1. ASSET DESCRIPTION

On this tab details about the asset's location, functions, and a listing of the system components that work together to enable the asset to operate are entered.

Asset name:	Food and garden organics facility (FOGO)
Description:	In-tunnel composting facility with a 70,000 tpa capacity
Location:	Recycling Road, Hume, ACT
Primary function:	Composting facility

Example component names

Component #	Component name	Design life
1	permanent mechanical systems, stationary equipment, tanks and building elements	20
2	replaceable mechanical equipment and critical components	10
3	mobile plant and equipment	7

2. CLIMATE PROJECTION DATA

Cli-1 Level 2: a number of readily available climate change projections are identified and adopted for the asset region over the forecast useful life of the asset

On this tab climate and climate change projection data, based on the reporting of reputable scientific and research organisations, is provided to assist with the risk assessment.

The Intergovernmental Panel on Climate Change (IPCC) has developed four scenarios for global climate projections that relate to how the world may respond to the challenge of a changing climate, the need to continue to produce and use energy and resources, and the global greenhouse gas emissions that may occur. These scenarios incorporate diverging tendencies based on alternative economic, globalisation and environmental pathways. These have been modified through subsequent reports and renamed as Representative Concentration Pathways (RCPs) in the IPCC's Fifth Assessment Report.
The Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Bureau of Meteorology (BoM) released the Climate Change in Australia Technical Report in 2015, which links strongly to findings of the latest IPCC Fifth Assessment Report, and updates the projections previously outlined in the 2007 Technical Report. The 2015 Technical Report uses over 40 global climate models to produce climate change projections as they relate to IPCC RCP scenarios. These RCPs include:
> RCP2.6 requiring very strong emission reductions from a peak at around 2020 to reach a CO2 concentration at about 420 parts per million (ppm) by 2100
> RCP4.5 with slower emission reductions that stabilise the CO2 concentration at about 540 ppm by 2100
> RCP6.0 with some mitigation strategies and technologies, reaching 660 ppm by 2100 and total radiative forcing stabilising shortly after 2100
> RCP8.5 which assumes little curbing of emissions and increases leading to a CO2 concentration of about 940 ppm by 2100
Below, climate projection data has been provided for two scenarios including a mid term and a long term projection, under the moderate emissions scenario (RCP4.5) for 2050 and extreme emissions scenario (RCP 8.5) for 2090 as recommended under AS5334 The time periods represent scenarios that are 30 and 70 years from now, and so can have relevance to the various components compirsing the infrastructure asset, depending on their design life. The main reason for adopting the 2090 projection is to provide some perspective on the more extreme climate changes that may arise in coming decades (noting that the projections for these time extents may indeed arise much earlier or later than indicated, if at all; such is the uncertainty associated with the climate modelling and international responses to climate change) and whether these would eventuate into posing risks to the infrastructure. Projections for 2050 and 2090 are also more robust as these variables are reported for the Murray Basin Cluster by CSIRO which provides greater specificity.

A summary of current climate conditions and CSIRO's projected climate changes for various scenarios is tabulated below.

VARIABLE	BASELINE DATA		CLIMATE CHANGE PROJECTIONS			
			Absolute change	ie 20.9°C (20.7 to 21.3)	ie 21.8°C (21.3 to 22.3)	1,2
Mean maximum daily temperature (°C) - Summer (DJF)	27.3	1986 to 2005	Absolute change	+1.1 (0.6 to 1.5) ie 28.4°C (27.9 to 28.8)	+1.9 (1.4 to 2.6) ie 29.2°C (28.7 to 29.9)	1,2
				ie 7.7°C (7.5 to 8)	ie 8.4°C (8 to 8.7)	1,2
	18/1/1998	Discrete event	Absolute change	ie 41.3°C (40.6 to 41.8)	ie 42.4°C (41.3 to 43.4)	3
	24869	Discrete event	n/a			n/a
Lowest temperature for baseline 1986-2005 (°C)	-8.5 9/8/1994	Discrete event	Absolute change	+0.5 (0.4 to 1.1) ie -8°C (-8.1 to -7.4)	+1.3 (1 to 1.7) ie -7.2°C (-7.5 to -6.8)	3
Precipitation						
				ie 610.6 mm (548.9 to 647.6)	ie 593.9 mm (529.2 to 666)	1,2
				ie 170.3 mm (150.4 to 193.9)	ie 171.5 mm (130.2 to 198.7)	1,2
				ie 166.2 mm (149.7 to 190.8)	ie 166.6 mm (136.2 to 186.9)	1,2
				ie 126.1 mm (100.6 to 142.6)	ie 120.7 mm (101.9 to 152.4)	1,2
				ie 136.5 mm (119.3 to 153.8)	ie 138.2 mm (120.7 to 156.1)	1,2
Highest daily rainfall event for baseline 1986-2005	126 15/3/1989	Discrete event	Percentage change	+6.4% (-3.6 to 14.4) ie 134.1 mm (121.5 to 144.1)	+6.1% (-7.4 to 15.8) ie 133.7 mm (116.7 to 145.9)	3
	15/3/1989	Discrete event	n/a			n/a
Hail	2.5 hail-producing thunderstorms/ year	1990-2007		6 hail-producing thunderstorms / ye		6
				ie 7% to 8.4% increase in lightning frequency	ie 18.5% to 22.2% increase in lightning frequency	
Evapotranspiration (%)	n/a	n/a	Percentage change	+3.1% (1.9 to 5.1)	+5.5% (3 to 8.5)	1,2
		1986-2005	Percentage change	ie 124 km/h (124 to 124)	ie 124 km/h (124 to 124)	5
				ie 8.4 km/h (8.1 to 8.6)	ie 8.4 km/h (8.2 to 8.6)	1,2
				ie 17.6 km/h (17.2 to 18.1)	ie 17.7 km/h (17.3 to 18.1)	1,2
				ie 72.6 % (71.6 to 73.5)	ie 72.3 % (71.2 to 73.7)	1,2
				ie 46.3 % (45.7 to 46.9)	ie 46.1 % (45.4 to 47)	1,2
				ie 17.4 MJ/(m*m) (17.2 to 17.6)	ie 17.5 MJ/(m*m) (17.2 to 17.8)	1,2

*Baseline data uses a 20-year average (1986-2005) to align with the baseline used by CSIRO projection models to predict the future climate. In reality the 2020 climate may have already experienced the influence of increased emissions, therefore additional climate data is used to consider the whole picture such as "Highest temperature on record to date"

1. CSIRO BOM 2015, Climate Change in Australia Projections Cluster Report - Murray Basin, Appendix Table 1
2. CSIRO BOM 2015, Climate Change in Australia Summary Data Explorer, Murray Basin Cluster Projections
3. CSIRO BOM 2015, Climate Change in Australia Extremes Data Explorer, Murray Basin Cluster Projections
4. CSIRO BOM 2015, Climate Change in Australia Projections Cluster Report - Murray Basin, Appendix Table 2, Projections and baseline for Canberra
5. CSIRO BOM 2015, Climate Change in Australia Projections Cluster Report - Murray Basin, Figure 4.5.2
6. State of NSW and Department of Environment, Climate Change and Water 2010, Impacts of Climate Change on Natural Hazards Profile, Riverina Murray Region
7. IPCC, 2013: Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA

Although the climate projections included above represent the presently accepted forefront of climate change science, there is still a high level of uncertainty that exists in regard to the climate changes that may actually eventuate. This uncertainty becomes more pronounced as the timescale of the projection is extended. Several areas of uncertainty exist which influence the accuracy of climate change projections, including:
> Scenario uncertainty, due to the uncertain future emissions and concentrations of greenhouse gases and aerosols, resulting from uncertainties regarding the current and future activities of humans;
> Response uncertainty, resulting from limitations in our understanding of the climate system and its representation in climate models;
> Natural variability uncertainty, stemming from unperturbed variability in the climate system;
> Uncertainties regarding the assignment of probability distributions to regional climate change projections; and
> Uncertainties associated with projecting climate change at small spatial scales, particularly for coastal and mountainous areas.
Accordingly, a key principle toward adapting to a future with an uncertain climate may be to adopt 'adaptive management', *i.e.* implementing incremental changes and adaptation measures based on climate and scientific monitoring and prescribed responses. Some adaptation options for infrastructure that may be deemed appropriate in response to the most extreme climate projections may require large-scale engineering or other works, the need (or otherwise) for which will depend on the extent of climate change that actually transpires over time, as opposed to the conditions that were modelled. More guidance on risk management approaches is provided on Tab 3.

Source:
AS 5334-2013

TABLE B1 RISK CRITERIA—EXAMPLE OF QUALITATIVE MEASURES OF CONSEQUENCES

Consequence descriptor	Adaptive capacity (see Note 1)	Infrastructure, service	Social/cultural	Governance	Financial (see Note 2)	Environmental (see Note 3)	Economy (see Note 4)
Insignificant	No change to the adaptive capacity	No infrastructure damage, little change to service	No adverse human health effects	No changes to management required	Little financial loss or increase in operating expenses	No adverse effects on natural environment	No effects on the broader economy
Minor	Minor decrease to the adaptive capacity of the asset. Capacity easily restored	Localized infrastructure service disruption No permanent damage. Some minor restoration work required Early renewal of infrastructure by 10–20% Need for new/modified ancillary equipment	Short-term disruption to employees, customers or neighbours Slight adverse human health effects or general amenity issues	General concern raised by regulators requiring response action	Additional operational costs Financial loss small, <10%	Minimal effects on the natural environment	Minor effect on the broader economy due to disruption of service provided by the asset
Moderate	Some change in adaptive capacity. Renewal or repair may need new design to improve adaptive capacity	Limited infrastructure damage and loss of service Damage recoverable by maintenance and minor repair Early renewal of infrastructure by 20–50%	Frequent disruptions to employees, customers or neighbours. Adverse human health effects	Investigation by regulators Changes to management actions required	Moderate financial loss 10–50%	Some damage to the environment, including local ecosystems. Some remedial action may be required	High impact on the local economy, with some effect on the wider economy
Major	Major loss in adaptive capacity. Renewal or repair would need new design to improve adaptive capacity	Extensive infrastructure damage requiring major repair Major loss of infrastructure service Early renewal of infrastructure by 50–90%	Permanent physical injuries and fatalities may occur Severe disruptions to employees, customers or neighbours	Notices issued by regulators for corrective actions Changes required in management. Senior management responsibility questionable	Major financial loss 50–90%	Significant effect on the environment and local ecosystems. Remedial action likely to be required	Serious effect on the local economy spreading to the wider economy
Catastrophic	Capacity destroyed, redesign required when repairing or renewing asset	Significant permanent damage and/or complete loss of the infrastructure and the infrastructure service Loss of infrastructure support and translocation of service to other sites Early renewal of infrastructure by >90%	Severe adverse human health effects, leading to multiple events of total disability or fatalities Total disruptions to employees, customers or neighbours Emergency response at a major level	Major policy shifts Change to legislative requirements Full change of management control	Extreme financial loss >90%	Very significant loss to the environment. May include localized loss of species, habitats or ecosystems Extensive remedial action essential to prevent further degradation. Restoration likely to be required	Major effect on the local, regional and state economies

NOTES:
1 Adaptive capacity relates to the ability of the infrastructure element and/or organization to adapt/change/cope with change in the climate change variable.
2 Financial loss will be relative to the infrastructure element being considered (i.e. a single building, coastal town, rail system). Dollar values need to include replacement cost for the infrastructure item and financial loss/costs relating to the loss of the service provided by the infrastructure item.
3 While the term ‘environment’ can include both man-made and natural systems, in this Standard ‘environment’ is limited to the natural environment outside the asset being considered.
4 Economy refers to the local economy (e.g. town or region), the state economy, or the economy of Australia as a whole. Significance of this measure will depend on the asset being considered.

TABLE C1 QUALITATIVE MEASURES OF LIKELIHOOD			
Rating	**Descriptor**	**Recurrent or event risks**	**Long term risks**
Almost certain	Could occur several times per year	Has happened several times in the past year and in each of the previous 5 years or Could occur several times per year	Has a greater than 90% chance of occurring in the identified time period if the risk is not mitigated
Likely	May arise about once per year	Has happened at least once in the past year and in each of the previous 5 years or May arise about once per year	Has a 60–90% chance of occurring in the identified time period if the risk is not mitigated
Possible	Maybe a couple of times in a generation	Has happened during the past 5 years but not in every year or May arise once in 25 years	Has a 40–60% chance of occurring in the identified time period if the risk is not mitigated
Unlikely	Maybe once in a generation	May have occurred once in the last 5 years or May arise once in 25 to 50 years	Has a 10–30% chance of occurring in the future if the risk is not mitigated
Rare	Maybe once in a lifetime	Has not occurred in the past 5 years or Unlikely during the next 50 years	May occur in exceptional circumstances, i.e. less than 10% chance of occurring in the identified time period if the risk is not mitigated

RISK MATRIX EVALUATION TABLE						
Risk Ratings: E - Extreme, H - High, M - Moderate, L - Low		**CONSEQUENCE**				
		INSIGNIFICANT	**MINOR**	**MODERATE**	**MAJOR**	**CATASTROPHIC**
LIKELIHOOD	**ALMOST CERTAIN**	L	M	H	E	E
	LIKELY	L	M	M	H	E
	POSSIBLE	L	L	M	H	E
	UNLIKELY	L	L	M	M	H
	RARE	L	L	L	M	M

LEGEND:
E = Extreme risk, requiring immediate action.
H = High risk issue requiring detailed research and planning at senior management level.
M = Moderate risk issue requiring change to design standards and maintenance of assets.
L = Low risk issue requiring action through routine maintenance of assets.

DESCRIPTION OF IMPACTS AND CONTROLS									RISK ASSESSMENT									ADAPTATION RESPONSES	RESIDUAL RISK		
EXPOSURE AND VULNERABILITY			COMPONENTS POTENTIALLY IMPACTED					PLANNED CONTROLS	RATING FOR BASELINE CONDITIONS			RATING FOR 2030 RCP 8.5 PROJECTION			RATING FOR 2050 RCP 8.5 PROJECTION			MANAGEMENT OPTIONS	RESIDUAL RISK RATING POST ADAPTATION		
Risk ID:	*Climate variable*	*Description of impact*	*permanent mechanical systems, stationary equipment, tanks and*	*replaceable mechanical equipment and critical components*	*mobile plant and equipment*	*Construction*	*Operations*	*Description of controls either planned within current design or assumed to be planned for future packages of work*	*Likelihood*	*Consequence*	*Risk*	*Likelihood*	*Consequence*	*Risk*	*Likelihood*	*Consequence*	*Risk*	*Adaptation Details*	*Likelihood*	*Consequence*	*Risk*
001	Drought	Drought affects near surface ground movement, potentially causing differential settlement and expansion/contraction of soils, resulting in movement of infrastructure.	x					Geotechnical investigation inform site design (foundations, concrete slab)	Rare	Insignificant	L	Rare	Insignificant	L	Unlikely	Insignificant	L	Conduct localised repairs (general maintenance) where required.	Rare	Minor	L
002	Extreme heat	Extreme heat affects materials causing cracking and damage, resulting in reduced reliability and design life.	x				x	Concrete is inherently resilient to this risk. Expected thermal movement is a parameter used in design and materials selection.	Unlikely	Minor	M	Unlikely	Minor	M	Unlikely	Minor	M	No further adaptation measures identified.	Unlikely	Minor	M
003	Extreme heat	Increasing greenhouse gases (e.g. CO2) leads to increased rate of concrete carbonation, reducing service life of concrete elements through corrosion of reinforcement.	x					No planned controls identified at this stage.	Rare	Insignificant	L	Rare	Insignificant	L	Rare	Insignificant	L	Monitoring of concrete condition. Consider surface treatment.	Rare	Insignificant	L
004	Extreme heat	Extreme heat impacts on mobile plant equipment			x			Select mobile equipment that considers expected temperature ranges in their operations	Rare	Minor	L	Rare	Minor	L	Rare	Minor	L	No further adaptation measures required.	Rare	Minor	L
005	Extreme heat	Extreme heat impacts on permanent equipment	x	x			x	Select permanent equipment that considers expected temperature ranges in their operations or where possible consider HAVAC Systems.	Rare	Minor	L	Rare	Minor	L	Rare	Minor	L	No further adaptation measures required.	Rare	Minor	L
006	Extreme heat	Extreme heat effects concrete temperature management for early age crack risk and for concrete curing resulting in reduced reliability and design life of concrete foundations.				x		Planned controls documented in design and construction specifications, and include the thermal control plan and the concrete specification. Plan for concrete pours to occur during cooler/ finer weather conditions	Unlikely	Minor	M	*Risk only applicable to the construction phase*						n/a			
007	Extreme heat	Increase in extreme heat days resulting in 'stop work' days, and greater delays to the construction program than accounted for.				x		Additional buffer in program to account for increase in extreme weather days (i.e. 5 days per year).	Possible	Minor	M	*Risk only applicable to the construction phase*						n/a			
008	Extreme heat	Increase in extreme heat days resulting in 'stop work' days during operations					x	WHS management procedures for extreme heat days are covered in the facilities operational plans.	Possible	Minor	M	Possible	Minor	M	Possible	Minor	M	Regularly update WHS management plan and procedures to adjust to conditions. Considerations of occasional operational work at night to avoid heat during day time.	Possible	Insignificant	L
009	Extreme rainfall	Extreme rainfall leading to flooding of the site and facilities leading to impact on open processing of food and organic waste and contamination of flood water leaving the site (water quality compliance issues)					x	Stormwater tanks will be sized for complete capture of rainfall on site. Flood modelling shows the area is safe for general use. Drainage would be directed to be kept on site.	Rare	Moderate	M	Rare	Moderate	M	Rare	Moderate	M	Consider additional protection structures during detailed design.	Rare	Minor	L
010	Extreme rainfall	Extreme rainfall leading to flooding of the site and facilities leading to damage of facility components	x	x	x			Stormwater tanks will be sized for complete capture of rainfall on site. Flood modelling shows the area is safe for general use.	Rare	Minor	L	Rare	Minor	L	Rare	Minor	L	No further adaptation measures required.	Rare	Minor	L
011	Storms	Increased frequency, severity, and duration of significant storm events leading to unsuitable and unsafe conditions (e.g. localised flooding of site and access roads) for construction to proceed, resulting in 'stop work' days and greater delays to the construction program than accounted for.				x		Scheduling allows for anticipated wet weather days and their affect on construction duration and cost. Flood diversion in place during construction. Additional buffer in program to account for increase in extreme weather days .	Possible	Insignificant	L	*Risk only applicable to the construction phase*						n/a			
012	Storms	Lightning strike causes equipment failure e.g. electrical, equipment and systems.		x	x			Lightning protection will be provided for electrical and communication systems	Rare	Minor	L	Rare	Minor	L	Rare	Minor	L	No further adaptation measures required.	Rare	Minor	L

DESCRIPTION OF IMPACTS AND CONTROLS									RISK ASSESSMENT									ADAPTATION RESPONSES	RESIDUAL RISK		
EXPOSURE AND VULNERABILITY			COMPONENTS POTENTIALLY IMPACTED					PLANNED CONTROLS	RATING FOR BASELINE CONDITIONS			RATING FOR 2030 RCP 8.5 PROJECTION			RATING FOR 2050 RCP 8.5 PROJECTION			MANAGEMENT OPTIONS	RESIDUAL RISK RATING POST ADAPTATION		
Risk ID:	*Climate variable*	*Description of impact*	*permanent mechanical systems, stationary equipment, tanks and replaceable mechanical equipment and critical components*	*mobile plant and equipment*	*Construction*	*Operations*		*Description of controls either planned within current design or assumed to be planned for future packages of work*	*Likelihood*	*Consequence*	*Risk*	*Likelihood*	*Consequence*	*Risk*	*Likelihood*	*Consequence*	*Risk*	*Adaptation Details*	*Likelihood*	*Consequence*	*Risk*
013	Storms	Increased frequency, severity, and duration of significant storm events including hail cause damage to the sites exposed components such as roofs and uncovered equipment	x	x	x			Consider use of materials (especially roofing) that can withstand potential hail damage. Ensure that mobile and permanent equipment is sufficiently covered	Likely	Minor	M	Likely	Minor	M	Likely	Minor	M	No further adaptation measures identified.	Likely	Minor	M
014	Storms	Severe wind/ storm event has higher wind loading than designed, causing stress to site structures resulting in damage, reduced design life or safety hazard.	x					Site to be designed in accordance with Australian Standards in regards to wind loading. Maintenance of vegetation in the surroundings of the site	Rare	Minor	L	Rare	Minor	L	Unlikely	Minor	M	Ongoing monitoring of site components and maintenance if deficiencies are identified.	Rare	Minor	L
015	Bushfires	Extreme heat generated by bushfires (>300 degrees) comes in direct contact with site components causing damage.	x	x	x			Implementation of asset owner bushfire management plan and operational protocols. Maintenance slashing of vegetation in and regular updating and review of bushfire management plan.	Rare	Major	M	Rare	Major	M	Rare	Major	M	No further adaptation measures identified.	Rare	Major	M
016	Bushfires	Bushfires moves onsite and cuts off access roads impacting access.					x	Implementation of asset owner bushfire management plan protocols.	Rare	Insignificant	L	Rare	Insignificant	L	Rare	Insignificant	L	Maintenance slashing of vegetation and regular updating and review of bushfire management plan	Rare	Insignificant	L
017	Bushfires	Bushfires in region delay construction programme due to restricted access to site and/or health concerns from increased smoke and ash.				x		Monitor bushfire warnings. Implement protocols of the bushfires management standards and operations plan to the level required	Rare	Minor	L	*Risk only applicable to the construction phase*						n/a			
019	Snow & Frost	Snow and frost affect materials (e.g. concrete) resulting in reduced durability and/or design life.	x	x	x			Design concrete to resist freeze / thaw damage.	Rare	Insignificant	L	Rare	Insignificant	L	Rare	Insignificant	L	Ongoing monitoring of infrastructure and maintenance if deficiencies are identified.	Rare	Insignificant	L

5. Contributors

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