

Sustainable Design Report

Sumatran Tiger Exhibit, Taronga Park Zoo

Targona Conservation Society Australia

Prepared for

Taronga Conservation Society Australia

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1. Executive Summary

This report has been prepared to outline the proposed sustainable design initiatives to be incorporated into the Sumatran Tiger Exhibit. This document has been prepared on behalf of Taronga Conservation Society Australia for submission as part of the State Significant Development Approval Application to the NSW Department of Planning & Infrastructure.

Project Details

The project involves the redevelopment of the Taronga Zoo Sumatran Tiger exhibit into a new highly engaging exhibit reminiscent of an Indonesian village and rainforest. The proposed redevelopment includes three new tiger exhibits, Midpoint Building, viewing huts, an interactive Exit Building, Entry Building and back of house staff areas and tiger dens.

Sustainable Design Initiatives and Targets

The sustainable design initiatives developed for this project have considered elements of energy efficiency, waste and water use with an understanding of the proposed operations of the exhibit and visitor behaviour. Passive design and building fabric considerations have been incorporated to control heat gain and maximise occupant comfort within the exhibit.

Other sustainability initiatives proposed include:

- Water efficiency through specification of efficient appliances and fixtures and recycled water use;
- Materials efficiency through recycling and reuse of materials, waste minimisation in construction and recycling in operation;
- Appropriate recycling facilities will be provided to encourage recycling by both staff and visitors;
- Resource efficiency through the use of concrete with minimum 30% Portland Cement reduction and using energy reducing processes for the production of steel mesh for enclosures;
- Use of recycled / certified timber and bamboo products to minimise environmental impacts

2. Introduction

This report has been prepared to define the proposed Sustainable Design initiatives to be incorporated into the design of the Sumatran Tiger exhibit at Taronga Park Zoo. This report has been prepared on behalf of Taronga Conservation Society Australia (TCSA) to accompany a State Significant Development Application (SSDA) to the NSW Department of Planning & Infrastructure.

The project's environmental targets, energy and water efficiency initiatives, materials and construction management have been outlined in this report.

2.1 Project Description

The project involves the renovation of the existing Sumatran Tiger exhibit into a new highly engaging, dramatic and rewarding exhibit for visitors. The exhibit aims to immerse visitors in an emotional journey of the issues surrounding tiger conservation including unsustainable palm oil plantations. It aims to inspire and motivate visitors to act to contribute to and create positive changes for the tiger's future. The exhibit will allow visitors to observe and interact with tigers in a setting reminiscent of the tiger's natural habitat of Sumatra.

Six tigers plus young offspring are expected to be housed at this new exhibit and the renovation of the existing site aims to offer a comfortable and suitable new home for these tigers.

The concept plan for the Sumatran Tiger Adventure includes the following:

- Retention and upgrade of two existing holding areas;
- Three new tiger exhibits;
- Traditional Sumatran village area with village stores and visitor airplane experience in the Entry Building;
- Midpoint building with bus viewing;
- Engaging tiger viewing areas;
- Educational experience in the Exit Building.

2.2 Reference Documents

The following documents have been referenced in preparation of this report:

Details	Author	Revision or Date
A-SD-101 Managers Office - Plan	Lahznimmo	C
A-SD-102 Managers Office - Section		C
A-SD-103 Open Plan office area		C
A-SD-104 Staff Lunchroom		C
A-SD-105 Staff Amenities		C
A-SD-106 Tiger Dens		C
A-SD-107 Tiger Dens – Plan and Section		C
A-SD-108 Tiger Dens – Details		B
A-SD-109 Loading / Keeper Access		B
A-SD-110 Food Preparation		B
A-SD-111 Server / Plant		B
A-SD-200 Mid Point Building – Ground Plan		C
A-SD-200B Mid Point Building – Level 1 Plan		C
A-SD-201 Mid Point Building – Elevations		C

A-SD-202 Mid Point Building – Sections		C
A-SD-203 Mid Point Building – Sections		C
A-SD-210 Arrival Building Plan		A
A-SD-211 Arrival Building Section		A
A-SD-212 Arrival Building Elevation		A
A-SD-220 Exit Building – Supermarket		A
A-SD-221 Exit Building – Elevation		A
A-SD-222 Exit Building – Elevation – East		A
A-SD-223 Exit Building – Elevation - South		A
A-SD-230 Village Shops		A
A-SD-240 Inbound Viewing – Tiger Patrol Camp		A
A-SD-241 Inbound Viewing – Tiger Patrol Camp		A
A-SD-250 Inbound Viewing – Bridge		A
A-SD-1100 Location Plan		B
A-SD-1200 Existing Site Plan		C
A-SD-1400 Proposed Site Plan		D
A-SD-1401 Proposed Roof Plan		C
A-SD-3000 Site Sections		C
Sumatran Tiger Experience Concept Plan Report	Jon Coe Design Pty Ltd	1 May 2014
Landscape Concept Plan	Green and Dale Associates	February 2015
Preliminary Project Design Brief Sumatran Tiger Adventure	Capital Works Infrastructure and Operations Division, Taronga Conservation Society Australia	12 June 2014
Environmentally Sustainable Design Principles	Capital Works Infrastructure and Operations Division, Taronga Conservation Society Australia	-

2.3 Terms of Reference

DGU	-	Double Glazed Unit
SRI	-	Solar Reflectance Index
WC	-	Water Closet

3. Sustainable Design Initiatives

This section outlines the sustainable design initiatives to be incorporated into the design of the Sumatran Tiger exhibit including building fabric design, water efficiency, energy efficiency, materials, waste & recycling and indoor environment quality for occupants.

3.1 Energy Efficiency – Passive

3.1.1 Building Fabric

Glazing

Performance glazing systems are to be incorporated to control solar gain into conditioned and unconditioned spaces. This will provide an efficient building fabric that will improve indoor comfort in unconditioned spaces and reduce reliance on mechanical systems in conditioned areas. High performance glazing including double glazing with performance coatings and performance laminates are to be adopted in the design.

Insulation

Appropriate insulation to all exposed floors, roofs and external walls shall be incorporated to all conditioned spaces to meet Section J Energy Efficiency requirements. The following spaces are to be conditioned:

- Entry Building
- Exit Building
- Back of House Staff areas

The following minimum insulation specifications are to be met:

- Minimum R2.0 insulation to all exposed floors
- Minimum R3.0 insulation to all terracotta roofs
- Minimum R3.0 insulation to all metal deck roofs
- Minimum R2.5 insulation to all external walls

Roof and Wall Colour

Light coloured roofs and walls are to be incorporated where possible to reflect solar radiation and minimise excessive heat gain into buildings in accordance with Taronga ESD principles.

Light coloured insulated metal deck roof panels with Solar Absorptance < 0.475 shall be used for the tiger dens, back of house and Staff Areas, Entry Building, Exit Building and Midpoint Building.

In keeping with the exhibit's Sumatran theme, medium coloured terracotta tile roofs with Solar Absorptance < 0.7 is nominated to the village shops, chicken coop and gateway station. Medium coloured (Solar Absorptance < 0.7) thatch roofing is nominated to the inbound viewing hut.

3.1.2 Shading

Eaves and overhangs are to be incorporated to conditioned and unconditioned spaces to minimise excessive solar gain and improve indoor comfort. Large overhangs to the Exit Building and Midpoint Building where full height glazing is proposed shall provide shading and minimise direct solar gain.

3.1.3 Natural Ventilation

Natural ventilation is to be maximised through high level roof ventilation in staff back of house areas and tiger dens. Stack and cross ventilation in these areas will encourage air flow to improve thermal comfort for both tigers and staff. Above bench ventilation and ventilation louvres are to be provided to the staff office and the keeper lunchroom in addition to the high level ventilation.

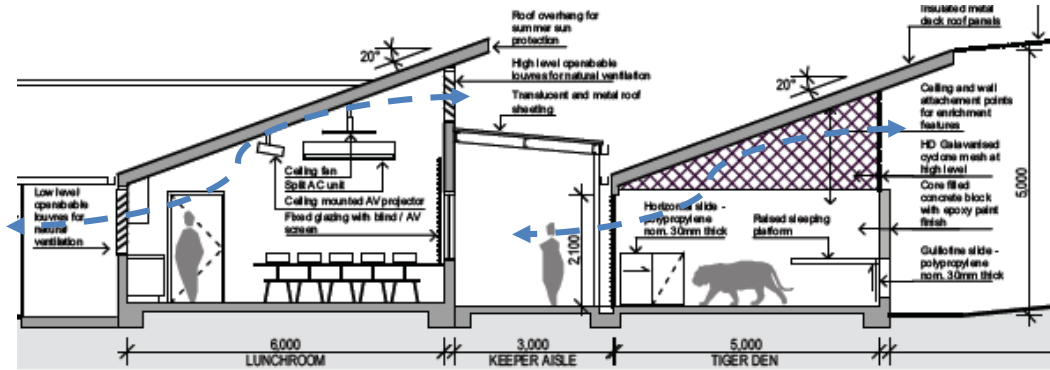


Figure 1: Cross Ventilation in BOH Staff Areas and Tiger Dens

The Midpoint building is naturally ventilated to reflect traditional Sumatran buildings and minimise energy consumption associated with air conditioning and heating. Cyclone mesh promote cross ventilation within the mid-point building. Fans are to be provided to improve comfort in warmer months.

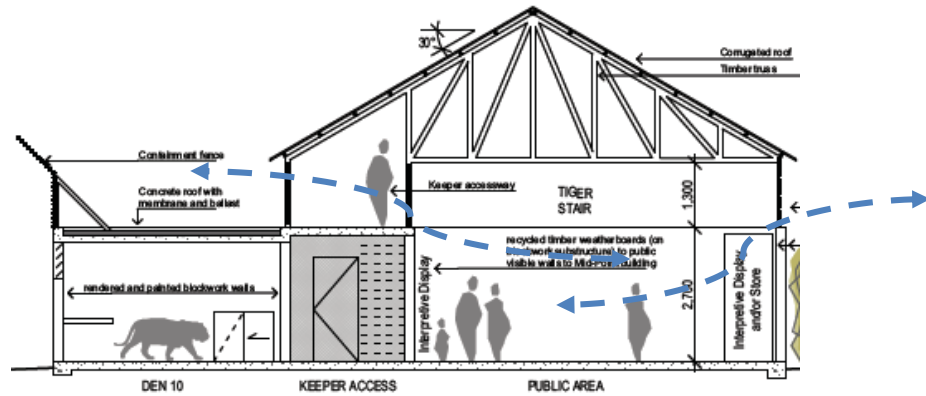


Figure 2: Cross Ventilation to Midpoint Building

All inbound and outbound viewing huts are to be fully naturally ventilated to mirror Sumatran huts.

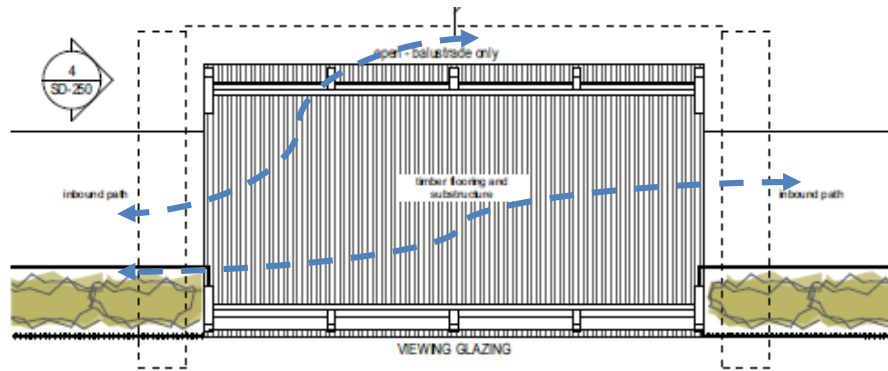


Figure 3: Natural Ventilation to Inbound Viewing Bridge

3.1.4 Skylights

Translucent roof sheeting is to be provided to non-conditioned transient spaces including the keeper access areas to maximise the amount of natural light into internal spaces and reduce the requirement for artificial lighting. Vision glazing to the adjoining staff offices and lunchroom will allow natural daylight to penetrate into these areas.

3.2 Energy Efficiency – Active

3.2.1 Internal Lighting

Internal lighting designs are to meet the following requirements to minimise energy consumption:

- Light fittings specifications are to be limited to efficient fluorescent or LED fixtures
- Daylight sensors are to be installed where appropriate to allow ballasts to dim at the perimeter when natural daylighting is sufficient
- Appropriate switching and controls including occupancy sensors and time clocks to reduce consumption when not in use
- Push button timers limited to two (2) hours to be installed to store rooms to reduce consumption when not in use

The following lighting controls are to be installed:

Location	Lighting Controls
Entry Building	Automatic time switch with manual switch
Exit Building	Automatic time switch with manual switch
Back of house staff areas	Occupancy sensors to entry areas, lunchroom, lockers and bathroom. Manual switch to office areas.
Midpoint Building	Automatic time switch with daylight sensor to allow dimming at perimeter. Manual switch for out of hours functions.
Store areas	Push button timer limited to two (2) hours
Viewing areas	Daylight sensors

3.2.2 External Lighting

External light fittings are to be efficient fluorescent or LED types and to be provided to inbound and outbound paths around the site and landscaping areas. All external lighting is to include photoelectric sensors to detect when external lighting should switch on and off to reduce energy consumption.

3.2.3 HVAC

Air conditioning systems to the Entry and Exit buildings are to be ducted energy efficient systems with controls including time clocks to reduce consumption when areas are not in use. Staff offices and lunchroom are to have split system air conditioning. All air conditioners are to be within one star of the highest available cooling star rating under the Australian Government's Energy Rating System for appliances of similar capacities.

Exhaust fans in the staff bathroom and food preparation area shall be connected to light switches to minimise energy consumption when not in use.

3.2.4 Appliance Selections

All appliances are to be of minimum 4 star rating where possible under the Minimum Energy Performance Standard (MEPS) rating system to reduce energy consumption associated with appliance use. Due to the limited market availability of 4 star rated products, appliances of the highest star rating in the required capacity range shall be specified where 4 star products are not available.

The following appliances are expected to be installed and minimum star ratings are nominated:

Appliance	Location	Size	Minimum star rating required
Refrigerator/freezer	Staff Lunchroom	100-200L	3 star
		200-300L	3.5 star
		300-400L	4 star
		400-500L	4 star
		500-600L	4.5 star
Dishwasher	Animal food prep kitchen & Staff Lunchroom	9 or fewer settings	3.5 star
		10 or more settings	4 star
Television	Staff Lunchroom	Less than 50cm	4 star
		50cm – 70cm	4 star
		70cm – 90cm	4 star
		90cm – 110cm	4 star
		110cm – 130cm	4 star
		130cm - 150cm	4 star
		>150cm	4 star

3.2.5 Domestic Hot Water

A solar hot water system with electric booster is to be incorporated to the development to provide for all domestic hot water requirements. Solar collectors are to be located on the roof of the keeper access areas. This location was selected as shading is limited and the roof is tilted to face north to increase solar exposure.

Minimum R1.0 insulation shall be provided to all external hot water pipework to reduce heat losses and increase energy performance. Solar collector panels are placed close to the point of use in the staff areas, keeper access areas and food preparation areas to minimise the pipework required and reduce losses in transportation of the heated water.

3.2.6 Energy Metering

Energy shall be installed to all major uses to allow for measuring and recording of energy use. No gas connection is proposed to the exhibit. Data shall be collected to set targets and monitor for any leaks or equipment malfunctions. The following energy uses are to be separately metered:

- Main energy meter
- External lighting
- Office/back of house building

3.3 Water Efficiency

3.3.1 Water Fixtures

All water fixtures and fittings to be installed to the project are to be water efficient and meet the following minimum Water Efficiency Labelling Scheme (WELS) targets:

- WCs to be minimum 4 star WELS rated
- Showers to be 3 star WELS rated with flow rate $\leq 9\text{L/s}$
- Kitchen and bathroom taps to be 6 star WELS rated
- Appliances (dishwashers) to be minimum 4 star WELS rated

The above specifications shall reduce the overall potable water consumption within the site in operation.

3.3.2 Non-potable Water Use

Non-potable water will be used for WC flushing, water features and irrigation on the site to minimise potable water consumption. The site will draw this non-potable water from the Taronga Wastewater Treatment and Reuse Plant which is located to the west of the site.

Stormwater is to be collected from around the site via a new stormwater drainage system which is to be linked to the existing stormwater system to feed the Treatment and Reuse Plant.

3.3.3 Water Metering

Water meters are to be installed to each of the major areas to allow for viewing of water use. This will enable any leaks or excessive water consuming equipment to be determined and appropriately dealt with to minimise potable water consumption. The following water uses will be separately metered:

- Non-potable supply
- Potable water supply
- Rainwater supply (if proposed)
- Irrigation
- Bathrooms / office areas

3.3.4 Irrigation

Landscaping to the site has been carefully selected to ensure the environment is appropriate for animal welfare. As the theme of the exhibits are to be reminiscent of Sumatra and rainforest, tropical species of plants will be required to create the atmosphere required and ensure the tigers are provided with a comfortable environment. These plants will require substantial amounts of irrigation, however rainwater is to be used for irrigation to reduce the consumption of potable water.

The swamp forest discovery trail leading to the water edge will require the use of tropical plant species to house water birds and immerse visitors in a wetland setting.

In the village and entry areas it is anticipated that the majority of plant species incorporated are native with low water demands to reduce the amount of irrigation required. A few tropical trees will be showcased to enhance the setting. Irrigation requirements are to be optimised through the use of weather sensing equipment to avoid over watering of plants and where possible the captured rainwater shall be used for any established irrigation lines.

3.4 Materials

3.4.1 Materials Sourcing

An audit of the existing materials on the current Sumatran Tiger Exhibit is to be undertaken by the Head Contractor prior to the purchase of any materials to determine the extent of material reuse, recycled or reconditioned for use within the new exhibit. Possible materials for use on the site such as bricks may be available on site. Existing landscaping materials such as boulders, rocks and trees are to be transplanted from within the development area.

Recycled materials are proposed for the following uses in the new exhibit:

- Timber weatherboard cladding to Entry and Exit Building
- Timber fencing adjacent to Exit Building
- Brickwork walls in village areas

3.4.2 Sustainable Timber/Bamboo

Where timber / bamboo is not available from existing materials on site, the following priority order for sourcing materials is to be followed:

1. Recycled / reclaimed timber and bamboo
2. Forest Stewardship Council (FSC) Certified new timber
3. Programme for the Endorsement of Forest Certification (PEFC) certified (Australian Forestry Standard) timber

Timber is proposed to the following locations:

- Shutters and soffit to village shops
- Sleeping platforms for tigers
- Timber flooring to Midpoint Building
- Soffit to Entry Building
- Chicken roost
- Exit Building garage flooring
- Cladding to gate to dens
- Flooring, substructure and balustrade to inbound viewing bridge

Bamboo is proposed to the following locations:

- Ceiling and screens to outbound viewing huts

Minimum 50% by cost of all timber items are to be recycled/reclaimed or certified. The use of reclaimed and certified timber / bamboo shall ensure the project is encouraging environmentally appropriate forest management, supporting communities and have minimal impact on the environment and wildlife.

Any timber that is required solely for the purpose of ensuring the Sumatran Tigers are provided with an environment similar to their natural habitat that is not FSC or PEFC certified is permitted for use.

3.4.3 Recycled Content for Concrete

Concrete used for buildings and pathways are to have a reduction in Portland cement of at least 30% across all different concrete mix designs. At least 25% of fine aggregates shall be manufactured sands and mixes shall contain at least 50% captured or reclaimed water.

The Portland cement reduction shall be calculated compared to a reference case representing the amount of Portland cement that would have been used in the project if no supplementary cementitious materials were used. The following Portland cement content shall be used to establish the reference case:

Concrete Strength grade (MPa following AS1379)	Portland cement content to be used in establishing reference case (kg Portland cement/m ³ concrete)
20	280
25	310
32	360
40	440
50	550
65	550
80	610
100	660

Captured or Reclaimed Water

Captured or reclaimed water is defined as rainwater captured on either the concrete supplier's manufacturing site, or another site, or recycled/recovered from a previous use such as blackwater or greywater from any locations.

Alternative Coarse and Fine Aggregate

Acceptable types of alternative coarse and fine aggregate are listed in Cement Concrete and Aggregate Australia publications Use of Recycled Aggregates in Construction and Guide to the Specification and Use of Manufactured Sand in Concrete.

Portland cement contributes the largest portion of embodied energy and greenhouse gases in concrete, therefore a reduction in Portland cement results in a substantial energy and greenhouse gas savings.

3.4.4 Responsible Sourcing of Steel

All structural steel to the exhibit shall be sourced from a responsible steel maker. Structural steel is expected to be used to back of house areas, the mid-point building and mesh enclosure pylons.

For a steel manufacturer or steel maker to be considered a responsible source of steel, both the following initiatives must be met:

- The steel making facilities where the steel for the project is being sourced have a currently valid ISO14001 Environmental Management System (EMS) in place; and
- The steel maker supplying the steel is a member of the World Steel Association's (WSA) Climate Action Program (CAP).

A steel pole and mesh enclosure is to be installed to the exhibits to allow visitors to observe the tigers in their natural habitat whilst providing adequate protection. Approximately 1600m² of exhibit area is to be enclosed by this steel mesh. Due to security requirements and sourcing constraints, only the following initiative shall be met for the stainless steel mesh:

- The steel making facilities where the steel for the project is being sourced have a currently valid ISO14001 Environmental Management System (EMS) in place.

3.4.5 PVC

The use of PVC products is to be minimised where possible for the following common uses of PVC:

- Pipes, conduit and associated fittings;
- Wire and cable insulation;
- Vinyl flooring and resilient wall coverings

Where the use of PVC cannot be avoided, PVC products that meet the Best Practice Guidelines for PVC in the built environment shall be sourced where possible. No minimum target for the amount of best practice PVC has been set. To be compliant to the Best Practice Guidelines, any of the following pathways must be demonstrated:

- ISO 14001 certified EMS that includes the requirements of the Best Practice Guidelines;
- Independently audited manufacture's declaration of compliance to the Best Practice Guidelines; or
- Product third party certification of compliance to the guidelines.

3.5 Indoor Environment

3.5.1 Low VOC paints, adhesives and sealants

Paints including tints for internal walls shall have <1 g/L Volatile Organic Compounds (VOCs) to reduce any impacts on the animals and occupants.

Water based adhesives, paints and treatments are to be used where possible. Other paint products used on the project are to have a low VOC content as per the published Green Building Council of Australia (GBCA) Maximum TVOC Content Limits for Paints, Varnishes and Protective Coatings.

3.5.2 Composite Wood Products

A minimum of 90% of new engineered wood products used in workstations, tables, storage and joinery is to be specified with low formaldehyde content to reduce the extent of emissions in the exhibit and to occupants.

Formaldehyde is known to cause issues such as watery eyes, skin irritations, nausea, coughing and allergic reactions when levels reach 0.1 ppm parts of air. Control of this is especially important to ensure visitors and staff do not experience the effects of formaldehyde.

3.5.3 Insulation

All thermal insulation products to be installed for services, wall and flooring constructions are to have zero Ozone Depleting Potential (ODP) in both manufacture and composition to reduce the potential for ozone depletion.

3.6 Waste & Recycling

3.6.1 Recycling of Materials

A comprehensive survey of the existing site is to be conducted prior to construction to identify existing materials for reuse or recycling. Possible recycled materials include bricks and timber from existing structures. Refer to Section 3.4.1.

Materials and facilities from the demolition process of the existing exhibit will be reclaimed where possible and reused in and around the zoo.

3.6.2 Construction Materials Recycling

The project has set a target to divert a minimum 90% of demolition and construction waste from landfill. A project specific Waste Management Plan (WMP) is to be developed and implemented by the contractor to manage all waste streams expected to be generated on site.

Soil or contaminated materials such as asbestos are to be excluded from the 90% recycling / re-use rate.

3.6.3 Recycling Facilities

Appropriate waste recycling and disposal facilities are to be provided to indoor and outdoor areas. Recycling and general waste bins are to be provided in all buildings and every 20 meters along outdoor paths. Recycling facilities are to include paper, organic and comingled waste recycling. Signage describing instructions for use is to be displayed adjacent to each recycling point.

The expected waste volumes to be produced in operation have been estimated as follows:

Space Type	Measure	Waste & Recycling Volumes	General waste per day	Recycling per day
Offices	49.8 m ²	10L / 100m ² / day – General Waste 10L / 100m ² / day – Recyclables	4.98 L/day	4.98 L/day
Public areas	350 visitors per hour	1L/ visitor / day – General Waste 1L/ visitor / day – Recyclables	2,100 L/day	2,100 L/day

The visitor demand level is expected to be around 350 visitors per hour, therefore the provision of appropriately sized recycling and general waste points shall be provided to cater for this high level of traffic. Three (3) recycle stations are to be incorporated into the exhibit, with 1x co-mingled recycling bin and 1x general waste bin provided at each station.