)	General solid (non-putrescible) waste	Reuse on-site where possible or reuse for similar projects. Sandstone may be incorporated in design or sold.
Sediment fencing, geotextile materials	General solid (non-putrescible) waste	Reuse at other sites where possible or disposal to landfill
Concrete (solids and washouts) and asphalt	General solid (non-putrescible) waste	Reuse on-site where possible or recycled off-site
Steel reinforcing, other metal (e.g. wire mesh), bulk electrical cabling, mesh	General solid (non-putrescible) waste	Off-site recycling
Conduits and pipes	General solid (non-putrescible) waste	Off-site recycling
Timber formwork / bamboo	General solid (non-putrescible) waste	Reuse on-site or off-site recycling
Cross laminated timber	General solid (non-putrescible) waste	Reuse on-site or disposal to landfill
Plasterboard	General solid (non-putrescible) waste	Off-site recycling or disposal to landfill
Bricks, tiles	General solid (non-putrescible) waste	Off-site recycling
Glass	General solid (non-putrescible) waste	Off-site recycling
Light bulbs	Hazardous waste	Off-site recycling
Plant Maintenance		
Tyres	Special waste	Off-site recycling or disposal
Empty oil and other drums / tins (e.g. fuel, chemicals, paints, spill clean ups)	Hazardous waste if the containers were previously used to store Dangerous Goods (Class 1, 3, 4, 5 or 8) and from which residues have not been removed. General solid (non-putrescible) waste if cleaned by triple washing or vacuuming.	Transport to comply with the transport of Dangerous Goods Code applies in preparation for off-site recycling or disposal at licensed facility. (Note: Discharge to sewer subject to Trade Waste Agreement with Sydney Water)
Batteries	Hazardous waste	Off-site recycling
Packaging		
Packaging materials, including wood, plastic (including stretch wrap or LLPE), cardboard and metals	General solid (non-putrescible) waste	Off-site recycling
Wooden crates	General solid (non-putrescible) waste	Reused for similar projects, returned to suppliers, or off-site recycling
Work Compound and Associated Offices		
Recyclable beverage containers	General solid (non-putrescible) waste	Co-mingled recycling at off-site licensed facility
Clean paper and cardboard	General solid (non-putrescible) waste	Paper and cardboard recycling at off-site licensed facility
General domestic waste generated by workers (soiled paper and cardboard, food stuffs, polystyrene)	General solid (non-putrescible) waste mixed with putrescible waste	Recovery at a suitable treatment facility or disposal at landfill
Pump-out waste and septage (sewage)	Liquid (trade) waste	Off-site disposal at licensed facility or disposal direct to sewer where arranged with Sydney Water.

For further information on how to determine a waste's classification, refer to the Waste Classification Guidelines (EPA 2014).

5.3 Waste Generation Rates

The Building Contractor will need to record the types and quantities (including the volume in cubic metres and weight in tonnes) of wastes produced during the site preparatory and construction phase of the Project, and on this basis, the numbers and capacity of skips, bins and other containers can be determined.

A guide/estimate of the potential waste percentages is provided based on “rule of thumb” waste generation rates for construction projects, as indicated in **Tables 6** and **7**. These figures have been referenced primarily from the UK’s WRAP composition and conversion factors in lieu of suitable Australia references and adapted as required. Conservative estimates have been made where indicative waste compositions were not available.

Table 6 Assumed Waste Generation Rates - Earthworks

Waste Material	Estimated Waste %	Volume/Weight Ratios (tonnes per m ³)
Soil / Rubble	100%	1.25

Source: UK WRAP 2014

Table 7 Guideline to Waste Generation Rates for Construction

Material	Estimated Waste % (Lighter Material Build)	Estimated Waste % (Typical Building)	Conversion Factors (tonnes per m ³)
Hard Material (i.e. bricks, tiles)	12%	32%	1.20
Timber	30%	24%	0.34
Plasterboard	20%	6%	0.33
Concrete	9%	9%	1.27
Metals	6%	6%	0.42
Plastics	15%	15%	0.25
Cardboard	4%	4%	0.20
Green waste	3%	3%	0.09
Soil	1%	1%	1.20

Source: UK WRAP 2014

The above guidelines will be applied as appropriate to excavation works and construction of buildings and structures. Estimated waste compositions will depend on the type of site preparatory and construction work undertaken. Explanation in the text has been provided where estimated waste compositions differ from the guidelines provided above.

The UK Department for Environment, Food and Rural Affairs (DEFRA) and the UK Building Research Establishment (BRE) have developed a number of benchmark indicators to help determine approximate tonnages of waste produced during various construction projects including civil engineering and commercial retail works.

The benchmarks include Environmental Performance Indicators (EPI) which measure the volume (m³) of waste produced per 100 m². The EPI indicators provided in **Table 8** have been used for the purposes of this WMP to estimate the amounts of construction wastes generated by the Project.

An average of the EPI indicators for the commercial building types has been used to estimate construction wastes associated with general buildings around the site given construction methods and materials utilised at the site will incorporate sustainability measures such as the use of cross laminated timber as a naturally insulating material and to reduce false ceiling requirements.

Table 8 Environmental Performance Indicators (EPI) for Construction

Project Type	Average Waste Produced (m ³ /100m ² floor area)
Commercial other	16.9
Commercial offices	20.4
Commercial retail	22.1
Average of Commercial EPI Indicators	19.5

Source: UK BRE's www.smartwaste.co.uk

5.4 Estimation of Waste Volumes/Tonnages

Excavation Works

The volume and corresponding weight of excavated materials for the development site is estimated to be in the range of 14,875 tonnes with the bulk of earthworks occurring to the north-west of the site and in the creation of moats and creeks across the site (see **Table 9**).

Soil and rock excavated material will be re-used on the site as fill material and for landscaping, provided no contamination is present. If sandstone is present, sandstone rock may be re-used in the design of buildings and other structures.

Table 9 Estimated Waste Generation - Excavated Materials for Re-use

Site Area	Estimated Excavated Material Generation (m ³)	Estimated Excavated Material Generation (t)
North West Corner	500	625
North East Corner	100	125
South West Corner	200	250
Site Wide Moats and Creeks	11,100	13,875
Total Estimated	11,900	14,875

Approximately 15,500 m³ of imported fill materials will be required to be placed at the site.

5.4.1 Construction of New Buildings

The estimated tonnes of waste materials generated during the construction of the proposed development have been calculated using waste generation rates provided in **Table 7** and **8**, and approximate building areas and are presented in **Table 10** and **11**.

Table 10 Estimated Waste Generation – Building Construction Activities

Building	Approximate Area (m ²)	Estimated Waste Volume (m ³)	Estimated Waste (t)
Entry Building (incl. Gift Shop)	920	179	92
Kiosk	68	13	7
Café / Restaurant	929	181	93
Administration Building	1,130	220	113
Public Toilets	68	13	7
Sub -Total	3,115	607	311

Building	Approximate Area (m ²)	Estimated Waste Volume (m ³)	Estimated Waste (t)
The Aquarium	343	67	46
Reptile / Insect Habitat	350	68	47
The Nocturnal House	350	68	47
Total Back of House (BOH)	2,906	567	388
Sub-Total	3,949	770	528
Total	7,064	1,377	838

Table 11 Estimated Waste Volumes and Materials for the Development

Material	Split	Waste (m ³)	Conversion Factor	Total Waste (tonnes)
Hard Material (i.e. bricks, tiles)	See Table 7	319	1.20	383
Timber		367	0.34	125
Plasterboard		168	0.33	55
Concrete		124	1.27	157
Metals		83	0.42	35
Plastics		207	0.25	52
Cardboard		55	0.20	11
Green waste		41	0.09	4
Soil		14	1.20	17
Total	100%	1,377¹	-	838¹

Note 1: Totals may not add up due to rounding.

It is estimated that more than 45% of the construction wastes will be made up of hard materials which may be re-used on-site (or at another development) where possible. Of the remaining 55% it is anticipated that it will be possible for at least 50% of the materials to be recycled off-site resulting in an overall recycling rate of greater than 70%. It is noted that all waste generation rates are approximate only.

There will also be wastes generated during the construction of access roads, car parking areas, the service yard, landscaped areas and animal yards, and public pathways.

Council has developed generic forms that should be completed by the Building Contractor which require expected quantities of wastes to be identified, how different waste types will be recycled or disposed of, and identification of recycling/disposal destinations. Refer to a copy of Council's WMP template in the Blacktown DCP (BDCP) 2015 Part G.

Additionally, the Building Contractor will need to specify the locations of skips/bins/stockpiles likely to be required during the site preparatory and construction phases (see **Section 5.7.1**).

5.5 Waste Avoidance

Project specific waste avoidance measures being considered by Sydney Zoo include:

- Use of cross laminated timber sourced from New Zealand as a naturally insulating material to realise benefits such as a reduced requirement for finishing trades, easy integration of cabling into roofing, reduced false ceiling requirement, and increased speed of deployment.
- Use of durable timber piles sourced from Tasmania to be used for fencing and other structures.
- Reuse of excavated rock and soil materials on site for landscaping.
- Mulching and reuse of green waste on site for landscaping.
- Exploring use of alternative reused materials for play equipment (e.g. balestrades).

The Building Contractor will identify opportunities for waste avoidance by:

- appropriate sorting and segregation of site preparatory and construction wastes to ensure efficient reuse and recycling of wastes;
- selecting construction materials taking into consideration to their long lifespan and potential for reuse;
- ordering materials to size and ordering pre-cut and prefabricated materials;
- reuse of formwork;
- planned work staging, coordination and sequencing of various trades;
- use of naturally ventilating buildings to reduce ductwork;
- use of prefabricated components for internal fit outs;
- reducing packaging waste on-site by purchasing in bulk, requesting cardboard or metal drums rather than plastics requesting metal straps rather than shrink wrap, using returnable packaging such as pallets and reels, returning other packaging materials to suppliers (where possible and practicable); and
- subcontractors informed of site waste management procedures.

The Building Contractor, in consultation with Sydney Zoo, will advise on material selection for the reduction of embodied energy and resource depletion. This includes:

- the use of recycled concrete and steel;
- the reduction of PVC use;
- the use of low volatile organic compounds (VOC) paints, floor coverings and adhesives;
- the use of low formaldehyde wood products and post-consumer reused timber or Forest Stewardship Council (FSC) certified timber where possible;
- the use of fittings and furnishings that have been recycled, are made from or incorporate recycled materials, and have been certified as sustainable or environmentally friendly by a recognised third party certification scheme; and
- the use of building materials, fittings and furnishings including structural framing, roofing and façade cladding chosen with consideration to their longevity, adaptation, disassembly, reuse and recycling potential.

5.6 Re-use, Recycling and Disposal

Effective management of construction materials and site preparatory/construction waste, including options for reuse and recycling where applicable and practicable, will be conducted. Only Project wastes that cannot be cost effectively reused or recycled are to be sent to landfill or appropriate disposal facilities.

Refer to **Table 5** for an outline of the proposed reuse, recycling and disposal methods for potential waste streams generated by the development.

The following specific procedures will also be implemented on site:

- concrete, tiles (where applicable) and bricks will be reused or recycled off-site;
- steel will be recycled off-site, all other metals will be recycled where economically viable;
- framing timber will be reused on-site or recycled off-site;
- windows, doors and joinery will be recycled off-site (where possible);
- waste oil will be recycled or disposed of in an appropriate manner;
- all used crates will be stored for reuse unless damaged;
- all glass that can be economically recycling will be;
- all solid waste timber, brick, concrete, rock that cannot be reused or recycled will be taken to an appropriate landfill site and disposed of in an approved manner;
- all asbestos, hazardous and/or intractable wastes are to be disposed of in accordance with Workcover Authority and EPA requirements;
- provision for the collection of batteries and other recyclable resources will be provided on site;
- beverage container and paper/cardboard recycling will be provided on-site for employee use or these items will be sorted recycling at an appropriately licensed facility; and
- all garbage will be disposed of via a council approved system.

5.7 Waste Storage

5.7.1 Number of Skips / Stockpiles

The Project will be managed ensuring effective source separation and appropriate collection of waste during site preparatory and construction works.

For construction stages, consider minimum dedicated skips for:

- timber;
- plasterboard/gyprock;
- concrete;
- bricks;
- steel/scrap metal;
- general waste; and
- other waste (i.e. for the collection of materials that may be re-used on future projects).

Separate receptacles for the safe disposal of hazardous waste types (i.e. batteries, etc) will also be provided.

Employee beverage container recycling bins should be provided nearby to common areas at work sites for plastic and glass bottles, soft drink cans, aluminium cans to ensure these items do not end up at landfill. Specialised bins for cigarette butts should also be provided to ensure these do not become a potential source of fire if thrown in bins and/or skips.

5.7.2 Space and Siting Requirements

Waste storage areas will be accessible and allow sufficient space for storage and servicing requirements. The storage areas will also be flexible in order to cater for change of use throughout the Project. Where space is restricted, dedicated stockpile areas are to be delineated on the site, with regular transfers to dedicated skip bins for sorting.

The positions of the designated waste holding areas on site will change according to building works and the progression of the development, but must consider visual amenity, health and safety, and accessibility in their selection. Appropriate siting of waste stockpile locations will take into account slope and drainage factors to ensure contamination of stormwater drains does not occur during rain events.

All waste placed in skips or bins for disposal or recycling shall be adequately contained to ensure that the waste does not fall, blow, wash or otherwise escape from the site. Waste containers and storage areas are to be kept clean and in a good state of repair.

Stockpiles of materials will be managed in accordance with the Soil and Water Report and relevant Environmental Guidelines.

5.8 Waste Servicing

5.8.1 Servicing and Transport

The frequency of the waste removal will, in most cases, be dictated by the volume of material being deposited into each of the dedicated skips. Skips are to be checked on a daily basis by the Site Manager to ensure that skips do not overflow. If skips and/or bins are reaching capacity, removal and replacement should be organised for the next 24 hours.

All skips/bins leaving the site or body of any vehicle or trailer used to transport waste from the premises, will be covered with a suitable tarpaulin to ensure that the spillage of wastes and escape of dust from the skips whilst in transit is eliminated. Mud, dust and any other material likely to fall from or be cast off the wheels or underside/body of any vehicle leaving the site will be removed before the vehicle leaves the premises.

All waste collection for site preparatory and construction works are to be conducted between 7am and 7pm Monday to Friday, and between 7am and 1pm on Saturdays, or as per the SEARs. All site generated building waste collected in the skips and/or bins will be transported by appropriately licensed waste collection contractors and deposited in the approved and appropriately licensed recycling centre, transfer station or landfill site.

5.8.2 Contaminated / Hazardous Waste

During the construction phases of the Project, there must be a commitment to engage qualified and certified contractors to remove all contaminated/hazardous materials (e.g. asbestos) and dispose of all contaminated/hazardous waste at an appropriately licenced facility, where applicable. In the event that any contaminated or hazardous materials are unexpectedly uncovered during demolition or excavation works, the Site Manager is to stop work immediately and contact the relevant hazardous waste contractor prior to further works being undertaken in the area. Handling, transport and disposal of asbestos will meet the requirements of the POEO (Waste) Regulation 2014. Consultation with Workcover NSW concerning the handling of any asbestos waste should also be undertaken.

Reference should be made to the Contamination Report and/or the Construction Environmental Management Plan (or equivalent document) for further details on contamination and hazardous materials waste management.

5.8.3 Liquid Waste Management

Liquid waste is often produced from the washing down of plant and apparatus. No liquid wastes or wash down waters will be disposed of via the stormwater drainage system. Any liquid wastes or dangerous goods wastes generated by the development (e.g. due to damage or leakage of containment) will be disposed of by a suitably qualified contractor to an appropriately licensed disposal facility.

Washdown of equipment, plant and machinery and concrete delivery trucks will take place within a specified, appropriately bunded, washdown bay or alternatively at an offsite facility having a suitable washdown bay. There may be a local sewer that this waste water can be connected to; alternatively, this could be transferred into a localised site waste water treatment facility or plant if available. Waste water storage tanks (where applicable) will be carefully monitored to ensure overflow does not occur. Any refuelling activities will be undertaken in designated areas with appropriate spill containment measures to avoid overspill to sensitive areas.

Reference should be made to the Erosion & Sedimentation Control Plan (or equivalent document) for details on stormwater and wastewater management.

5.8.4 Spills Management

Spills on the worksite are most likely to involve fuel, hydraulic oil or engine oil spilled from plant items, and paints and solvents. If a spillage occurs, immediately identify the spilled materials, notify the Site Manager and contain the spill as soon as possible to avoid the spilled materials spreading to other areas.

Containment measures for spillages will be provided at appropriate locations and in close proximity to staff car park areas, dangerous goods stores areas and main Project work areas (e.g. a spill kit containing non-combustible absorbent material). Material Safety Data Sheets (MSDS) will also be located nearby spill kit areas for advice on spillage clean-up and disposal.

5.9 Signage

Standard signage will be posted in all storage and waste collection areas and all skips/drums/bins will be labelled correctly and clearly to identify materials stored within. Damaged signage / labelling will be renewed as observed.

Refer to the EPA's website under 'waste tools' and construction and demolition waste and recycling signs.

Figure 5 Photos of Australian Standard Signage



Source: <http://www.epa.nsw.gov.au/wastetools/signs-posters-symbols.htm>

5.10 Training and Awareness

All staff (including sub-contractors and labourers) employed during the site preparatory and construction phases of the Project must undergo induction training regarding waste management for the Project site.

Induction training is to cover, as a minimum, an outline of the WMP including:

- legal obligations;
- emergency response procedures on site;
- waste storage locations and separation of waste;
- litter management in transit and on site;
- the implications of poor waste management practices;
- correct use of general purpose spill kit; and

- responsibility and reporting (including identification of personnel responsible for waste management and individual responsibilities).

It is the responsibility of the Contractor or site operative to notify Council and/or the EPA of the appointment of waste removal, transport or disposal contractors.

5.11 Monitoring and Reporting

The following measures will be undertaken to improve construction waste management and to provide more reliable waste generation figures:

1. Compare projected waste quantities with actual waste quantities produced.
2. Conduct waste audits/visual waste audits during construction activities to compare to other projects.
3. Take note of waste generation amounts, waste types and disposal methods.
4. Review past waste disposal receipts.
5. Record this information to track waste avoidance, reuse and recycling performance and to help in waste estimations for future waste management plans.

Records of waste volumes recycled, reused or contractor removed are to be maintained. Dockets and receipts verifying recycling and disposal methods in accordance with the WMP must be kept and presented to Council and/or the EPA as required.

Daily visual inspections of waste storage areas will be undertaken by site personnel and inspection checklists and logs recorded for reporting to the Site Manager on a weekly basis or as required. These inspections will be used to identify and rectify any resource and waste management issues.

Waste audits are to be carried out by the Building Contractor to gauge the effectiveness and efficiency of waste segregation procedures and recycling and reuse initiatives. Where audits show that the above procedures are not carried out effectively, additional staff training will be undertaken and signage re-examined.

5.12 Incident Response

Likely incidents to occur during the construction phase of the Project may involve fuel or chemical spills, seepage or mishandling of hazardous waste, or unlicensed discharge of pollutants to the environment.

All environmental incidents are to be dealt with promptly to minimise potential impacts. An incident register must be maintained on-site at all times and include the contact details of the 24 hour EPA Pollution line.

5.13 Roles and Responsibilities

All personnel have a responsibility for their own environmental performance and compliance with all legislation.

It will be the responsibility of Sydney Zoo and the Building Contractor to implement the WMP, and an employee responsibility to ensure that they comply with the guideline at all times.

Where possible, an Environmental Management Representative (EMR) should be appointed for the Project. Suggested roles and responsibilities are provided in **Table 12**.

Table 12 Building Contractor - Suggested Roles and Responsibilities

Construction Site Manager	<ul style="list-style-type: none">• Ensuring plant and equipment are well maintained.• Ordering only the required amount of materials.• Keeping materials segregated to maximise reuse and recycling.• Ultimately responsible for routinely check waste sorting and storage areas for cleanliness, hygiene, health and safety issues, contaminated waste materials• Responsible for ensuring that all monitoring and audit results are well documented and carried out as specified in the WMP.
Environmental Management Representative (EMR)	<ul style="list-style-type: none">• Approaching and establishing the local commercial reuse of materials where reuse on-site is not practical.• Establishing separate skips and recycling bins for effective waste segregation and recycling purposes.• Ensuring staff and contractors are aware of site requirements.• Provision of training of the requirements of the WMP and specific waste management strategies adopted for the Project.• Contaminated waste management and approval of off-site waste transport, disposal locations and checking licensing requirements.• Approval of off-site waste disposal locations and checking licensing requirements.• Assessment of suspicious and potentially contaminated materials, hazardous materials and liquid wastes.• Monitoring, inspection and reporting requirements.

Daily visual inspections of waste storage areas may be delegated to other on-site staff. All subcontractors will be responsible for ensuring that their work complies with the WMP through the Project induction and contract engagement process.

It is the responsibility of the Building Contractor or site operative to notify the Principal Certifying Authority (Council and/or the EPA) of the appointment of waste removal, transport or disposal contractors.

6 OPERATIONAL WASTE MANAGEMENT PLAN

Ineffective waste management for commercial premises can lead to environmental pollution, offensive odours, litter, attraction of vermin and occupational safety and hygiene problems. Waste outputs from zoos including waste food products, faeces, animal bedding and biological products (e.g. carcasses) also have the potential to transmit disease and pathogens. Waste management is therefore important for zoo biosecurity.

Effective waste management reduces costs through the reuse of resources and minimisation of fees associated with removal, transportation and disposal of waste, and improves environmental outcomes locally, regionally and globally. Effective waste management is achieved through the implementation of a WMP for the operational life of the development.

6.1 Targets for Resource Recovery

The performance of each development contributes to overall NSW State recycling targets, which for the commercial and industrial (C&I) sector, represents 70% of total C&I waste recycled by the year 2021 (see NSW Waste Avoidance and Resource Recovery Strategy 2014-21).

Waste minimisation measures that can be implemented to assist in achieving this resource recovery target are provided in the following sections. Waste audits will determine the actual percentage of wastes that were recycled and disposed of at landfill during operations.

6.2 Waste Streams and Classifications

The operation of the zoo will generate the following broad waste streams:

- general (residual) waste;
- container recycling;
- food organics waste;
- green waste;
- medical/cytotoxic wastes from animal care and on-site veterinary services including animal carcasses, sharps etc;
- animal faeces/manure and liquid sludge wastes;
- animal bedding and waste feed products;
- bulk packaging wastes including polystyrene and cardboard boxes;
- office wastes including clean paper/cardboard and also printer toners, ink cartridges, e-waste;
- bulky waste items such as furniture and damaged display materials;
- wastewater (blackwater) from washdown of animal back of housing and public amenities/toilets at the site; and
- stores, plant and general maintenance wastes.

It is not anticipated that any radioactive waste will be generated as a result of veterinary services undertaken at the zoo.¹ Potential waste types along with their waste classification are provided in **Table 13**. For further information on how to determine a waste's classification, refer to the Waste Classification Guidelines (EPA 2014).

¹ Information based on letter received from the Keith Merchant, Director of Commercial and Clinical Services at the University of Sydney, Veterinary Teaching Hospitals, dated 8th September 2015.

Table 13 Potential Waste Generation with Classifications

Waste Types	NSW Classification	Proposed Reuse / Recycling / Disposal Method
Visitor Areas / Staff Areas		
General (residual) waste	General solid (putrescible) waste	Disposal at landfill
Recyclable beverage containers	General solid (non-putrescible) waste	Recycling at off-site licensed facility
Food waste	General solid (putrescible) waste	Compost on site or off-site recycling and treatment at a suitably licensed facility.
Clean office paper	General solid (non-putrescible) waste	Off-site recycling at a suitably licensed facility
Bulk cardboard	General solid (non-putrescible) waste	Off-site recycling at a suitably licensed facility
Bulk polystyrene	General solid (non-putrescible) waste	Disposal at landfill
E-waste, batteries, printer toners and ink cartridges	Hazardous waste	Off-site recycling
Staff and public amenities (sewage)	Liquid (trade) waste	Off-site disposal at licensed facility or disposal to sewer where arranged with Sydney Water
Animal Housing / Care		
Animal feed (wet waste)	General solid (putrescible) waste	Disposal to landfill
Animal feed (vegetable waste etc)	General solid (putrescible) waste	Compost on site or off-site recycling / treatment at a suitably licensed facility.
Animal feed packaging	General solid (non-putrescible) waste	Disposal at landfill
Animal faeces/manure, animal bedding	General solid (putrescible) waste or Clinical and related waste (where potentially cytotoxic)	Compost on site or off-site recycling / treatment at a suitably licensed facility.
Animal waste sludge (pool areas)	General solid (putrescible) waste	Compost on site or off-site recycling / treatment at a suitably licensed facility.
Animal carcasses	Clinical and related waste (where used for medical research or potentially cytotoxic) or General solid (putrescible) waste	Appropriate handling and processing for medical research and/or off-site treatment/disposal at a suitably licensed facility.
Medical / veterinary wastes (e.g. sharps, cytotoxic waste)	Clinical and related waste	Off-site treatment / disposal at a suitably licensed facility.
Animal housing washdown liquids (sewage / blackwater) including sanitisation chemicals	Liquid (trade) waste	Off-site treatment/disposal at licensed facility or on-site treatment prior to disposal to the sewer where arranged with Sydney Water.
Maintenance		
Light bulbs / fluorescent tubes	Hazardous waste	Off-site recycling
Furniture / bulky items	General solid (non-putrescible) waste	Off-site reuse or disposal to landfill
Spent Smoke Detectors ¹	General solid (non-putrescible) waste or Hazardous waste (commercial varieties)	Disposal at landfill or offsite disposal at licensed facility
Glass (other than containers)	General solid (non-putrescible) waste	Off-site recycling
Cleaning chemicals, solvents, area wash downs, empty oil / paint drums / chemical containers	Hazardous waste if containers used to store Dangerous Goods (Class 1, 3, 4, 5 or 8) and residues not been removed. General solid (non-putrescible) waste if containers cleaned by triple washing or vacuuming	Transport to comply with the transport of Dangerous Goods Code for off-site recycling or disposal at licensed facility. Discharge to sewer subject to Trade Waste Agreement with Sydney Water
Air-conditioning parts, air/water filters	General solid (non-putrescible) waste	Disposal to landfill
Garden organics/green waste (lawn mowing, leaves, branches, cuttings)	General solid (non-putrescible) waste	Compost on site or off-site recycling and treatment at a suitably licensed facility.

Note 1: The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) have special disposal requirements for disposal of more than 10 smoke alarms. Contact ARPANSA for more information. <http://www.arpansa.gov.au>

6.3 Waste Management Overview

The waste and recycling management system for the proposed development has been designed in accordance with Council's DCP 2015 and EPA waste policy requirements.

An overview is provided below:

- Public litter bins for waste and recycling storage placed at strategic locations in public areas including along entry building, car parking areas, public pathways, picnic, play area and kiosk areas, and at the arena;
- Indoor waste and recycling bins for each building at site;
- Indoor food waste receptacles for the café/restaurant and administration building staff kitchen areas;
- Packaging recycling bins for the café/restaurant and entry building / retail buildings;
- A bin holding area of adequate size for all buildings and in back of house areas to store larger bins for transfer to the Service Yard and/or Loading Dock for collection as required;
- Daily cleaning of animal back-of-house areas and daily collection of wastes generated at the zoo prior to zoo public opening hours;
- Separate waste receptacles for storage of medical / clinical and related waste at the Veterinary Centre and animal enclosure back of house areas as required;
- A refrigerated area at the Curatorial Building for storage of clinical waste (animal tissue, animal carcasses) prior to transport as required;
- Suitable transport vehicles (i.e. buggy or other vehicle) for transfer of various waste streams and bin types between the zoo and the Services Yard and/or other waste collection point as appropriate;
- A designated waste bin storage area at the Services Yard for storage of bins including backup bins, with bin cleaning and repair facilities and the following areas:
 - A designated holding area for storage of discarded / damaged bulky items, e-waste and other recyclable items;
 - A designated area for storage and shredding of green waste collected from the site;
 - A designated area for storage of animal manure collected from the site;
 - A designated area for storage of waste cooking oil and lubrication oil; and
- A wastewater collection system will be implemented for capture of hippo pool water.

Sydney Zoo plan to connect to a nearby existing trunk sewer so that wastewater generated on-site as a result of animal back of house enclosure cleaning and public amenities/toilets can be discharge to the sewer under Trade Waste Agreement with Sydney Water.

In addition, Sydney Zoo are investigating the practicality and feasibility of on-site processing of organic wastes generated at the zoo (i.e. food waste, green waste and animal manure) to realise resource recovery and potential energy recovery opportunities.

Refer to **Figure 6 - 9** for site layout plans showing the indicative locations of each of the main waste and recycling storage areas.

Figure 6 Main Waste Storage Area at the Services Yard (and Potential Future Organics Processing Area)



Source: Aspect Studios (L03 Revision A) – Services Yard denoted by yellow dotted outline.

Figure 7 Waste Storage Areas at the Entry Building















Building 1
Entry / Retail

Source: Misho & Associates / Aspect Architects October 2015 - Waste storage areas and transfer routes denoted by yellow outline.

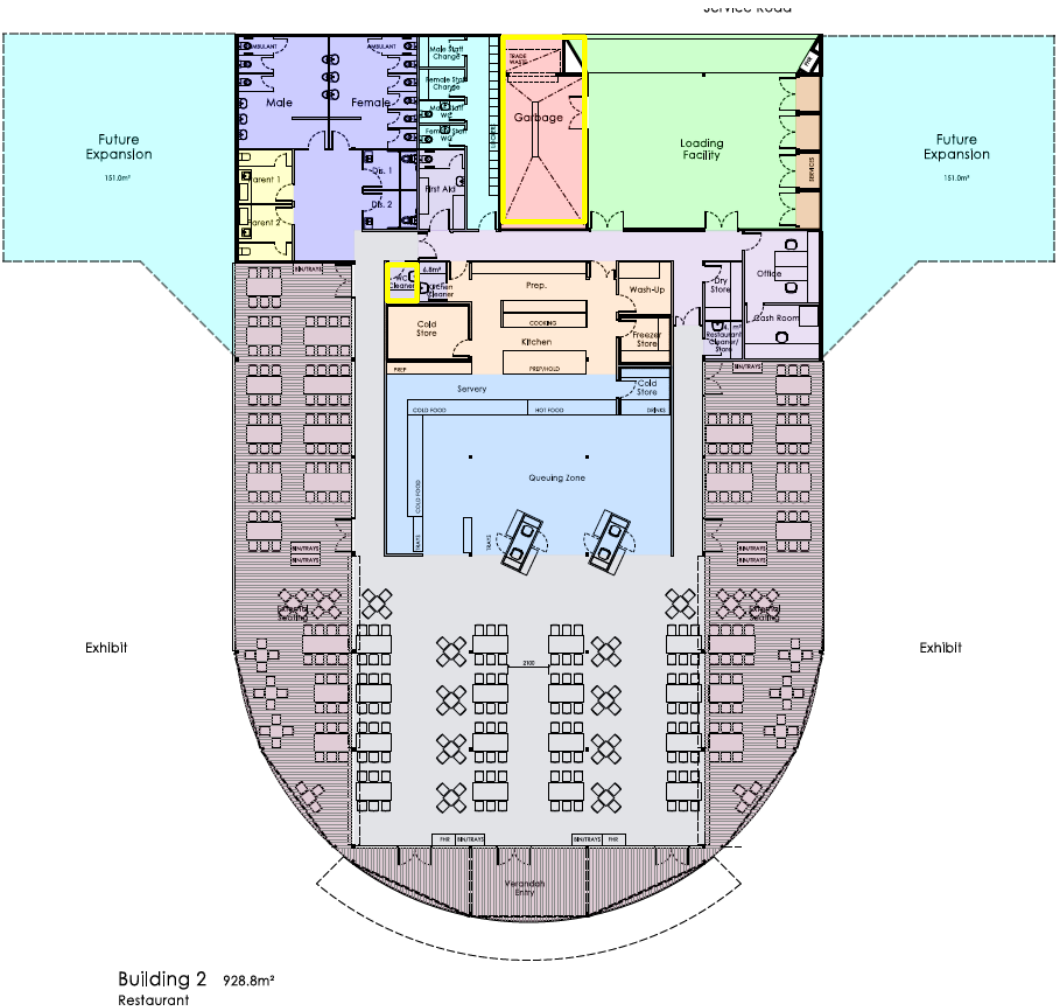
Figure 8 Waste Storage Areas at the Administration / Services Building



Veterinary		Curatorial		Administration	
	Area		Area		Area
	Vet Office 17.0m ²		General Manager 21.2m ²		General Manager 26.6m ²
	Vet Area 170.2m ²		WorkSpace 185.6m ²		Reception 21.5m ²
	First Aid 16.5m ²		Food Prep. 246.4m ²		Meeting Room 39.9m ²
			Wet Areas 69.0m ²		WorkSpace 212.5m ²
					Breakout 79.3m ²

Source: Misho & Associates / Aspect Architects October 2015 - Waste storage areas denoted by yellow outline.

Figure 9 Waste Storage Areas at the Café/Restaurant



Building 2 928.8m²
Restaurant

Source: Misho & Associates / Aspect Architects October 2015 - Waste storage areas denoted by yellow outline.

6.4 Available Industry Waste Generation Rates

6.4.1 General Waste and Recycling for Different Building Types

Waste generation rates have been calculated for the zoo applying waste generation rates provided by EPA data in the Better Practice Guidelines for Waste Management and Recycling in Commercial and Industrial Facilities (2012) document.

Average and maximum waste generation rates published by the EPA have been provided to be indicative of average and peak visitation rates at the zoo and are presented in **Table 14** and **Table 15**. These waste generation rates will be used to calculate anticipated waste amounts for the proposed zoo development.

Table 14 Average Waste Generation Rates

Type of Premises	Related Area of the Zoo	General Waste Generation	Recycling Generation ¹
Offices	Administration / services building	8 L/100m ² /day	6 L/100m ² /day
Variety gift shops	Entry building and gift shop	15 L/100m ² /day	35 L/100m ² /day
Cafes ²	Café / restaurant	215 L/100m ² /day	130 L/100m ² /day
Takeaway	Kiosk and staff lunch area	175 L/100m ² /day	685 L/100m ² /day
Medical and optical	Veterinary centre	35 L/100m ² /day	10 L/100m ² /day
Butcher	Feed preparation areas	185 L/100m ² /day	100 L/100m ² /day
Car parking	Car parking areas	1 L/100m ² /day ³	1 L/100m ² /day ³

Source: EPA's Better Practice Guidelines for Waste Management and Recycling in C&I Facilities (2012)

Notes:

1. Recyclable waste generation includes paper and cardboard waste, as well as mixed recyclables (bottles, cans etc)
2. Waste generation rate distributed between general waste and recycling.

Table 15 Maximum Waste Generation Rates

Type of Premises	Related Area of the Zoo	General Waste Generation	Recycling Generation ¹
Offices	Administration / services building	16 L/100m ² /day	12 L/100m ² /day
Variety gift shops	Entry building and gift shop	22 L/100m ² /day	100 L/100m ² /day
Cafes ²	Café / restaurant	500 L/100m ² /day	220 L/100m ² /day
Takeaway	Kiosk and staff lunch area	175 L/100m ² /day	690 L/100m ² /day
Medical and optical	Veterinary centre	80 L/100m ² /day	17 L/100m ² /day
Butcher	Feed preparation areas	200 L/100m ² /day	145 L/100m ² /day
Car parking	Car parking areas	2 L/100m ² /day ³	2 L/100m ² /day ³

Source: EPA's Better Practice Guidelines for Waste Management and Recycling in C&I Facilities (2012)

Notes:

1. Recyclable waste generation includes paper and cardboard waste, as well as mixed recyclables (bottles, cans etc)
2. Waste generation rate distributed between general waste and recycling.

6.4.2 Animal Manure

Review of publicly available data on cow manure waste generation rates and food consumption as a percentage of animal body weight has been used to estimate amounts of hippo and elephant manure generation.

Table 16 Estimated Manure Waste Generation Rates by Animal Weight

Animal Type	Average Animal Weight (kg)	Amount of food consumed daily as a % of body weight	Estimated Animal Manure Generation (kg/day)
Cow	600 (dairy) ¹	2.5% ¹	36 ¹
Hippo	1,650 ²	1.5% ³	~25
Elephant	4,800 ²	2.5%	~120

Sources:

1. [http://files.harc.edu/Sites/GoldCoastCHPMarketAssessments/Anaerobic Digestion](http://files.harc.edu/Sites/GoldCoastCHPMarketAssessments/Anaerobic%20Digestion)
2. <http://africawildlife.org>
3. Husbandry Guidelines for the Common Hippopotamus, Western Sydney Institute of TAFE, Richmond

6.5 Estimation of Waste Volumes/Tonnages

6.5.1 Waste Generated in Buildings

Using the standard industry waste generation rates outlined in the previous section and the floor areas provided for the development, conservative waste generation volumes and the proposed number of bins for the proposed development have been calculated and are presented in **Table 17** and **18**.

The estimated volumes have been converted into tonnes per day by applying conversion rates taken from Victoria's Ecorecycle Waste Wise Events toolkit for 'garbage' (0.15 tonnes per 1000 L) and 'co-mingled containers' (0.063 tonnes per 1000 L).

Table 17 Estimated Operational Waste Generation Rates (L/day)¹ - Average Visitation Periods

Building	Approximate Area (m ²)	General Waste Generation	Recycling Generation	General Waste Mobile Garbage Bins	Recycling Mobile Garbage Bins
		Average L/day	Average L/day		
Entry Building (incl. gift shop)	920	138	322	1 x 240 L	1 x 660 L
Kiosks (x 2)	68	119	466	2 x 240 L	2 x 240 L
Café / Restaurant	929	1,997	1,208	3 x 660 L	2 x 660 L
Feed Preparation Areas	522	966	522	2 x 660 L	1 x 660 L
Administration Offices	310	25	19	1 x 240 L	1 x 660 L
Administration Lunch Area	70	123	480		
Veterinary Centre	204	71	20	1 x 240 L	1 x 240 L
Car Parking (incl. overflow)	40,324	403	403	See Section 6.5.2	
Estimated Total Volumes		3,439	3,036	5 x 240 L	3 x 240 L
Estimated Total Tonnages		0.52	0.19	5 x 660 L	5 x 660 L

Notes:

1. All waste generation rates are approximate.

Table 18 Estimated Operational Waste Generation Amounts (L/day)¹ – Peak Visitation Periods

Building	Approximate Area (m ²)	General Waste Generation	Recycling Generation	General Waste Mobile Garbage Bins	Recycling Mobile Garbage Bins
		Average L/day	Average L/day		
Entry Building(incl. gift shop)	920	202	1,012	1 x 240 L	2 x 660 L
Kiosks (x 2)	68	119	469	2 x 240 L	2 x 240 L
Café / Restaurant	929	4,645	2,044	8 x 660 L	4 x 660 L
Feed Preparation Areas	522	1,044	757	2 x 660 L	2 x 660 L
Administration Offices	310	50	37	1 x 240 L	1 x 660 L
Administration Lunch Area	70	123	483		
Veterinary Centre	204	163	35	1 x 240 L ²	1 x 240 L
Car Parking (incl. overflow)	40,324	806	806	See Section 6.5.2	
Estimated Total Volumes		6,346	4,837	5 x 240 L	3 x 240 L
Estimated Total Tonnages		0.95	0.30	10 x 660 L	9 x 660 L

Notes:

1. All waste generation rates are approximate.

It is noted that all waste generation rates are approximate only. The estimations provided show that approximately 43% to 47% of typical waste amounts generated within public and staff buildings may be recycled. This excludes separate collection of the food waste stream for further resource recovery opportunities.

Annual waste generation rates have been estimated taking into account fluctuations in peak and off-peak days. Assuming a maximum of 73 peaks day per year primarily during the school holiday periods (with the remaining 292 days assumed to be average or non-peak days), the total estimated annual waste volumes are calculated to be in the range of 1,467 kL per annum for general waste and 1,240 kL per annum for recycling (or 220 tpa and 78 tpa respectively).

It is recommended that scheduled visual waste audits are undertaken approximately one month into the operational phase of the zoo to ensure the number and volume of bins is sufficient for storage of waste amounts generated. Waste audits, including weight-based reporting, should also be undertaken at times during the year which are representative of peak and off-peak visitation rates to quantify actual waste generation rates generated by the development.

The assessment of generated waste volumes will be influenced by Management and employee attitude to recycling and disposal, and the adequacy of signage and education provided for visitors to the zoo.

6.5.2 Public Place Waste and Recycling

Waste and recycling generation rates for public areas at the zoo including the entry building, public pathways, kiosk and picnic areas, the play area, the arena, and the car parking areas, have been estimated using data collated by SLR during previous projects of a similar nature and scaling of waste amounts relative to the size of the study areas being compared and the peak visitation rates likely experienced at each location.

The estimated volumes have been converted into tonnes per day by applying conversion rates taken from Victoria's Ecorecycle Waste Wise Events toolkit for 'garbage' (0.15 tonnes per 1000 L) and 'co-mingled containers' (0.063 tonnes per 1000 L).

Table 19 Estimated Peak Public Place Waste Generation Rates

Public Place	Waste	Recycling
Annual Volume (L/day)	1,744	849
Annual Tonnes (t/day)	0.26	0.05

It is noted that all waste generation rates are approximate only. The estimations provided show that approximately 49% of public place waste amounts may be recycled.

It is recommended that scheduled visual waste audits are undertaken approximately one month into the operational phase of the zoo to ensure the number and volume of bins is sufficient for storage of waste amounts generated. Waste audits, including weight-based reporting, should also be undertaken at times during the year which are representative of peak and off-peak visitation rates to quantify actual waste generation rates generated by the development.

The assessment of generated waste volumes will be influenced by the communication strategies employed by Management at the zoo to promote appropriate source separation of recyclable materials.

6.5.3 Organic Wastes

An estimated maximum of 369 tpa of organic waste has been estimated to be available for on-site or off-site composting based on the following estimated waste generation rates for food waste, animal manure and greenwaste (and assuming no biosecurity risks are identified).

Food Waste

Waste generation rates for the zoo have been estimated applying waste compositional information which shows that food waste typically makes up 28% by weight of the general waste stream at a café² and using a conversion factor of 0.34 tonnes per 1000 L³.

Table 20 Estimated Food Waste Generation Rates – Average and Peak Visitation Periods

Unit	General Waste Generation		Food Waste Generation	
	Average	Maximum	Average	Maximum
Café / Restaurant	0.30	0.70	0.08	0.20
Staff Kitchen Area	0.02	0.02	0.01	0.01
Total Tonnes (t/day)	0.32	0.72	0.09	0.20
Total Volume (L/day)	2,120	4,768	262	589

It is noted that all waste generation rates are approximate only. Any food waste collected separately for recycling / resource recovery will contribute to overall resource recovery performance of the zoo.

Annual food waste generation rates have been estimated taking into account fluctuations in peak and off-peak days. Assuming a maximum of 73 peaks day per year primarily during the school holiday periods (with the remaining 292 days assumed to be average or non-peak days), the total estimated annual food waste volumes are calculated to be in the range of 119 kL per annum (or 41 tpa).

²EPA Industry Fact Sheets 2012

³VIC EPA Sustainable Learning Waste Materials Density Data Sheet

It is recommended that scheduled visual waste audits are undertaken approximately one month into the operational phase of the zoo to ensure the number and volume of bins is sufficient for storage of waste amounts generated. Waste audits, including weight-based reporting, should also be undertaken at times during the year which are representative of peak and off-peak visitation rates to quantify actual waste generation rates generated by the development.

The assessment of generated waste volumes will be influenced by Management and employee attitude to recycling and disposal, and the adequacy of signage and education provided for visitors to the zoo.

Feed Preparation / Post Feeding Waste

The amount of feed waste created from food preparation areas has been estimated.

During food preparation, it is anticipated that all vegetable and biodegradable matter that has not been contaminated will be collected for on-site or off-site composting. Wet waste from the preparation of carnivore diets would require disposal to landfill. Animal feed packaging will also be generated during the food preparation stage. Post feeding of animals, some leftover feed waste would need to be collected for disposal however the majority of this waste may be composted where appropriate.

Table 21 Feed Waste Estimates

Type of Feed Waste	Estimated Feed Waste Generation (kg/day)
Biodegradable / compostable waste	50 – 100
Biodegradable wet waste requiring disposal	20 – 40
Feed waste packaging requiring disposal	10 - 20
Post feeding wastes requiring disposal	<10

Source: Sydney Zoo 2015

It is estimated that a maximum of 36.5 tpa compostable feed waste will be generated by the zoo.

Animal Manure

The animal manure waste generation rates provided in **Table 22** is representative of a large regional zoo, housing a similar number of species and animals as the proposed zoo, and are based on data collated by SLR on previous projects of a similar nature. A bulk density factor of 0.5 t/m³ for manure has been assumed⁴.

Table 22 Estimated Manure Waste Generation Rates for a Large Regional Zoo

Project Reference	Animal Manure Generation (tpa)
Total Annual Animal Manure Generation	276

For the purposes of this report, animal manure generation amounts include animal bedding material such as straw.

Animal manure generation also been estimated for the hippo enclosure and elephant enclosure based on waste generation rates outlined in **Section 6.4.2**.

⁴SLR's desktop study of publicly available information on bulk densities for different animal manures gives an average of 0.5 t/m³.

In addition, it has been estimated that the hippos will release approximately 45 kg of faecal matter into the pool water within their enclosure each day.⁵ Pool water will be treated in a separate system using a series of cascading sediment ponds and faecal sludge collected for composting either on-site or off-site at a suitably licensed facility.

Table 23 Estimated Hippo Manure Waste Generation

Item	Hippo Manure Generation	Elephant Manure Generation
Manure generation (kg/day)	~25	~120
Number of each animal type	6	2
Faecal matter in pool water	~45	N/A
Total Estimated Manure Generation (kg/day)	195	240
Estimated Manure Generation (tpa)	71	88

It is noted that all waste generation rates are approximate only. Additionally, there may be some double counting present in the figures above given the amount of time hippos spend in the water compared to on land.

It is recommended that scheduled visual waste audits are undertaken approximately one month into the operational phase of the zoo to ensure animal manure management and storage is suitable for the amounts generated. Waste audits, including weight-based reporting, should also be undertaken at to quantify actual waste generation rates generated.

Green Waste

For the purposes of this WMP, it has been estimated that green waste (including grass, leaves, tree branches, hedge trimmings etc) collected from around the site will fill a maximum of 2 x 1 m³ skips per week. Grass is likely to make up a large proportion of the green waste stream by weight, while leaves are likely to make up the largest component by volume. Applying a conversion rate of 0.15 t/m³ for 'garden/vegetation' sourced from the EPA Victoria's Waste Wise Events toolkit, it is estimated that approximately 0.3 tonnes per week (or 15.6 tpa) of green waste will be generated by the site.

It is noted that all waste generation rates are approximate only. Green waste collected for shredding and reuse as mulch on the site or recycled via composting will increase the resource recovery performance of the site.

It is recommended that scheduled visual waste audits are undertaken approximately one month into the operational phase of the zoo to ensure the number and volume of bins is sufficient for storage of green waste amounts generated. Waste audits, including weight-based reporting, should also be undertaken during the year to be representative of seasonal variations to quantify actual green waste generation rates generated by the development.

⁵Estimate based on dugong manure waste generation. Hippos typically sit in water during the day, grazing on land at night <http://animals.sandiegozoo.org/animals/hippo>.

6.5.4 Wastewater

Wash down of animal back of housing enclosure areas after removal of animal faeces and disinfection will generate wastewater (also called blackwater). Sydney Zoo plan to connect to an existing trunk sewer line to the west of the site for discharge of this wastewater to the sewer under a Trade Waste Agreement with Sydney Water and estimate that between 5 L to 15 L of wastewater per m² per day will be generated during these activities.

The following table provides estimated daily wastewater generation rates for the zoo based on the above assumptions.

Table 24 Wastewater Generation Rates – Washdown of Animal BOH Enclosures

BOH Enclosures	Area (m²)	Estimated (Low) Wastewater Generation (L/day)	Estimated (High) Wastewater Generation (L/day)
Total	2,096	10,480	31,440

6.5.5 Medical / Clinical and Related Wastes

For the purposes of this WMP, an estimated 0.16 tpa of medical waste is anticipated to be generated by the zoo operations. This waste generation rate has been estimated based on previous projects of a similar nature that have been undertaken by SLR and by comparison to a large regional zoo having a similar number of species and animals as the proposed zoo.

6.6 Waste Avoidance

6.6.1 Guidelines for Retail Packaging

A Purchasing Policy will be implemented for the gift store, kiosks and cafes/restaurants and will include strategies for waste minimisation such as:

- Source materials (i.e. napkins and takeaway containers, cups and utensils) that use recycled content.
- Bulk purchasing or the purchase of items that use minimal packaging.
- Investigation of supply chain options that ship products in reusable packaging and/or return to supplier options for packaging such as polystyrene boxes.
- Avoid use and distribution of plastic bags, particularly light single use plastic bags that are likely to become a source of windblown litter at the site.

6.7 Re-use, Recycling and Disposal

The following measures will be implemented on site:

- food waste that can easily be collected separately from other wastes, such as at the cafe/restaurant in food preparation areas and the employee kitchen and lunch areas, will be recycled;
- used cooking oil will be collected for recycling at the café/restaurant;
- green waste collected from gardens and landscaped areas within the site will be reused where appropriate as mulch for landscaping at the site;
- co-mingled or beverage container recycling will be carried out at the site;
- recycling bins will be co-located with general waste bins as a policy to provide the public and employees with an option for recycling;
- clear signage will be provided for public and employee waste bins to identify the materials that can be deposited in the bins;
- signage and/or bins will be colour-coded using Australian Standard bin colours to identify general landfill waste, co-mingled or beverage container recycling, and paper/cardboard recycling;
- beverage container and paper/cardboard recycling will be provided on-site for employee use (particularly clean office paper and cardboard boxes);
- provision for the collection of batteries and other recyclable resources (such as e-waste, fluorescent tubes, light bulbs, printer toners and ink cartridges) will be provided on site;
- waste oil/lubricating oil will be recovered and recycled wherever possible;
- all garbage will be disposed of via a Council/EPA approved system.

In addition, Sydney Zoo are investigating opportunities for on-site composting of animal manure (where suitable), green waste and food waste generated by the zoo for potential energy recovery and a reduction of the site's carbon footprint. Investigations will be undertaken in consultation with Council and the EPA and include identification of appropriate composting technology, environmental compliance requirements, cost benefit analysis and funding opportunities, as well as identification of potential third party waste streams in the area that could enhance the outputs of the composting process. Refer to **Section 6.10** for further information.

Composting and/or treatment alternatives to on-site composting of organic wastes have been investigated and opportunities have been identified nearby the site (at the UR3R facility).

6.8 Waste Storage and Infrastructure Types

6.8.1 Waste Receptacles

The type of receptacles available for different building types and activity areas around the zoo are outlined below.

Public Place Litter Bins

Public place areas proposed for the zoo include pathways, kiosks, picnic areas, and an arena. Public areas also include entry/exit buildings and car parking areas.

Approximately 1,314 m of public pathway is planned. Review of local government and industry best practice for location of bins suggests that the optimal distance that a bin should be placed from a user is between 30 m and 50 m. Assuming bins are placed at 50 m from each other along the pathway; approximately 26 bin stations would be required for placement at regular intervals around the zoo.

However, bin placement will also need to take into account the design of the zoo and animal enclosures. Where bins cannot be located at 50 m intervals along pathways (due to mesh or elevated pathways) bins should be placed at the entry and exits to these areas. Bins should also be placed at entry and exit points to the zoo, at each picnic area and play area, and adjacent to the kiosk and gift store in visible locations. Bins will also be required at regular intervals at the car parking areas.

Based on a review of the conceptual site plan for the zoo and taking into account the above information, it is recommended that at least 15 bins stations are planned for the public pathway, 3 bin stations for each picnic area, 2 bin stations for the arena, 1 bin station for the play area, 4 bin stations for the entry building and 6 - 8 bin stations for the main car parking area. Indicative locations are identified on the conceptual site plan attached as **Appendix A**.

Bin stations implemented should be flexible to change of needs. Visual assessment of public areas should be undertaken within one month of operations, and at times representative of peak visitation periods, to identify potential "hot spots" for littering and to determine optimal locations for bins.

To encourage customer and employee recycling, general waste and container recycling bins will co-located and positioned in easily accessible areas for effective recycling results in all public place areas.

A number of litter bin options are available including litter bins with and without lids, compacting and solar compacting litter bins.

Bin types used at the site will need to be resilient to Australian weather conditions (i.e. harsh solar conditions, wind and rain) to prevent damage and colour fading over time. It is recommended that bins with lids are utilised to ensure waste materials are suitably contained; being sheltered from the wind and keeping waste out of reach of pests (i.e. birds and vermin) to avoid waste items disposed of in bins becoming a source of windblown litter.

It is further recommended that solar compacting / smart bins are considered to enable real time monitoring of available bin capacity or fullness. Solar compacting bins have a compaction ratio of 1:5 and can therefore significantly increase the waste and recycling storage capacity of public bins by 4 to 5 times at the site. This will reduce the requirement for resources associated with visual monitoring and emptying of bins during the day which will be of particular importance during peak visitation periods⁶. Compaction of waste within the bins operates using solar energy.

⁶Wet 'n' Wild Sydney have implemented approximately 16 solar compacting bins and have since reported an 80% increase in collection efficiency and no overflowing bins in the park, with bins emptied during closed hours only rather than during operational hours as was previously required.

Examples of the different types of litter bins with lids are presented in **Figure 10**.

Figure 10 Public Place Litter Bins



Educational bin wrapping

Smart recycle and general waste bin station



Photo taken at Adelaide University in SA 2015

Example Smart Recycle Litter Bin

Entry Building

The Entry building will use Mobile Garbage Bins (MGBs) for waste and recycling (including packaging recycling) storage. The building has been designed with a designated area (approximately 30 m²) within the retail store room for waste and recycling (including packaging recycling) for waste storage. A roller shutter door access will be provided to this waste storage area to enable MGBs to be rolled out to the waste vehicle collection point.

Café / Restaurant

Waste receptacles are required for food preparation areas and for table cleaning purposes, as well as for use by customers. Waste receptacles included within kitchen and food preparation areas will include clearly labelled general waste bins, recycling bins, food waste bins, separate fish waste bins, as well as grease trap and cooking oil containers. A refrigerated waste room will be provided nearby the loading dock area. Cardboard boxes will be collected separately for recycling, and depending on the amounts generated, balers or compactors may be appropriate to provide further capacity for storage. Clearly labelled general waste and recycling bins will be co-located and provided for customers as appropriate. A total waste storage area of 40.7 m² has been allowed for in the back-of-house area of the café / restaurant.

Figure 11 Cardboard Balers / Compactors



Cardboard Baler



Cardboard Compactor

Administration, Curatorial and Food Preparation Building and Veterinary Buildings

Bins which encourage source separation of recyclables will be utilised within all offices, administration and services buildings for use by employees and contractors/subcontractors visiting the site. Separate collection of clean office paper and cardboard, and printer toner and ink cartridges will also be undertaken in office areas containing printers. Cardboard boxes and other packaging that can be recycled will be stored separately. Balers and/or compactors may be utilised to increase waste storage space where large quantities of these waste streams are generated.

Careful segregation of clinical and all related waste is required to protect personnel from injury and potential infection, and to ensure correct containment of waste in order to comply with the provisions of the POEO Act and associated Waste Regulation. Special medical and clinical waste receptacles will be provided for sharps storage and other clinical waste storage. All clinical and related wastes are to be disposed of in colour coded receptacles, and MGBs and trolleys should be used when transporting wastes to decrease spills, minimise collector contact with waste and to minimise manual handling. MGBs and trolleys must be made of a rigid material, lidded, lockable, leak proof and washable. These receptacles will be supplied by suitably licensed contractors. Refer to the Biosecurity Report for further information. Bins will be stored for emptying at a designated loading area along the western side of the building. A total waste storage area of 35 m² has been allowed for in the administration / services building.

Figure 12 Medical Waste Receptacles



Example Clinical Waste Bin



Example Medical Waste Bin



Example sharps containers

Back-of-house Animal Enclosures

Suitably sized buckets and receptacles will be provided for each separate back-of-house area for the collection of animal waste products on a daily basis (i.e. early morning prior to zoo public opening hours) and as required including manure, feed waste, bedding materials.

6.8.2 Waste Storage Areas

Waste storage areas for each building will be conveniently located for servicing of the zoo and loading areas. At the end of each day, waste and recyclables from each building waste storage area must be transferred to the main waste and recycling storage area at the Services Yard.

Provisions must be made for the separation of recyclables and hazardous materials in each building waste storage area and at the main waste storage area at the Services Yard.

Storage of cardboard and paper must be in a dry, vermin-proof area and must not be stored for more than two weeks in order to prevent infestation by pests.

Storage of medical/clinical wastes must comply with relevant industry and health and safety standards.

Green waste, food organics and animal manure must be stored in appropriate receptacles and in appropriately bunded areas at the Service Yard to ensure these materials do not enter the stormwater drain during rainfall events and do not become a source of nuisance odours for customers or off-site sensitive receptors.

Stockpiles of materials will be managed and designed in accordance with relevant EPA licensing conditions and Environmental Guidelines as appropriate.

6.8.3 Space Requirements

Waste and recycling storage areas must be constructed of an adequate size to accommodate all waste and recycling bins associated with the development.

Doors and/or gates to holding areas and the centralised storage area must be able to be opened from both the inside and outside and wide enough to allow for easy passage of waste and recycling containers.

Sufficient space should be provided for the segregation and storage of varying waste types including provision for the collection of batteries, fluorescent tubes, smoke detectors, e-wastes and other recyclable resources.

Sufficient space must also be provided for reuse items such as crates and pallets for occupational safety purposes.

6.8.4 General Amenity Considerations

The design of waste collection and storage areas has incorporated the following measures to ensure best practice waste management:

- Bin washing facilities connected to appropriate drainage systems (i.e. floors of waste storage areas are bunded, graded and drained, and finished to a smooth even surface).
- Water supply to the area should be provided (hot and cold) to allow for appropriate cleaning.
- Adequate ventilation provided to prevent nuisance odour.
- Robustness of construction of storage areas, ensuring impervious floors, walls and ceilings.

- Areas to be vermin proof with close fitting doors.
- Adequate and suitable lighting.
- Storage areas to be undercover, concealed and secure (lockable).
- Good signage pertaining to waste sorting, reporting and OH&S.

All waste sorting and storage areas are to be kept clean and odour and vermin free. It is the responsibility of the Facility Site Manager and cleaners (see **Section 6.13**) to check each waste sorting and storage areas for cleanliness, hygiene, and health and safety issues.

6.8.5 Construction of Waste Storage Rooms

The design of waste collection and storage areas has incorporated a number of measures to ensure best practice waste management. Waste and recycling storage rooms will be constructed to the following requirements:

- The waste storage rooms will be constructed in accordance with the requirements of the BCA ensuring impervious floors, walls and ceilings.
- The floors of waste rooms and recycling rooms must be constructed of concrete at least 75mm thick or other approved material graded and drained to a Sydney Water Corporation approved drainage fitting located in the rooms.
- The floor must be finished to a smooth even surface coved at the intersection with walls and plinths and provided with a ramp to the doorway where necessary.
- The walls of the waste and recycling rooms must be constructed of approved solid impervious material and shall be cement rendered internally to a smooth even surface coved at all intersections.
- The ceilings of waste and recycling rooms must be finished with a rigid smooth faced non-absorbent material capable of being easily cleaned.
- The waste and recycling rooms must be provided with an adequate supply of hot and cold water mixed through a centralised mixing valve with hose cock which is fitted with an aerator to increase water efficiency.
- A close fitting and self-closing door openable from within the room must be fitted to all waste and recycling rooms.
- Waste rooms and recycling room(s) must be constructed in such a manner as to prevent the entry of vermin.
- Waste and recycling rooms must be located for convenient access by users and must be well ventilated and well lit.
- Smoke detectors will be fitted in accordance with Australian Standards and connected to the fire prevention system of the building.
- Clear and easy to read signs and warning signs must be fixed to the external face of each waste and recycling room where appropriate.
- Compacters and/or other mechanical devices must be childproof where used in the storage of waste.

6.9 Waste Transfer and Servicing

6.9.1 General Waste Transfer Requirements

The site caretaker/cleaners will be responsible for monitoring bin fullness, replacing full bins with empty bins, and transferring full bins between building waste storage rooms to the Services Yard for contractor pickup.

The following waste servicing and access requirements will be implemented:

- Arrangements will be in place so that the waste storage rooms are not accessible to the general public.
- All doors will be openable from both inside and outside the waste storage areas and must be wide enough to allow for the easy passage of waste/recycling containers.
- Step-free access between the waste storage rooms, the Service Yard and the waste collection point will be provided.
- The gradient of the waste storage rooms and any associated access ramps will be sufficiently level so that access for the purpose of emptying containers can occur in accordance with WorkCover NSW Workplace Health and Safety requirements. The EPA's Better Practice Guide (2008) recommends that the bin transfer gradient should not exceed 1:30 for bins of greater than 360L capacity.
- The transfer of waste and waste bins will be undertaken during off-peak visitation periods wherever possible and avoid conflicts with visitors along public pathways.
- Waste from public areas and back-of-house animal enclosures around the zoo will be transferred by buggy or vehicle to the Services Yard.
- Waste will be collected by private waste collection contractor from the Services Yard, and building loading dock areas as appropriate.

6.9.2 Liquid Waste / Wastewater

General requirements for liquid waste and wastewater management are outlined below:

- Liquid, semi-liquids or moist substances will not be placed in waste containers, unless securely wrapped or contained to prevent the substance from leaking.
- Any liquid wastes or dangerous goods wastes generated at the zoo (e.g. due to damage or leakage of containment) should be disposed of by a suitably qualified contractor to an appropriately licensed disposal facility.
- No liquid wastes or wash down waters will be disposed of via the stormwater drainage system.
- Any wastewater storage tanks (including stormwater collection tanks) should be carefully monitored to ensure overflow does not occur.

An existing trunk sewer line is situated along the western part of the proposed site. Sydney Zoo propose to connect to this trunk sewer line for management of wastewater (blackwater) generated on site due to hose down of animal back of house enclosures and use of amenities / toilets by the public. Specific requirements associated with the management of wastewater generated at the zoo are discussed below:

- The physical removal of animal faeces from back of house enclosures will be undertaken prior to disinfecting and wash down of these areas and will occur at the commencement of keepers shifts between 7am and 9am. It is proposed that the blackwater generated by these cleaning activities will be discharged to the sewer in accordance with the relevant Trade Waste Agreement with Sydney Water. Back of house areas will be constructed to ensure no wash down waters enter the stormwater system.

- Public amenities wastewater / sewage will be discharged to the sewer in accordance with the relevant Trade Waste Agreement with Sydney Water. The zoo will open to the public at 9am with peak visitation hours for the zoo, and therefore peak sewer system throughput, will occur during the middle of the day.

Given the timeframes of each activity requiring discharge of wastewater to the sewer system, there will be no overlap between the two demands on the sewer system during the day. Additional information on the existing sewer system has been provided by Sydney Zoo and is summarised below.

The adjacent existing trunk sewer (to the West of the proposed Zoo site) is a DN375 (375mm diameter) and is of varying depth 1.5 m to 7.5 m. The deepest 7.5 m section traverses under the Great Western Highway. The shallowest sections are located to the North of the proposed Sydney Zoo site. It is understood that connection stubs have already been provided at every manhole along this trunk main which Sydney Zoo could connect into.

The sewer was designed with a capacity to cater for an overall equivalent person (EP) of 3,500 from the WSPT Bungarribee Precinct. This EP value was calculated as follows:

- Local Commercial Space = 4.4 ha at 75 EP/ha = 330 EP
- Open Space = 77 ha at 10 EP/ha = 770 EP
- Amphitheatre = 50,000 persons at 0.048 = 2,400 EP

The Zoo is likely to cater for a maximum peak of 8,000 persons. The applicable Sydney Water WSA code dictates that the equivalent EP for this number of persons is $8000 \times 0.05 = 400$ EP (calculated using the nearest category for a zoo being the category described as "General Public Entertainment Facilities"). The Sydney Zoo person calculation of 400 EP falls well within the overall 3,500 EP threshold that has been allowed for the entire WSPT Bungarribee Precinct, and WSPT confirms that existing demand for sewage services across the Bungarribee Precinct is only nominal. As such, no shortfall in terms of cumulative sewage capacity is expected as a result of the Sydney Zoo connection to the existing trunk sewer.

6.9.3 Stormwater Treatment for Car Parking Areas

Car parking areas must drain to a stormwater treatment device capable of removing litter, oil, grease and sediment prior to discharge to the stormwater system. All stormwater treatment devices are required to be regularly maintained and cleaned to ensure these devices remain effective, with all solid and liquid wastes collected from these devices disposed of in accordance with this WMP and the POEO Act.

6.9.4 Spills Management

Fuel for chainsaw and vehicle operation will be stored in aboveground tanks at the Services Yard. Containment measures for spillages should be provided at the Service Yard and also at appropriate locations in close proximity to staff car park areas and dangerous goods stores areas (e.g. a spill kit containing non-combustible absorbent material). Material Safety Data Sheets (MSDS) should also be located nearby spill kit areas for advice on spillage clean up and disposal.

Clean up facilities and spill kits specifically prepared for management of clinical and related wastes (i.e. cytotoxic wastes) will need to be provided in waste storage area dealing with these waste types.

6.9.5 Medical / Clinical and Related Waste

Disposal of wastewater, waste food and biological products including animal faeces and urine presents potential biosecurity risks. Waste products may need to be disinfected or transported off-site by an appropriately licenced contractor prior to disposal.

All animal waste products collected from back-of-house animal enclosures should be assessed for biosecurity risks before disposal or recycling / reuse.

Biosecurity cleaning procedures must be followed for any equipment/personnel that has come in contact with potentially cytotoxic waste. Associated washdown waters must be collected and either treated on-site or transported to an appropriately licenced facility for treatment/disposal.

Careful segregation of clinical and all related waste is required to protect personnel from injury and potential infection, and to ensure correct containment of waste in order to comply with the provisions of the POEO Act and associated Waste Regulation. Waste pharmaceuticals, drugs and medicines and various waste chemicals, and cytotoxic wastes, identified by the EPA in Table 1 of their "Waste Tracking Fact Sheet – waste that must be tracked" must be tracked when transported within NSW or interstate, unless subject to certain exemptions. Non-compliance with this regulation may lead to financial penalty. Refer to the Biosecurity Report for further information.

6.9.6 Contaminated / Hazardous Wastes

- All contaminated and hazardous wastes (i.e. fluorescent tubing, batteries, e-wastes and smoke detectors) should be recycled at an appropriately licensed facility.
- Fluorescent tubes and other light globes can be recycled via prepaid packs suitable for Australia Post to recycling facilities in Australia.
- E-waste (electronic waste such as computers, mobile phones, printer toners and ink cartridges) and batteries contain heavy metal contaminants and should be recycled at an appropriately licensed recycling facility.
- Commercial-use smoke detectors should be returned to the supplier for disposal (it is a condition of the supplier's licence to sell smoke detectors) and not disposed of with general landfill waste as they contain small amounts of radioactive material. Contact the supplier and/or the EPA or ARPANSA for information on how to return used smoke detectors.

6.9.7 Collection Frequency

Collection frequencies will be organised with those private contractors engaged for waste collection and treatment / disposal. It is anticipated that daily collections will be organised for general waste and recycling generated at the site, while clinical waste will be collected as required. Where food waste and animal manure are required to be processed at an off-site facility, daily pickups will be arranged.

6.9.8 Access Requirements for Waste Collection Vehicles

Waste storage areas must allow access by waste collection vehicles to travel in a forward direction at all times while servicing bins with the access driveways to be of sufficient strength to support the collection vehicles in use. It is typically a requirement that access to waste storage areas should be assessed for medium to heavy rigid vehicles (HRV).

Waste collection vehicles vary in size and type according to the waste collection service employed. Access to waste collection areas by collection vehicles may be impeded where inadequate turning circle areas are provided. Access to waste collection areas will therefore be designed in consultation with contracted waste collectors to ensure adequate provisions (such as appropriate turning circles and clearance where in-house collection is required) are in place for collections vehicles to be able to service the development efficiently and effectively, with limited need to reverse.

It is understood that waste collection vehicles will utilise the loop road running around the site with access to the site occurring prior to opening hours each morning. The vehicles will drive past the administration building and enter the Services Yard via a south gate for collection of waste. The vehicles will then exit the Services Yard via a north gate before travelling along the loop road east past the restaurant.

Refer to Appendix C and D of the Better Practice Guidelines (EPA 2012) for more information on collection vehicles, and vehicle access and turning circle requirements.

6.9.9 Waste Collection Contractors

Written evidence of a valid and current contract/s with licensed waste collector/s will be held at the premises. Medical waste or clinical and related wastes (i.e. sharps waste) and animal wastes must only be collected by appropriately licensed and EPA approved waste contractors. Liquid wastes / wastewater must only be collected by licensed waste contractors as approved by Sydney Water and the EPA.

6.10 Potential Options for Organics Waste Processing at the Site

Sydney Zoo are investigating the practicality and feasibility of on-site processing of organic wastes generated at the zoo (i.e. food waste, green waste and animal manure) for increased resource recovery, potential energy recovery and a reduction of the site's carbon footprint. Processing of organic wastes would be undertaken at the Services Yard.

On-site processing of organic wastes will be subject to Sydney Zoo demonstrating compliance with relevant environmental assessment, planning and licensing requirements, giving particular regard to the air quality (odour and bioaerosols), health and safety, land quality and water quality aspects of the proposal. Composting processes will also need to demonstrate compliance with Australian Standard (AS4454) for Composts, soil conditioners and mulches as well as the EPA's Environmental Guidelines for Solid Waste Landfills, Composting and Related Organics Processing Facilities, Use and Disposal of Biosolids Produces, as applicable.

Investigations will be undertaken in consultation with Council and the EPA and include quantification of available organic waste inputs and composition, identification of an appropriate composting technology suited to the feedstock materials, environmental impact and compliance requirements, cost benefit analysis and funding opportunities, and potential identification of potential third party waste streams in the area that could enhance the outputs of the composting process. Community acceptance in the area of the proposal and the marketability of composting or treatment outputs should also be determined.

A range of technologies are available and the most common of these are outlined below. Technologies must be reviewed for suitability of processing the available feedstock and taking the scale operations into account.

Composting technologies for resource recovery:

- Windrow composting;
- Aerated Static Pile (ASP) Composting;
- Mobile Aerated Floor (MAF) Composting;
- In-Vessel Composting (IVC);
- Anaerobic Digestion (AD); and
- Various other composting units (e.g. OSCA, Hungry Pig, HotRot etc).

Energy from Waste (EfW) treatment technologies for resource recovery and energy recovery:

- Anaerobic Digestion; and
- Advanced Thermal Treatment (ATT) - pyrolysis or gasification.

Facilities in NSW proposing to thermally treat waste for the recovery of energy must comply with the EPA's NSW Energy from Waste Policy Statement 2014.

6.11 Communication Strategies and Signage

Waste management initiatives and management measures should be clearly communicated to employees, contractors/subcontractors including cleaners, and the public.

Benefits of providing this communication include:

- improved satisfaction with services;
- increased ability and willingness to participate in reuse and recycling initiatives;
- improved amenity and safety;
- improved knowledge and awareness through standardisation of services;
- increased awareness or achievement of environmental goals and targets;
- increased awareness of biosecurity measures and health and safety requirements;
- reduced contamination of recyclables stream;
- improved segregation of materials for biosecurity / health and safety purposes;
- increased recovery of recyclables and organics (where implemented) material; and
- greater contribution to state-wide targets for waste reduction and resource recovery.

To realise the above benefits, the following communication strategies should be considered:

- Use consistent signage and colour coding throughout the zoo.
- Ensure all staff are trained in correct waste separation and management procedures.
- Provide directional signage to show location of bins and routes to centralised waste storage areas.
- General waste and recycling bins should be co-located at all times.
- General waste and recycling bins, as well clinical and related waste bins should be colour-coded with clear labels identifying the type of waste that may be disposed of in each bin to ensure no cross contamination.
- Employees and contractors/subcontractors should adhere to the WMP for compliance, in consultation with Management.
- Repair signs and labels promptly to avoid breakdown of communications.
- Renew signage on a regular basis to generate fresh messaging for promotion of reuse and recycling initiatives.

The full set of signage can be found on the EPA's website:

- <http://www.epa.nsw.gov.au/wastetools/signs-posters-symbols.htm>
- <http://www.cityofsydney.nsw.gov.au/live/waste-and-recycling/collection-days-and-bins>

6.12 Monitoring and Reporting

Monthly waste tonnage reports should be reported for the site to track resource recovery performance and to demonstrate improvements in waste management and diversion from landfill over time. Monthly reports should include major waste streams including general waste, recycling, food waste, green waste, medical waste, and other recyclables.

Visual assessment of bins / compactors / other waste collection equipment utilised at the zoo prior to collection will be undertaken by Management within the first month of operations to ensure the Waste Management System is sufficient for the needs of the zoo.

It is recommended that compositional audits and/or visual assessments are undertaken on a half-yearly basis to ensure employees and visitors to the zoo are disposing of waste correctly and to track the zoo's environmental performance against recycling/resource recovery targets.

Where audits show that recycling is not carried out effectively, additional employee training should be undertaken by Management, and waste management strategy and signage re-examined.

Records should be kept of all animal carcass disposals and cytotoxic waste movements. Refer to the Biosecurity Report for further information.

6.12.1 Trackable Wastes

Clinical and related wastes will need to be tracked in accordance with EPA requirements, unless subject to certain exemptions.

A consignment authority (CA) is required for waste tracking purposes and subject to approval by the EPA. CA is an approval given by a receiving facility to a consignor (who can be a producer or its agent) to transport a specific type of waste for a period of not more than a year, and must be created before movement of waste can occur. The CA is used to create transport certificates (TCs) for each waste movement and can be created by either the consignor or the receiving facility. A paper printout of the TC must accompany the waste during transit and the relevant parts of the paper TC must be certified as correct by the consignor, transporter and receiving facility.

The EPA has made available an online waste tracking system to help streamline the waste tracking process. Online waste tracking (OWT) enables approved facilities to create CAs online.

A consignor of waste must retain each CA for a period of 4 years in total after the day on which the CA was obtained. A copy of each waste TC must also be retained for a period of 4 years after the day on which a copy of the certificate was given by the consignor to the transporter of the waste. Copies of these documents must be made available for inspection by the EPA on request.

6.13 Roles and Responsibilities

It should be the responsibility of Management to implement the WMP and a responsibility of the employees, cleaners and other contractors/subcontractors to ensure that they comply with the guideline at all times.

Management should routinely check waste sorting and storage areas for cleanliness, hygiene and health and safety issues, and also ensure all monitoring and audit results are well documented and carried out as specified in the WMP.

Where possible, an Environmental Management Representative (EMR) should be appointed for the zoo. An outline of waste management responsibilities are presented in **Table 25**.

Table 25 Waste Management Responsibility Allocation

Responsible Person	General Tasks
Management	<p>Ensure the WMP is implemented throughout the life of the operation.</p> <p>Update the WMP on a regular basis (e.g. annually) to ensure the Plan remains applicable.</p>
EMR / Management	<p>Approaching and establishing the local commercial reuse of materials where reuse on-site is not practical.</p> <p>Approval of off-site waste processing and disposal locations and checking licensing and compliance requirements, particularly for trackable wastes.</p> <p>Undertake liaison and management of contractor collections.</p> <p>Organise internal visual waste audits of bin fullness on a regular basis.</p> <p>Organise an external waste compositional audit within the first year of operation, and then on a regular basis (for example, once every 3 years) to track environmental performance against recycling/resource recovery targets.</p> <p>Manage any complaints and non-compliances reported through waste audits etc.</p> <p>Perform inspections of all waste storage areas and waste management equipment on a regular basis for cleanliness.</p> <p>Organise cleaning and maintenance requirements for waste management equipment as required.</p> <p>Ensure effective signage, communication and education is provided to alert new employees about the provisions of this WMP and waste management equipment use requirements.</p> <p>Monitor and maintain signage to ensure it remains clean, clear and applicable.</p> <p>Ultimately responsible for the management of all waste management equipment, cleaning requirements, waste transfer and collection arrangements.</p>
Caretakers/Cleaners	<p>Monitor bins to ensure no overfilling occurs.</p> <p>Monitor waste management equipment to ensure appropriate use.</p> <p>Ensure waste storage rooms are kept tidy.</p> <p>Transfer bins to waste storage rooms, the Service Yard and contractor collection points as required.</p> <p>Cleaning of all bins and waste storage rooms on a weekly basis or as required.</p>
Service Yard Manager	<p>Management of all wastes stored at the Services Yard – ensuring compliance with licensing conditions, siting and storage requirements and undertaking general housekeeping measures to ensure waste does not become a source of windblown litter or odour.</p>
Employees and Contractors/Subcontractors	<p>Removal of general waste, recyclables, food waste, cardboard waste, bulky waste items, e-waste, hazardous waste and animal manure from activity areas to waste storage rooms on at least a daily basis.</p>
Gardening Contractor	<p>Removal of all garden organics waste generated during gardening maintenance activities and transfer to the Services Yard or reuse on the garden as appropriate.</p>

Indicative Locations for Public Place Bin Stations



Source: Aspect Studios (L03 Revision A) – the location and number of public bin stations (general waste and recycling bins) are indicative only.