Recycling Enterprise Precincts A "How To" Guideline



Client: Queensland Government, Department of State Development, Infrastructure, Local Government and Planning

Date: 22 December 2022

Contents

1	Purpose of Recycling Enterprise Precinct Guideline	1				
2	Recycling and Recovered Materials in Queensland					
2.1	Recovered Materials Context and Policy Drivers in Queensland	3				
	2.1.1 Recovered Materials and Waste Streams in Queensland					
	2.1.2 Waste Management and Resource Recovery Strategy	5				
	2.1.3 Resource Recovery Roadmap and Action Plan 2.1.4 The Broader System of Priorities and Obligations	6 7				
3	Recycling and Material Recovery Challenges and Opportunities	Perceling and Material Decourse Challenges and Organistics				
	Recycling and Material Recovery chanenges and opportunities	0				
4	Recycling Enterprise Precincts	11				
4.1	What is a Recycling Enterprise Precinct?	11				
	4.1.1 Prepare Precincts					
	4.1.2 Transform Precincts	14				
4.2	Purpose and Benefits of a Recycling Enterprise Precinct	14				
5	Guiding Principles	Guiding Principles 19				
5.1	What are Guiding Principles for Recycling Enterprise Precincts?					
6	Precinct Location Guidance	22				
6.1	Location Introduction	22				
6.2	Location Objectives					
6.3	Detailed Location Guidance					
7	Precinct Development Guidance	26				
7.1	Development Introduction					
7.2	Strategic Development Intent					
7.3	Development Objectives					
7.4	Precinct Wide Detailed Development Guidance	27				
	7.4.1 Economic Development and Land Use					
	7.4.2 Place and Infrastructure					
	7.4.3 Environment and Sustainability					
8	Land Use Guidance	33				
8.1	Land Use Introduction					
8.2	Sub-Precincts					
8.3	Enterprise Sub-Precinct					
8.4	Enterprise Support Sub-Precinct					

0.5	Environ	Environmental Sub-Precinct					
8.6	Summary of Land Use Within Sub-Precincts						
8.7	Facilitie	acilities Located Within Land Uses					
9	Planni	ng Pathways	38				
9.1	Plan Ma	aking	38				
9.2	Develop	Development Assessment					
10	Investment Attraction Guidance 40						
10.1	Why Investment Attraction Matters40						
10.2	Investment Attraction Functions and Activities40						
10.3		Investor Needs	42				
	Implementation Guidance 43						
11	Implen	nentation Guidance	43				
11 11.1	Implen	nentation Guidance Precinct Activation	43 43				
11 11.1	Implen 11.1.1	nentation Guidance Precinct Activation How to Get Businesses in the Precinct Working Together	43 43 43				
11 11.1	Implen 11.1.1 11.1.2	nentation Guidance Precinct Activation How to Get Businesses in the Precinct Working Together Development of Precinct	43 43 43 43				
11 11.1	11.1.1 11.1.2 11.1.3	nentation Guidance Precinct Activation How to Get Businesses in the Precinct Working Together Development of Precinct Collaboration	43 43 43 43 43				
11 11.1 11.2	11.1.1 11.1.2 11.1.3	nentation Guidance Precinct Activation How to Get Businesses in the Precinct Working Together Development of Precinct Collaboration Operations and Maintenance	43 43 43 43 43 44				
11 11.1 11.2 11.3	11.1.1 11.1.2 11.1.3	nentation Guidance Precinct Activation How to Get Businesses in the Precinct Working Together Development of Precinct Collaboration Operations and Maintenance Performance Evaluation	43 43 43 43 43 44 44				
11 11.1 11.2 11.3 11.4	11.1.1 11.1.2 11.1.3	nentation Guidance Precinct Activation How to Get Businesses in the Precinct Working Together Development of Precinct Collaboration Operations and Maintenance Performance Evaluation Remediation	43 43 43 43 43 44 44 44				
11 11.1 11.2 11.3 11.4 11.5	11.1.1 11.1.2 11.1.3	nentation Guidance Precinct Activation How to Get Businesses in the Precinct Working Together Development of Precinct Collaboration Operations and Maintenance Performance Evaluation Remediation. Governance.	43 43 43 43 43 44 44 46 47				
11 11.1 11.2 11.3 11.4 11.5 11.6	11.1.1 11.1.2 11.1.3	nentation Guidance Precinct Activation How to Get Businesses in the Precinct Working Together Development of Precinct Collaboration Operations and Maintenance Performance Evaluation Remediation Governance Risk	43 43 43 43 43 44 44 44 46 47 48				
11 11.1 11.2 11.3 11.4 11.5 11.6	11.1.1 11.1.2 11.1.3	nentation Guidance Precinct Activation How to Get Businesses in the Precinct Working Together Development of Precinct Collaboration Operations and Maintenance Performance Evaluation Remediation Governance Risk Precinct Risks	43 43 43 43 43 44 44 46 47 48 48				

Tables

Table 2.1:	Waste Streams and Their Recovered Material Sub-Components	3
Table 2.2	Summary of Material Types and Recovery Rates 2020-21	4
Table 2.3	Waste Reduction Targets to 2050	5
Table 3.1	Summary of Opportunities for Resource Recovery Activities	8
Table 4.1	Benefits from Recycling Enterprise Precincts	15
Table 6.1	Detailed Location Guidance	24
Table 7.1	Detailed Economic Development and Land Use Guidance	28
Table 7.2	Detailed Place and Infrastructure Development Guidance	29
Table 7.3	Detailed Environment and Sustainability Development Guidance	30
Table 8.1	Enterprise Sub-Precinct Aims and Preferred Land Use	34
Table 8.2	Enterprise Support Sub-Precinct Aims and Preferred Land Use	35
Table 8.3	Environmental Sub-Precinct Aims and Preferred Land Use	35
Table 8.4	Preferred Land Use by Sub-Precinct	36
Table 8.5	Example Facilities in Different Land Uses	36
Table 10.1	Investment Attraction Functions and Activities in Precinct Development	41

Precinct Key Performance Indicators	45
Remediation Approaches for Different Sub-Precincts	46
Key Governance Principles	48
High Level Risks in Precinct Development	48
Risk Management Stages Applicable to a Precinct	. 49
	Precinct Key Performance Indicators Remediation Approaches for Different Sub-Precincts Key Governance Principles High Level Risks in Precinct Development Risk Management Stages Applicable to a Precinct

Figures

Figure 1:	Waste and Resource Management Hierarchy	6
Figure 2:	Waste and Recovered Materials Strategic Policy Line of Sight	7
Figure 3:	Recycling Enterprise as Enablers of the Circular Economy	11
Figure 4:	Recycling Enterprise Precinct Operating Concept	13
Figure 5:	Difference between a Recycling Enterprise Precinct and Resource Recovery Centre	15
Figure 6:	Example Operating Models for Precincts	16
Figure 7:	Resource Recovery Precincts Guiding Principles	19
Figure 8:	Recycling Enterprise Precinct Location Objectives	22
Figure 9:	Recycling Enterprise Precinct Development Objectives	26
Figure 10:	Conceptual Land Use Arrangement in a Recycling Enterprise Precinct	33
Figure 11:	Stages and Key Activities for a Multi-Phase Recycling Enterprise Precinct Development	43
Figure 12:	Collaborative Governance for Evolving Recycling Enterprise Precincts	47

In the spirit of reconciliation, E3 Advisory acknowledges the Traditional Custodians of country throughout Queensland and their connection to land, sea and sky. We pay our respects to their Elders past, present and emerging and extend that respect to all Aboriginal and Torres Strait Islander people today.

1 Purpose of Recycling Enterprise Precinct Guideline

This *Recycling Enterprise Precinct Guideline* ('the Guideline") has been prepared by E3 Advisory for the Department of State Development, Infrastructure, Local Government and Planning. It is intended to assist any entity seeking to establish a Recycling Enterprise Precinct ("a precinct") by providing guidance on the key actions, activities and matters to consider when locating and developing a precinct. It is not intended to be a traditional planning guideline. It has been written to provide contextual, informative, and strategic guidance on how to establish an innovative precinct that enables the transformation of recovered materials into new products with a commercial value and maximises the potential of the circular economy.

Using the guideline is expected to help to deliver the following benefits:

- Contribution to the creation of new advanced manufacturing opportunities for Queensland
- Creation of new industries and new jobs built on recycling enterprises and recovered materials
- Creation of new technologies and processes that help support Queensland's transition to a low carbon future
- Enhanced sustainability outcomes, including making a contribution to the achievement of the Government's zero net emissions by 2050 target¹, and minimising carbon wastage
- Greater social acceptance of value adding manufacturing practices that make better use of recovered materials minimising the negative health and environmental impacts of outdated practices
- Better use and re-use of recovered materials resulting in reductions in landfill.

This guideline should be read as a "how to" tool to help improve decision making and facilitate development of successful recycling enterprise focussed precincts. It can be used by any entity seeking to establish a precinct including industry, local government and state government entities alike. Users will need to decide for themselves if every element is suitable for their purposes.

 $^{{}^{1}\,}https://www.des.qld.gov.au/climateaction/emissions-targets$

The broad structure of the guideline is shown below.



The guideline is set up in key parts to help aid user comprehension. In summary the flow is as follows:

- **Recycling and Recovered Materials Context** this provides an overview of waste and recovered materials in Queensland and the surrounding policy and strategy environment.
- **Recycling and Recovered Materials Challenges and Opportunities** this provides a high level snapshot of the key issues facing recycling and recovered materials, as well as available opportunities.
- **Recycling Enterprise Precincts and Their Purpose** this provides an overview of what a recycling enterprise precinct is and how it will help to further the development of recycling enterprises.
- Guiding Principles these encapsulate what should be achieved through the development of precincts.
- Location Guidance this sets out what to consider when seeking to identify likely candidate places for a precinct and is central to understanding **where** a precinct can be developed.
- **Development Guidance** this sets out what to consider when seeking to plan and build a precinct and is central to understanding **how** a precinct can be developed.
- Land Use Guidance this sets out a suggested approach for how to establish land use and planning arrangements for a precinct, including the role of sub-precincts.
- **Planning Pathways** this sets out available planning pathways that exist in Queensland to establish a precinct.
- Investment Attraction Guidance this sets out the matters that should be considered in seeking to attract investors that reinforce the central recycling enterprise role of the precinct.
- Implementation Guidance this sets out a range of matters that will help ensure the successful implementation of the precinct and covers precinct activation, operations and maintenance, evaluation, site remediation, risk and governance.

2 Recycling and Recovered Materials in Queensland

2.1 Recovered Materials Context and Policy Drivers in Queensland

2.1.1 Recovered Materials and Waste Streams in Queensland

Resource recovery from waste is aimed at recovering valuable materials from waste streams and reusing those materials for new purposes. In the context of this guideline a 'material' is any substance that things can be made from. Those materials that are recovered and then value added to through various processes are referred to as 'recovered materials'. Doing this is an important part of a transition towards a sustainable circular economy and a low carbon future.

Waste is made up of multiple materials as received from residents, businesses, and governments. It is important to categorise waste and better understand the treatments and processes used to recover materials from each of the waste streams.

Currently, the Queensland Government reports waste characteristics and statistics across three broad waste streams:

- Municipal Solid Waste
- Commercial and Industrial Waste
- Construction and Demolition Waste.

Table 2.1 below provides a breakdown of the waste streams, presenting the typical composition of recovered material types and their sub-types.

Table 2.1:	Waste Streams and Their Recovered Material Sub-Components

'Resource recovery' refers to use of waste as an input to create valuable products as new outputs and it includes reuse, reprocessing, and recycling of resources, as well as energy recovery.

'Recovered material'

means those materials which can be feasibly used, reused, or recycled, and which have been diverted or removed from the waste stream for sale, use, reuse, or recycling, whether or not requiring subsequent separation and processing.

Waste streams	Recovered material types	Recovered material sub-types	
Municipal Solid	Organic	Green, food	
Waste	Glass	Bottles	
	Paper	Cardboard	
	Plastics	Containers, bottles	
	E-Waste	Batteries, appliances	
Commercial	Glass	Glass windows, solar panels	
and Industrial Waste	Organic	Food, animal	
	Paper	Cardboard, newspapers	
	Plastics	Excess material	
	Textiles	Excess material	

	E-Waste	Solar panels, batteries, appliances
Construction	Solid Materials	Concrete, timber, bricks, pavers, asphalt
and Demolition Waste	Loose Materials	Soil
	Hazardous Materials	Asbestos

In 2019-20, Queensland produced nearly 9 million tonnes of waste.² This was a 20% reduction on the amount produced in 2018-19³. In 2020-21, the total tonnage increased slightly to 9.3 million tonnes.⁴

In the ten years to 2017-18, the total amount of waste generated in Queensland outstripped population growth in the state by 19%⁵, indicating increased levels of domestic waste generation, but also influenced by the processing of waste generated interstate in Queensland. Queensland's waste disposal levy, which commenced on 1 July 2019, imposed a levy on various waste types. This has seen a significant reduction in unprocessed waste entering Queensland.

In recent years there have been increased rates of material recovery in Queensland. In 2020-21,

- 56% of the total amount of waste was recovered, an increase of 9.7% compared to 2019-20
- 28% of municipal solid waste was recovered
- 55% of commercial and industrial waste was recovered
- 80% of construction and demolition waste was recovered.⁶

A summary of the key material types and their recovery rates in Queensland for 2020-21 is provided in Table 2.2⁷.

Material	Total managed (t)	Total landfilled (t)	Recovery rate (%)
Food organics	880,000	820,000	7%
Garden organics	1,600,000	590,000	63%
Paper and cardboard	1,100,000	570,000	47%
Plastics	330,000	290,000	13%
Glass	190,000	89,000	54%
Ferrous metals	1,100,000	140,000	86%
Non-ferrous metals	140,000	22,000	84%
Timber	820,000	640,000	22%
Textiles	220,000	215,000	2%
Masonry, aggregates, soils	2,600,000	330,000	87%

Table 2.2 Summary of Material Types and Recovery Rates 2020-21

Note - the information contained in this table is based on data received from the Queensland Government. Some rounding and aggregation has been applied to ensure that total data aligns with Statewide level data. Tyres and solar panels have not been included as there is insufficient public sector data.

² Based on reporting by waste handling entities.

³ Recycling and Waste in Queensland 2020, State of Queensland 2021

⁴ Data sourced from https://www.qld.gov.au/environment/management/waste/recovery/data-reports/recycling-waste

⁵ Waste Management and Resource Recovery Strategy, State of Queensland 2019

⁶ Data sourced from https://www.qld.gov.au/environment/management/waste/recovery/data-reports/recycling-waste and E3 Advisory analysis ⁷ E3 Advisory analysis of data sourced from Queensland Government Recycling and Waste data and Queensland Waste and Resource recovery Infrastructure Report, Arcadis, 2019

2.1.2 Waste Management and Resource Recovery Strategy

Considering population growth, the waste people generate, and the need to continue to reduce landfill rates, the Queensland Government released the *Queensland Waste Management and Resource Recovery Strategy* (the 'Strategy') in 2019. This outlines the policy drivers and strategy response for waste management and resource recovery activities in Queensland. It includes strategic priorities designed to shift the way waste is managed and support the transition to a zero-waste society. These are:

- Reducing the impact of waste on the environment and communities
- Transitioning to a circular economy for waste
- Building economic opportunity.⁸

The vision for waste management and material recovery in Queensland is well articulated in the strategy:

"Queensland will become a zero-waste society, where waste is avoided, reused, and recycled to the greatest extent possible. Strategic investment in diverse and innovative resource recovery technologies and markets will produce high-value projects and generate economic benefits for the state."⁹ "Resource recovery from waste is a transition stage toward a sustainable circular economy."

Lag-Brotons, Velenturf, Crane, Head, Purnell and Semple 2020

Waste reduction and recycling targets out to 2050 are set out in the Strategy. These reflect the Queensland Government's objectives and intent to become a recovered materials and waste management leader in Australia. The targets are summarised in Table 2.3 below.

Target	Waste Stream	Baseline (2018)	2025	2030	2040	2050
Waste reduction (total generation per capita)	MSW	0.54 tonnes per capita	10% reduction	15% reduction	20% reduction	25% reduction
	MSW	31.1%	50%	60%	65%	70%
Recycling (as a percentage of	C&I	46.5%	55%	60%	65%	>65%
total waste generated)	C&D	50.9%	75%	80%	>80%	>80%
	Overall	44.9%	60%	65%	70%	75%
	MSW	32.4%	55%	70%	90%	95%
Landfill diversion (recovery	C&I	47.3%	65%	80%	90%	95%
waste generated	C&D	50.9%	75%	85%	85%	85%
	Overall	45.4%	65%	80%	85%	90%

Table 2.3 Waste Reduction Targets to 2050¹⁰

⁸ Waste Management and Resource Recovery Strategy, State of Queensland 2019

⁹ Waste Management and Resource Recovery Strategy, State of Queensland 2019

¹⁰ Data sourced from Queensland Waste Management and Resource Recovery Strategy 2019

The Queensland Government envisages through strategic infrastructure and industrial development, these targets can be met. Coordinated infrastruture, planning and investment attraction has a key role in allowing operations for materials recovery activities and industry development to occur at scale.

The current waste management hierarchy framework establishes a relationship between preference and relevant waste management actions. The action to avoid and reduce waste is the most critical and most preferred, whereas the disposal of waste to landfill sites is the least preferred action to undertake. Figure 1 depicts this hierarchy.¹¹



Figure 1: Waste and Resource Management Hierarchy

The Strategy also reinforces the importance of the concept of a circular economy as being fundamental to reducing waste, improving sustainability outcomes and working towards processes that see recovered materials from waste being transformed into new products and energy sources.

The Strategy highlights key potential economic and social benefits due to the new proposed strategies in managing waste and extracting valuable materials from waste. This includes job creation, regional investment, lower levels of resource extraction, innovation, revenue opportunities and the efficient use of materials. 'Circular Economy' is reflective of a resource supply chain map, creating a closed loop of resource flow between manufacturing/re-manufacturing, and consumption of resources. The key activities which enable a circular economy are; recycling, refurbishing, reusing and maintenance. These processes currently allow the efficient use of resources which would otherwise be disposed of in landfill.

2.1.3 Resource Recovery Roadmap and Action Plan

Building on the direction set out in the Strategy, the Queensland Government released the *Queensland Resource Recovery Industries 10-year Roadmap and Action Plan* (the 'Roadmap') in 2019. This Roadmap

¹¹ Diagram sourced from Queensland Waste Management and Resource Recovery Strategy 2019

highlights Queensland Government strategies and actions targeted at supporting industry to drive diversion of waste from landfill to resource recovery, to meet the 2050 targets. A Resource Recovery Industry Development Program was further introduced by the State funded through the Waste Levy, to develop high-value resource recovery industries.

The Roadmap highlights four key strategies in overcoming the challenges whilst on the Roadmap towards 90% recycling waste by the year 2050. These strategies are:

- 1. Accelerating the project pipeline
- 2. Market and supply chain development
- 3. Responsive policy and legislative framework
- 4. Advancing new technologies.

These strategies present a staged approach towards advancing development of industries and businesses that use resource recovery and recovered materials. As a result of these initiatives, the Queensland Government has decided to progress precinct development, due to the complementary industrial activities and infrastructure developments that are required for resource recovery and recycling enterprises.

2.1.4 The Broader System of Priorities and Obligations

Resource recovery and waste management policy does not occur in isolation. It occurs as part of a complex and interrelated system. For this reason, it is important to recognise that the actions and priorities at a State level impact on and are interdependent with the obligations and priorities for different levels of government and as part of the national obligations that Australia has in the global community.

A selection of these policies and obligations is shown in Figure 2. This highlights the various polices, priorities and initiatives which exist from the local government level through to the international community. What Queensland does to manage its waste and how it recovers resources needs to be considered within this broader strategic policy landscape.

Figure 2: Waste and Recovered Materials Strategic Policy Line of Sight



3 Recycling and Material Recovery Challenges and Opportunities

Developing new industries and places based around materials recovered from waste that will help establish Queensland as a leader in recycling, advanced manufacturing and innovation associated with recovered materials will be a challenging endeavour at the outset.

To successfully transition recycling and recovered materials related activities into a future focused, sustainable industry that is socially accepted with recognised positive economic and environmental benefits will require addressing some challenges.

Developing new industries focused on recycling and recovered materials will mean that existing challenges need to be addressed. Table 3.1 outlines some of the challenges, and presents complementary opportunities for each. It highlights how recycling enterprise precincts can assist in addressing these challenges.

Table 3.1	Summary of Opportunities for Resource Recovery Activities
-----------	-----------------------------------------------------------

Challenge	Opportunity and role of precincts in addressing challenges
Decentralised population. Queensland's decentralised population means that waste is produced in large volumes in the South East where 70% of the population reside but also in significant volumes by the series of major provincial centres along the coast, and the myriad of smaller inland communities.	Recovering materials from waste should generally occur relatively close to the production source of that waste. This is particularly the case for low value, high volume material like organics and aggregates. Having a series of large population centres means that there is an opportunity to establish centres of excellence that recover materials not just in South East Queensland but also in larger centres close to the sources of waste. Having a decentralised state also provides the opportunity to develop industries that can manage regional scale materials recovery activities. Precincts present an opportunity to provide places that can manage recycling and materials recovery activities at variable scales, but with enough input materials to make materials recovery from some, if not all, waste streams viable in various locations around the state. This will see the added benefit of local jobs and higher skilled jobs being located across the State.
Industry is evolving. The range of activities associated with recycling and materials recovery is broad and there is no single "industry" that represents both waste and materials recovery focussed businesses. Because of this, there are challenges for industry to overcome when considering a joined-up approach to position the industry as part of the manufacturing sector where it is likely to gain greater community acceptance.	There is a significant opportunity to develop and grow the recycling and recovered materials industry and position it as part of the manufacturing sector. There are significant opportunities for job creation. Opportunities exist for industry participants to partner with other participants and with research and development organisations to develop new technologies to recover materials from waste and to scale up or commercialise intellectual property, and develop new supply chains. Areas like the recovery of rare earth minerals, and the processing of batteries and e-waste are examples where new supply chains can be created that significantly value add to products and supplement other minerals processes in the state. Industry can work with government efficiently to identify and address regulatory, investment, and industry development barriers and develop the jobs and market potential of the industry. This will help develop confidence, improve social licence, and help the industry to grow to scale. This will help generate new quality jobs and skills and support local economic development.

Chal	lenge
Cilai	lenge

Opportunity and role of precincts in addressing challenges

Developing recycling enterprise precincts will help to create places where like minded businesses and activities can locate and grow, creating a stronger industry platform. Precincts can potentially enable research and development partners and other key supporting facilities like trade training facilities to also co-locate reinforcing the maturing of the industry. Precincts also allow the opportunity to showcase better practice and allow community and industry to see processes and outputs in action.

Managing landfill.

Disposing of unprocessed waste in Queensland still relies heavily on landfill. This is a land use that is typically unpopular with residents who are in close proximity to facilities and requires significant environmental regulation, making land fill difficult to locate. Recovering materials from waste should help reduce the volume of waste needing to be disposed of in landfill. The more material recovered, the less residual waste that needs to be disposed of in landfill.

There is a significant opportunity to reduce landfill and build social licence for waste related developments. By making the recovery of materials a more sustainable manufacturing process, there is the opportunity to position recycling and recovered materials as part of a drive to create new jobs, new industries and move to a circular economy, all of which achieve better economic, environmental and social outcomes.

Precincts allow recovered materials related activities to be collocated and to develop to significant scale. Co-locating uses together will increase the total volume of materials that can be recovered, over time reducing the amount of material going to landfill to zero.

Inefficient use of land.

Many of the businesses currently undertaking materials recovery activities operate on poorly located and serviced sites with very little shared user infrastructure. There is limited aggregation of uses into the same location. These businesses often have approvals that require significant buffering from surrounding uses, creating an inefficient use of land. Providing the opportunity for recycling enterprises to locate in closer proximity to each should help develop focused areas where collaborative approaches apply, and where supply chains and industry can be matured.

Finding land in South East Queensland, or close to other major provincial centres for industrial uses can be difficult, particularly for higher impact uses. Taking a precinct approach where like industries can be collocated allows for hard to locate industries to be located together and planned for as a collective. This allows buffers around facilities to be collective rather than around each individual business. This would create a much more efficient use of scarce industrial land. Precincts also allow for shared facilities and supporting services that enable recycling enterprises to be located close by further creating efficiencies in land use.

Approval pathways.

Materials recovery facilities are required to obtain planning and (in many cases) environmental approvals, which is some cases are taking many years to secure. This creates uncertainty and is a significant disincentive to private sector investment in the industry. There is an opportunity for recycling and recovered materials related activities to be better managed as manufacturing enterprises rather than waste management activities.

Precincts allow an opportunity to provide strategic approvals for materials recovery and recycling operations inside a precinct rather than business by business assessments, reserving specific assessment for "special industries" as defined in the Queensland planning system, for example. Having a precinct scale approval framework would be a huge incentive to private sector investment creating much needed certainty.

Infrastructure needs.

Recycling and recovered materials related activities have a variety of infrastructure demands. All require good, reasonably priced transport. Some require significant energy inputs, There is an opportunity to use Queensland's excellent road, rail and port infrastructure to transport input materials to recycling enterprise precincts and export output products. Queensland's north south rail and road spine and extensive port facility network facilitates efficient movement of materials where these need to be moved to specialised facilities for materials recovery processing or for export. Queensland's significant

Challenge	Opportunity and role of precincts in addressing challenges
which make location decisions problematic. Carrying low value input	investment and comparative advantage in renewable energy and hydrogen also provides unique support for sustainably positioned recycling activities.
materials great distances will drive costs up making some activities commercially unviable. The collective infrastructure requirements to support activities cannot be more efficiently delivered where businesses are scattered widely.	Queensland has strong infrastructure planning and delivery credentials. These can be used to support development of precincts which can leverage off the main power, water and transport infrastructure systems and can leverage the high quality municipal infrastructure networks including waste infrastructure, water supply, local roads and sewerage. Locating activities in precincts will improve the ability to use existing infrastructure efficiently and minimise the need for new infrastructure to support individual enterprises.
Community sentiment.	There is an opportunity for activities to be recognised as recycling and
Resource recovery activities struggle to gain community acceptance as they are largely still seen as part of the waste sector, where social license is in some parts of the State not strong. Much of the opposition to resource recovery is	materials recovery activity and form part of the transition to a sustainable future where waste to landfill is reduced or eliminated. A focus on new technology, sustainability and new jobs benefits that derive from materials recovery activities should help to better position the industry and its activities in a more positive light in the community.
grounded in fears about health and environmental impacts that are perceived to exist with waste management practices.	Precincts present an opportunity to better locate recovered materials related industries and better manage the impacts of these uses so that health and environmental impacts are minimised. Precincts also provide the opportunity to develop pilot and demonstration projects that allow the positive benefits of recycling and materials recovery to be showcased. These include addressing environmental impacts, creating new quality jobs and positioning Queensland as a circular economy leader. In doing this, community sentiment can be improved which will increase the community acceptance of activities, over time making it easier to locate future facilities and precincts.
Complexity of waste streams	There is an opportunity for recycling and recovered materials related
There is no easy way to recover materials from waste. There are a range of different waste streams each with materials that can be recovered. Each stream has different preparation and materials transformation needs. Some materials have more capital- intensive requirements and need more land. Others are less complex. This means some materials may need to be transported to more specialised facilities, while others can be prepared	sensible to do so. There is also an opportunity to have specialised facilities that deal with materials that are more difficult or costly to recover or reuse. Equally, for those that are easier and less capital intensive, there is the opportunity to establish fit for purpose facilities close to the input source. Precincts are places that can be scaled to suit a variety of activities. Some may be large and deal with the broad range of materials processing, where others could specialise in particular materials recovery activities. They also offer the opportunity to share infrastructure, equipment and support services. Common user infrastructure, including material recovery facilities can be used efficiently in a precinct and service a range of industry participants.
and / or transformed into new products	

locally.

4 **Recycling Enterprise Precincts**

4.1 What is a Recycling Enterprise Precinct?

The term 'precinct' generally refers to an area within defined boundaries where similar or complementary activities occur, and where people perceive co-location as a competitive advantage.

Precinct approaches are being more widely used around Australia. Their focus can range from innovation led precincts where the focus is on clustering industry, research and educational activity together, through to industry specific precincts centred on fields like health and medicine. One of the keys to precincts is to help businesses and enterprises improve connectivity, productivity and innovation.

The notion of using precincts to further industrial development focused on new forms of manufacturing is well established. The United Nations Industrial Development Organisation (UNIDO) for example promotes as best practice well serviced places dedicated to industrial development where technology and infrastructure along with environmental, social, and economic monitoring aspects all work together to make the place more sustainable.

Building from this type of thinking and being guided by the Strategy and Roadmap, recycling enterprise precincts are intended to be places focussed on the use and re-use of materials recovered from waste. As shown in Figure 3, they are enablers of the circular economy.



Figure 3: Recycling Enterprise as Enablers of the Circular Economy

Importantly, industrial and manufacturing processes associated with the recovery of materials will be colocated with support facilities and research opportunities that allow greater value adding to occur and advanced manufacturing opportunities to flourish.

Although materials recovery deals with waste as an input, recycling enterprise precincts are **not** landfill sites. They are enablers of industrial processes that transform recovered materials into new products.

A recycling enterprise precinct should be developed as a place primarily for industrial and economic development where the core purpose is to use recovered materials to create new value-added products. These places are enhanced through innovation, business co-location, infrastructure development, job creation, resource efficiency, and sustainability practices.

In practice, some of the key elements of a recycling enterprise precinct are likely to include:

- Preparation and transformation of material recovered from waste into new products
- Reuse, reprocessing and recycling of recovered materials
- Facilities and operations for sorting and processing waste into separate materials streams
- Facilities and operations to extract materials from each waste stream
- Access to research and innovation capability that use material inflows and co-location with industry to develop new information and processes in materials recovery
- Storage facilities and space for extracted materials
- Energy from waste operations that use any residual waste from processes inside the precinct as well as from outside the precinct
- Public sector and private sector presence with a mix of anchor enterprise tenants, production facilities and environmental land to provide buffering from sensitive uses if this is needed
- Good connections to transport infrastructure to support supply chains and facilitate the movement of goods in and out of the precinct.

Figure 4 below conceptually demonstrates the operations and interactions that occur in a recycling enterprise precinct.



Figure 4: Recycling Enterprise Precinct Operating Concept

There will be a range of preparatory and transformational activities which may occur within a recycling enterprise precinct. Both preparation and transformation activities involve the need for input material and end markets for products that are prepared, altered, reused, remanufactured or recycled in a precinct.

Preparatory activities value add to a material or 'commodity' by converting it from waste into something of higher value, ready to be transformed into new products and extending its life. Specific preparatory activities will depend on the recovered material or 'commodity' type but may including sorting, washing, crushing and preparing for transportation. These early-stage processes are industrial in nature, add value to the recovered materials, and reduce the amount of material going into landfill.

Transformation activities focus on creating valuable products as new outputs, sending material back out into the market and extending its life for as long as possible. This is where more significant value adding occurs and includes a wide array of processes such as heating and moulding of glass, shredding and extrusion of new plastics, pulping and making new paper products, transformation of organics into soil conditioners, remanufacturing or reskinning of solar panels, and typically involve higher capital costs and investment. These activities are typically higher impacting industries in nature, are likely to require more capital intensive processes, and some of them can be hard to locate.

4.1.1 Prepare Precincts

"Prepare" precincts can leverage off existing or planned local government or private sector resource recovery infrastructure and are scalable. These precincts can be developed by any entity including local governments or the private sector. These precincts can handle all commodities to varying degrees. The amount of material being handled in a precinct will be dependent on the catchment population and industry mix. Ideally, material handled in these precincts will be reused locally or prepared for transport to large transformation precincts or other end users where further value adding processes can be undertaken. These precincts are likely to be smaller in scale and more suited to smaller, lower impact, industrial use.

4.1.2 Transform Precincts

"Transform" precincts are more likely to include larger facilities and harder to locate activities. These are likely to be suited to industrially zoned areas that can be well buffered from surrounding sensitive land uses. These may be well suited to areas where existing planning and land use systems contemplate hard to locate industrial activities. They also lend themselves to being located near areas where existing infrastructure investment and capital investments have already been made or are planned. These precincts would also be expected to attract co-location of research and development organisations, and high value adding processes. Due to their scale, transport connections and power and water infrastructure will be important.

4.2 Purpose and Benefits of a Recycling Enterprise Precinct

There are many successful precincts around the world that are a significant catalyst for industrial and economic development. These precincts operate across a range of industry sectors such as technology, health, aerospace, or agricultural industry and others. While the characteristics and operational models for each sector varies, all successful precincts have one common characteristic - a focus on *industrial development and innovation*.

The development and operation of a recycling enterprise precinct provides opportunity for industrial and economic development based on the use of materials recovered from waste. The precincts also support transition to a circular economy by using recovered materials to create new products. They should also build on the foundations of the work done by local government and industry which have made significant inroads into diverting useful waste and end-of-life materials away from landfill.

Although materials recovery activities use waste as an input, precincts are not intended to be established to 'manage' waste. The purpose is to develop places where materials from waste can be recovered and to increase the value of that material through reuse, reprocessing and recycling into new products. In doing this the precincts will help to facilitate the transition to a circular economy and a cleaner-energy future. They should also:

- Cater for a range of materials recovery based use, reuse and remanufacturing processes
- Facilitate linkages between research institutions and industry to drive innovation
- Act as collaboration hubs to enable interoperability
- Have large enough scale to allow industry growth and development

Because these are places that serve multiple functions, they are different to simple resource recovery centres. The focus in the precinct is on new industries, new jobs, value adding and sustainability. The focus of a resource recovery centre is much narrower, and is not about creation of a place.

Figure 5 below reflects the simplistic difference in a 'Precinct' and a 'Centre'.

Figure 5: Difference between a Recycling Enterprise Precinct and Resource Recovery Centre



Precincts have presented significant benefits globally. These benefits work as a catalyst for industrial and economic development. Table 4.1Table 2.1 below reflects the key benefits that can be realised through a recycling enterprise precinct.

Table 4.1	Benefits from	Recycling	Enterprise	Precincts

Sector	Benefit
Environmental	Reuse of scarce material
	Reduced waste disposal
	Reduced greenhouse gases
	Land use efficiency
Social	Job creation
	Skilling towards future industries
	Social enterprises
Economic	Reduced resource costs

Reduced costs of waste disposal and additional income from by-products
Resilience against materials price volatility
Sustainable strategy and corporate social responsibility
Talent acquisition

Research conducted on exemplar precincts globally, has identified that different precincts can deliver unique and specific benefits depending on the materials inputs, choice of operating models, and the population the precinct services. There is no one model or approach that works best. Some examples of the different types of focus and operating model that have been applied to similar precincts are shown in Figure 6.

Figure 6:	Example Operating Models for Precincts

Industrial Symbiosis	 Circular economy is achieved at an organisational level where one organisation's waste is another organisation's resource. Key example of this operation is Kalundborg Symbiosis. 	Waste becomes Resource Organisation 1
Materials Recovery/ Symbiotic Exchange	 Circular economy is achieved where materials are extracted from waste and used as input into new products. Key example of this operation is EcoPark Hongkong. 	Waste Collected Waste Processed/ Resources Extracted Useable Resource/ New Products
Industrial Development	 Combination of recycling facilities, landfill sites, energy from waste facilities and other green design such as rooftop water catchments for residential and commercial complexes. Key example of this operation is Fujisawa Eco-Industrial Park. 	Landfill Residential/ Commercial

Case Study: Kalundborg Symbiosis, Denmark

Kalundborg Symbiosis is one of the world's largest and successful industrial symbiosis operations. It is located in Kalundborg, Denmark, a coastal city on the largest Danish island, opposite to Copenhagen.

This large-scale resource recovery process operates by the interchanging of water, energy and heat, as well as other waste that is sent to resource recovery centres in the precinct. Organisations in the area are predominantly operating within the energy sector, however biopharmaceutical, biotechnology and other sectors also exist within the symbiosis. Key partners include: Novo Nordisk, Novozymes, Equinor Refining and many more.

The key attribute of the Kalundborg Symbiosis is the level of industrial collaboration and trust that exists among the organisations. They play a key role in facilitating each other's resource requirements and allow a circular structure with resource efficiency to be achieved alongside economic feasibility.

13 partnering organisations form part of this symbiosis alongside other government agencies, which employ approximately 4500 people in the area. Projects started in Kalundborg in 1961, with many projects and initiatives occurring till present. The benefits as documented by the organisation that the partners share in area year include:

- Bottom-line savings of €24 million
- €14 million in socio-economic savings
- 635,000 tons of CO2 reduction
- 3.6 million m3 water re-use
- 100 GWh of energy re-use
- 87,000 tons of materials shared



Case Study: Eco-Park, Hong Kong

Eco-Park, is Hong Kong's first industrial recycling business park, developed in accordance with a government strategy for waste management, reduction and recovery. The strategy involved supporting the local recycling industry by providing long-term and affordable land for tenants, job creation, and efficient use of land to further encourage technological advancement in recycling processes.

A site of approximately 2 hectares is located within an industrial complex that borders the South China Sea. 140,000m2 of land is dedicated rental land, where resource recovery and recycling companies can co-locate within the business park. The park has been operating in the area since 2007, where the Hong Kong Government provided HK\$319 million of funding to support the construction of EcoPark.

Lots are allocated a specific resource recovery activity (i.e. Lot 1 allocated to metal recycling), with companies tendering to become tenants of the lot. There are currently 10 tenants operating within the business park, each specialising and contributing to recycling and resource recovery within Hong Kong. Supporting infrastructure in the park includes marine frontage and a weighbridge which tenants may use as required.

The park recovers resources such as plastics, rubber, wood, cooking oil, batteries, e-waste, metal, construction materials and glass. The surrounding areas including the visitor and working areas are also developed considering green design, which incorporates photovoltaic panels, solar heaters, fin systems, green areas and eco-paving blocks.

Although EcoPark is developed in a relatively small area in comparison to other eco-industrial precincts around the world, it is an example of efficient and effective use of land that enables circular economy within multiple sectors of manufacturing.



5 Guiding Principles

5.1 What are Guiding Principles for Recycling Enterprise Precincts?

The guiding principles are an expression of what is being sought from precincts. They encapsulate what should be achieved through the development of precincts, and what should be expected as minimum standards from all recycling enterprise precincts. They establish a platform of standards that drive the growth and development of the precinct, which is evident through how a precinct is located, how it is developed and how it is operated over time.

The guiding principles are fundamental to the development of precincts. Successful precincts in Australia and around the world are built on principles. These will establish the fundamental character of a precinct as a place for development based on use of recovered materials. Precincts should be enablers for the circular economy, and should foster sustainable job creation, higher levels of collaboration, research and innovation, and place making.

The guiding principles for recycling enterprise precincts are shown in Figure 7.

Figure 7: Resource Recovery Precincts Guiding Principles



Economic Growth

Economically successful precincts are commercially grounded and consider both the opportunities and risks that are present in the market, and operation of the precinct.

Industrial development is fundamental to growth in the recycling and recovered materials industry. Growth will facilitate market demand and skills development. Early government support and intervention may be necessary to establish the market conditions for precincts to grow and for the private sector to have the confidence to invest through relocation to a precinct and subsequent growth within a precinct.

Future Industries, Jobs and Skills

Precincts should be places for the future industries, jobs and skills development necessary to support recycling and use of recovered materials to become a powerhouse of the circular economy.

Focussing on building new industries and creating new jobs and skills reinforces that the role of precincts is to be focussed on new opportunities and to position precincts as part of the new economy, not part of previous approaches where waste is not valued. Industrial development, investment, and collaboration will be vital for the development of this industry.

Sustainable Core

All activities and practices performed within a precinct should be sustainable from an environmental, economic and social perspective.

Sustainable practices fundamentally underpin the development of a precinct, promoting circular economy, transition to low carbon, green corporate social responsibility and sustainable industrial development. Precincts should be places that contribute to better sustainability outcomes. Importantly, precincts should be places that foster processes and creation of new technologies that contribute to a low carbon future.

Locale Development

Precincts should be places for industrial activity where there is a sense of integration, communities of practice, and support services to enhance the central recycling enterprises.

Creating a place is a complex undertaking that requires long term commitment, public and private sector involvement, well planned land, good enabling infrastructure and a stream of investment so that the precinct is activated. Precincts should be seen as places that are vital and welcoming, with a strong sense of identity and strong linkages to their surrounding communities.

Respect for Community

Precincts should exist in harmony with the surrounding community, taking into account local community views, respecting unique local features and being aware of the need to co-exist with minimal negative impact to surrounding residents and businesses.

Precinct planning should be cognisant of incorporating and respecting the key elements of the surrounding community. This includes recognising community views on appropriate land uses, the suitability of waste management activities that may impact the community and ensuring that community concerns are heard and respected with ongoing open dialogue. It should also encompass respecting the unique heritage, cultural and indigenous features of a community. Developing a precinct provides a positive opportunity to work closely with the community to design a future state and proactively engage towards achieving community aspirations.

Collaboration Centric

Collaboration and innovation driven productivity are central to job creation and growth of the industry.

Precincts must provide opportunities for collaboration between the entities in a precinct. Networks of industry and research partners where ideas are shared and opportunities are harnessed will be crucial for development of a successful precinct. Research combined with industrial linkages and support will allow the development of the industry, better facilitate jobs and growth, and provide a platform for environmental and eco-efficient development.

Excellence in Enterprise

Precincts should demonstrate excellence in enterprise by actively managing precinct performance, stakeholder and community engagement, and regulatory obligations.

Successful precincts have an output that is significant enough to influence the wider industry and surrounding region. These precincts symbolically represent an enterprise region, and multiple participants manage the precinct as an "enterprise", facilitating the inclusion of new companies, and ensuring precinct performance continues to deliver outcomes.

Strong and Enduring Governance

Precincts will develop and evolve over time and need good robust governance to drive development and operation of a precinct towards success.

The roles and responsibilities of parties involving in establishing and operating a precinct will change over time as the precinct moves through its operating life cycle. Governance should be established to manage the precinct for its duration, ensuring the needs of stakeholders continue to be met over time. The integration of private and public sectors including research organisations into precinct governance is critical and collaborative governance models should be applied.

6 Precinct Location Guidance

6.1 Location Introduction

This location guidance material documents the matters that should be considered when seeking to identify likely candidate places for a recycling enterprise precinct.

Location guidance is central to understanding **where** a precinct can be developed. The arrangements for what happens inside a precinct and how a precinct is developed are dealt with in the companion Development Guidance part of this document.

6.2 Location Objectives

Based on analysis of other precincts, the following location objectives (shown in Figure 8) have been developed to guide the location and siting of future recycling enterprise precincts:



Figure 8: Recycling Enterprise Precinct Location Objectives

Positive Economic Impact

A precinct should be located so it leverages existing supply chains and material streams, sources inputs locally to reduce transport demand, leverages research collaboration opportunities, and provides opportunities for new local jobs in commercially viable enterprises.

Positive Social Impact

A precinct should be located so it creates social benefits by enhancing a community and by offering opportunities for corporate social responsibility.

Minimal Environmental Impact

A precinct should be located so it creates positive environmental impacts by minimising impacts on natural systems, enhancing existing ecosystems and contributing to a low carbon future.

Minimal Amenity Impact

A precinct should be located so that its impacts on sensitive land uses are minimised to the greatest extent possible.

Efficient Land Use

A precinct should be of sufficient scale that industrial uses can be co-located within the precinct.

Efficient Infrastructure Use

Wherever possible a precinct should be located so that maximum use can be made of existing infrastructure including, transport, energy, water, stormwater, sewerage and telecommunications.

6.3 Detailed Location Guidance

Flowing from the location objectives, this detailed location guidance sets out in more depth the matters that should be considered when seeking to identify a location for a recycling enterprise precinct.

Using this detailed location guidance will allow informed decisions to be made about whether a particular place is suited for use as a precinct. The factors to be considered in making this judgement include the suitability of place for use as a precinct when it is assessed against a series of focus areas. These are:

- Economic impact
- Social impact
- Environmental impact and sustainability
- Amenity
- Land Use
- Infrastructure.

The matters to be considered when assessing a place's suitability are set out in Table 6.1. For each focus area, there is one or more aims which provides guidance on what it is that the precinct should be seeking to achieve in relation to that focus area. To then help decision makers decide whether a place would be suitable as a precinct, specific guidance is provided for each focus area and its associated aims. This helps to provide a checklist of the things a place should have if it is to be suitable as a potential precinct location.

The intent in these guidelines is not to get to the level of specificity typically associated with planning guidelines – rather it is to help guide decision making to identify likely candidate places for precincts. Detailed investigations would need to be completed to confirm whether or not a site is suitable for development as a precinct. The development guidance in the next part of this document would also be used to inform those detailed investigations.

Focus Area	Aims	Specific Guidance
Economic impact	• Precincts should maximise access to supply chains.	 Precinct location should seek to maximise local availability of input materials to make industrial processes commercially viable and minimise transport requirements. Precinct location should seek to maximise access to potential markets for output products created in the precinct. Precinct location should seek to leverage off proximity to existing industrial enterprises or allow opportunities for existing industrial precincts to expand to accommodate materials recovery and recycling industries.
	 Precincts should facilitate knowledge transfer and maximise research collaboration opportunities. 	 Precinct location should seek to maximise opportunities to leverage proximity to research institutions. Precinct location should seek to leverage off proximity to knowledge based industry partners.
	 Precincts should have access to sufficient locally sourced labour. Precincts should have access to training to meet future skilled and specialised labour requirements. 	 People who work in precincts should not have to travel more than 50km to the precinct. Precincts should be located so that there is ample labour for the activities in the precinct. Precincts should be located within 50km of major technical and vocational education providers so that people can be trained to meet future labour and skills requirements.
Social impact	 Precincts should seek to enhance social outcomes. 	 Locate precincts within 50km of a labour market so local communities will benefit from new jobs and new market opportunities. Locate precincts so that buffers can be maintained between existing residential settlements and precincts to enhance community acceptance.
Environmental impact and sustainability	 Precincts should minimise environmental impacts. Precincts should maximise sustainability outcomes. Precincts should seek to maximise opportunities to transition to a low carbon future. 	 Locate precincts so that impacts on environmentally sensitive receptors and areas of significance including the Great Barrier Reef are minimised. Locate precincts so that impacts on biodiversity conservation areas including koala habitat are minimised. Locate precincts so that greenhouse gas emissions associated with transportation are minimised.
Amenity	 Precincts should minimise impact on sensitive land uses. Precincts should minimise impact on urban amenity. 	 Locate precincts so that sensitive land uses are impacted to the least extent possible. Proximity to sensitive land uses should be determined by the industrial uses located within the precinct. Precinct location should ensure that any special industry, high impact industry, or medium impact industry within a precinct maintain appropriate

Table 6.1 Detailed Location Guidance

Focus Area	Aims	Specific Guidance
		 buffers from sensitive land uses as agreed with assessment managers. Buffers to sensitive uses can be located outside the precinct, or contained in part or in whole inside the precinct.
Land needs	 Precincts should be of sufficient scale to allow an ecosystem of materials recovery and recycling industries to develop and to have impact. 	 Locations where a "prepare" precinct is considered suitable should allow for an area of between approximately 10 and 100 hectares to be used, with around 10 hectares of land to be available as industrial use land for materials recovery and recycling uses. (NOTE – this is provided as guidance only, with the land areas provided representing total land area for a precinct including internal buffering within the precinct. Appendix B provides additional guidance on land needs for recycling activities).
		 Locations where a "transform" precinct is considered suitable should allow for an area of between approximately 200 and 500 hectares to be used, with around 50 hectares of land to be available as industrial use land for materials recovery and recycling uses. (NOTE – this is provided as guidance only, with the land areas provided representing total land area for a precinct including internal buffering within the precinct. Appendix B provides additional guidance on land needs for recycling activities).
		 Locations should allow land within the precinct to be developed efficiently for materials recovery and recycling industries as well as supporting activities.
Infrastructure	 Precincts should have good access to existing enabling infrastructure. 	 Locations should minimise the need for new road and rail connections. Locations should allow for ready access to road and
	 Precincts should minimise impacts on local government infrastructure. 	 rail infrastructure. Locations should facilitate access to adequate energy, in particular renewable energy.
		 Locations should minimise the need for new bulk water infrastructure.
		 Locations should minimise the need for new telecommunications infrastructure.
		 Locations should minimise impacts on local government infrastructure, particularly sewerage.
		 Locations should leverage proximity to existing waste management infrastructure and materials recycling facilities.

7 Precinct Development Guidance

7.1 Development Introduction

This development guidance material documents the matters that should be considered when seeking to plan and build a recycling enterprise precinct on land that has been identified through the use of the location guidance and supplementary detailed site investigations as a suitable place for a precinct. Development guidance is central to understanding **how** a precinct can be developed.

7.2 Strategic Development Intent

Recycling enterprise precincts are intended to be industrial places that support circular economy objectives and where the primary focus of endeavour is on materials recovery and use of that material to create new products. The highest order use of land should be for these uses.

Activities that support materials recovery and recycling activities and enterprises that leverage and remanufacture the products being produced through the recovery activities should be located also within the precinct. This helps to support development of an industrial place driven by materials recovery and recycling. The precinct development pattern should also ensure other activities that support industrial and circular economy development can be located within the precinct, including land for essential infrastructure and land for environmental purposes.

7.3 Development Objectives

Based on analysis of best practice industrial and broad hectare industrially focused development precincts, the following development objectives (Figure 9) are provided to guide the internal layout, development, delivery and long term functioning of recycling enterprise precincts.



Figure 9: Recycling Enterprise Precinct Development Objectives

Recycling and Remanufacturing Led Economic Development Opportunities

A precinct should focus first on accommodating uses associated with materials recovery and recycling industries and which generate jobs and economic activity.

Co-location of Industries and Uses

A precinct should be planned and staged so that the maximum number of materials recovery and recycling industries and ancillary uses can be accommodated within the precinct and land can be used effectively for buffering purposes.

Create Quality Eco-Industrial Places

A precinct should be planned and developed so that legible sub-precincts are created and high quality industrial form and function is achieved.

Develop in a Commercially Sound Manner

A precinct should be planned and designed so that development occurs in stages that support investment and make best use of investments in enabling infrastructure.

Develop Quality and Efficient Infrastructure

A precinct should be designed so existing infrastructure use is maximised through sensible staging, new infrastructure is fit for purpose, and common user infrastructure is provided where this makes commercial sense.

Minimise Environmental Impacts

A precinct should be developed so that environmental impacts both within the precinct and on adjoining land uses are minimized.

Maximise Sustainability Outcomes

A precinct should be developed so that sustainability outcomes are maximised in relation to biodiversity conservation, carbon management, and reuse of materials and resources.

7.4 Precinct Wide Detailed Development Guidance

Flowing from the development objectives, this detailed development guidance sets out in more depth the matters that should be considered when seeking to develop a recycling enterprise precinct.

Using this detailed development guidance will allow informed decisions to be made about how best a suitable precinct location can be developed as a recycling enterprise precinct. The factors to be considered in undertaking this exercise to develop a place as a precinct are quite broad and to simplify the exercise these are grouped across three thematic areas. These are:

- Economic development and land use
- Place and infrastructure
- Environment and sustainability.

Within each theme, there are a series of focus areas which should be considered. These are:

- Economic development and land use
 - o Economic development and job creation

- o Land use
- Orderly development.
- Place and infrastructure
 - Internal movement
 - o External connection
 - Essential infrastructure
 - Urban realm and built form.
- Environment and sustainability
 - o Biodiversity, vegetation and landscapes
 - o Cultural heritage
 - Noise and vibration
 - o Air quality and odour
 - Fire protection
 - o Flood and water management
 - High impact and special industries
 - Contaminated land.

The matters to be considered when developing a precinct are set out in Table 7.1, Table 7.2, and Table 7.3. For each focus area, there is one or more aims which provides guidance on what it is that the precinct should be seeking to achieve in relation to that focus area. To then help decision makers decide how to develop a precinct, specific guidance is provided for each focus area and associated aims. This helps to provide a checklist of the things a place should have if it is likely to be a successful precinct.

The intent in these guidelines is not to get to the level of specificity typically associated with land development guidelines – rather it is to help guide decision making about the matters that should be considered when developing a successful recycling enterprise precinct.

Detailed master planning and subdivision design would need to be completed once a site has been confirmed as a suitable location for development as a precinct.

7.4.1 Economic Development and Land Use

Focus Area	Aims	Guidance
Economic development and job creation	 Precincts should be places of enterprise and innovation focused on recycling and remanufacturing industry development. Precincts should drive creation of new jobs and economic development opportunities. Precincts should seek to create opportunities for innovation and technology transfer. 	 Provide a range of opportunities that allow new and established industries to develop based on materials recovery, recycling and remanufacturing. Primary focus is on hosting industrial processes that use recovered materials. Provide for industry and research collaboration opportunities. Provide opportunities for a range of uses that support materials recovery and recycling enterprises. Ensure precincts support the needs of workers and encourage a range of skills and job types.

Table 7.1Detailed Economic Development and Land Use Guidance

Focus Area	Aims	Guidance
Land use	 Precincts should maximise the amount of land available for materials recovery and recycling uses and related ventures. Precincts should minimise impacts on sensitive land uses. Precincts should service the range of activities likely to occur in a precinct by creating sensible internal sub-precincts. 	 Land should be planned and acquired where necessary to ensure efficient land development can occur. Create an ordered land sub-division patten based on gross floor requirements and operating footprints of businesses. Buffer impacts from higher impact industries with other compatible uses. Give priority to materials recovery and recycling related land uses. Locate highest impact land uses furthest from sensitive land uses. Provide land within the precinct for activities that support materials recovery and recycling uses. Provide land within the precinct to minimise impacts on sensitive land uses adjoining the precinct. Create sub-precincts to manage activities within the precinct and use land efficiently.
Orderly development	 Precincts should be developed in stages to ensure efficient use of capital and land. Precinct staging should support development of a materials recovery and recycling eco-system. 	 Develop precincts in stages to ensure precincts are developed at a pace supported by investment and demand. Develop precincts in stages to make efficient use of existing infrastructure and maximise returns on new capital investments in infrastructure. Stage development so anchor tenant needs are met. Where early stage development underpins future funding of later stage development, priority should be given to staging high value high return land first.

7.4.2 Place and Infrastructure

Table 7.2	Detailed Place and Infrastructure Develo	pment Guidance

Focus Area	Aims	Guidance
Internal movement	 Precincts should provide efficient internal movement systems. 	• Develop roads, footpaths and active transport networks that support efficient movement of goods and people within the precinct.
		 Roads, footpaths and active transport networks should be developed to maximise connectivity within the precinct.
External connection	 Precincts should provide efficient external connections to transport systems. Precincts should seek direct 	 Precincts should be designed to facilitate direct access to existing road, rail and port infrastructure where possible and where scale of product movement warrants this.
	links to rail or port facilities where product volumes support these modes of transport.	 Direct access to rail and port facilities is preferrable where high volumes of material are being moved by rail or sea to minimise additional transport handling by road.

Focus Area	Aims	Guidance
Essential Infrastructure	 Precincts should have access to all essential infrastructure including transport, water, energy, telecommunications, stormwater, and sewerage. Precincts should seek to use existing infrastructure as efficiently as possible. Where infrastructure is provided within a precinct, it should be shared infrastructure where possible. 	 Develop precincts so that spare capacity in existing infrastructure systems is used first. Where new infrastructure is required, it should be designed so it is fit for purpose. Owners of infrastructure should agree on design standards for new infrastructure. Beneficiaries of infrastructure should contribute to the costs of providing infrastructure. Infrastructure requirements in precincts should be included in local government infrastructure plans where appropriate, or where not included in a local plans, should be set out in a stand-alone infrastructure plan for the precinct. Where possible, infrastructure that is used by multiple parties should be common user infrastructure, and duplicated services should be avoided.
Urban realm and built form	 Precincts should provide high quality urban realm. Built form should be appropriate for the scale and density of use in the precinct. 	 Development in precincts should be of a high quality and provide a sense of place. Areas where the public gather or that provide outdoor amenity should be high quality, and fit for purpose. Where practicable, buildings should be used to contain industrial premises. Minimum lot coverage ratios should be used to encourage efficient use of land, and should seek to limit large lots having small buildings.

7.4.3 Environment and Sustainability

Table 7.3	Detailed Environment and Sustainability Development Guidance
-----------	--------------------------------------------------------------

Focus Area	Aims	Guidance
Biodiversity, vegetation and landscapes	 Precincts should minimise impacts on biodiversity. Precincts should maintain natural habitats, such as koala habitat, where possible. Landscapes should be maintained where possible. 	 Biodiversity including vegetation and habitat is maintained and enhanced within the precinct. Corridors for wildlife movement are maintained and / or established through the precinct. Landscapes of value are maintained and enhanced through land use and site management.
Cultural heritage	 Precincts should maintain sites of cultural heritage Traditional custodiams should have input into precinct design where appropriate. 	 Places of cultural heritage are to be preserved. Cultural heritage should be maintained where possible and opportunities for traditional custodian input into precinct design should be maximised.

Focus Area	Aims	Guidance
Noise and vibration	 Precincts should seek to minimise noise impacts outside the precinct. 	 Development within a precinct should ensure that sensitive land uses are not exposed to excessive sound levels or excessive vibration.Where possible significant noise emitting industries should operate with noise attenuation measures applied. High noise emitting activities and activities that generate high levels of vibration should be located as far away from sensitive land uses as possible.
Air quality and odour	 Precincts should seek to minimise air quality and odour impacts outside the precinct. 	 Development within a precinct should ensure that sensitive land uses are not exposed to high levels of light, dust, odour or other emissions. Where possible significant dust emitting industries should operate with dust suppression measures applied. Activities that generate significant dust or odour should be located as far away from sensitive land uses as possible
Fire protection	 Precincts should seek to ensure fire risks are managed. 	 Activities that use flammable substances or generate a higher degree of fire risk should not be co-located. Uses that generate a significant fire risk, notably tyre stockpiling or plastics stockpiling and / or recycling should be located with appropriate fire mitigation measures.
Flood and water management	 Precincts should seek to ensure groundwater is protected and surface run-off does not negatively impact water courses. Precincts should seek to ensure surface run-off is appropriately managed in Great Barrier Reef catchment areas. 	 Precincts should not be located in flood prone locations. Precincts should be designed so that any groundwater infiltration does not present an adverse impact on groundwater sources. Precincts should be designed so any surface runoff is adequately retained on site prior to discharge to riverine systems. Precincts in the Great Barrier Reef catchment need to pay particular attention to ensure run-off does not have an adverse impact on the Great Barrier Reef.
High impact and special industries	 Precincts should accommodate high impact and special industries. 	 Areas set aside for high impact and special industries should be subject to strategic environmental assessment rather than activity by activity assessment. Approvals for high impact and special industries should assess the cumulative environmental impacts of high impact and special industries. High impact and special industries should be located as close as possible to each other to mitigate environmental impacts and use the buffer zones of other high impact and special industries.
Contaminated land	• Precincts should seek to minimise land contamination.	 Precincts should be designed to minimise the likelihood of land contamination.

Focus Area	Aims	Guidance
		 Development approvals and detailed site design should ensure uses that are likely to contaminate land are appropriately managed on site.

8 Land Use Guidance

8.1 Land Use Introduction

This land use guidance material documents the matters that should be considered when seeking to establish land use and planning arrangement for a precinct.

Land use guidance is central to understanding **how** a precinct can be planned.

In using this guideline is it important to recognise that the material is provided for guidance purposes. References, for example, to high and medium impact industry are made to help inform thinking about how precincts are developed and organised. Local governments will, for example, make their own determinations about the industrial classification of particular activities. Industrial uses might also change categorisation over time. Uses which might today be classified as high impact, might become less impacting over time as industrial processes change with technological advancements.

8.2 Sub-Precincts

To give effect to the aims of the land use related elements of a precinct's development, the detailed guidance material indicates that good practice is to establish sub-precincts within a recycling enterprise precinct. This is consistent with practice undertaken on most precinct scale development projects. The intent of sub-precincts is to manage the different land uses present in a precinct and ensure that the impacts of industry and need for separation is effectively achieved. The likely mix of industry types and uses and how these can be arranged within a precinct is shown conceptually in Figure 10.



Figure 10: Conceptual Land Use Arrangement in a Recycling Enterprise Precinct

Management of this mix of land uses can be achieved through the use of sub-precincts which will help to:

- Create sensible internal layouts within a precinct
- Maximise the amount of land available for materials recovery and recycling uses
- Co-locate similar land uses and complementary land uses
- Minimise impacts on sensitive land uses
- Service the range of activities likely to occur in a precinct.

There are three suggested sub-precincts that could be used within a recycling enterprise precinct. These are:

- Enterprise
- Enterprise support
- Environmental

8.3 Enterprise Sub-Precinct

The enterprise sub-precinct would be used to house the core materials recovery and recycling uses along with the manufacturing industries that use the outputs from those land uses. This would be the industrial core of the precinct and would likely contain those land uses that in isolation can be more difficult to locate. The intent is that uses within this sub-precinct would create buffers for each other, rationalising the space needed to buffer any single operator.

The specific aims of the sub-precinct and the preferred land uses that should be located within it are set out in Table 8.1.

Sub Precinct	Aims of Sub - Precinct	Preferred Land Use
Enterprise	 Provide industrial land for materials recovery a recycling industrial uses Provide industrial land for manufacturing enterprises that use products from materials recovery and recycling enterprises Provide land with good access to transport and enabling infrastructure Contain uses that generate impacts on sensitive land uses within one part of the precinct. 	 High impact industry Medium impact industry Low impact industry Special industry Office Transport infrastructure Utility installation

Table 8.1 Enterprise Sub-Precinct Aims and Preferred Land Use

8.4 Enterprise Support Sub-Precinct

The enterprise support sub-precinct would be used to house the various uses that support the core enterprise uses. This would be essential supporting services like commercial, personal services, and research related facilities that are likely to need to be located in close proximity to the core enterprises which rely on these support services. The intent is that uses within this sub-precinct would also help to create buffers around the core enterprises, further rationalising the use of space within the precinct.

The specific aims of the sub-precinct and the preferred land uses that should be located within it are set out in Table 8.2.

Table 8.2	Enterprise Support Sub-Precinct Aims and Preferred Land Use
-----------	-------------------------------------------------------------

Sub Precinct	Aims of Sub - Precinct	Preferred Land Use
Enterprise support	 Provide land for activities that support core enterprise uses including commercial and training uses, and transport and logistics uses. Provide land for uses that enhance amenity for services for workers employed in resource enterprises. Provide land with good access to transport and enabling infrastructure. Provide partial buffering of resource enterprises from sensitive land uses. 	 Low impact industry Warehouse Research and technology industry Food and drink outlet Health care service Office Shop Park Transport infrastructure Utility installation

8.5 Environmental Sub-Precinct

The environmental sub-precinct would be used to house those land uses which help deliver environmental and sustainability outcomes and which provide important buffers for the core enterprise uses in the enterprise sub-precinct. This would be the green and sustainable frame of the precinct. The intent is that uses within this sub-precinct would have positive environmental impacts and help underpin the sustainable nature of the precinct.

The specific aims of the sub-precinct and the preferred land uses that should be located within it are set out in Table 8.3.

Table 8.3 Environmental Sub-Precinct Aims and Preferred La	nd Use
------------------------------------------------------------	--------

Sub Precinct	Aims of Sub - Precinct	Preferred Land Use
Environmental	 Provide land for buffers around industries that require setback from sensitive land uses. Provide land for biodiversity and sustainability purposes. Provide land for environmental management including water cycle management. Provide land that improves overall amenity of the precinct. Provide land for renewable energy generation. 	ParkEnvironmental landUtility installation

(NOTE: environmental land is not a term used in the Planning Regulations, but its intent is to reflect a mix of land uses like open space, wetlands, retention basins and other passive uses that provide effective buffers for industrial and other enterprise uses)

8.6 Summary of Land Use Within Sub-Precincts

The various preferred land uses accommodated in the sub-precincts is summarised in Table 8.4 as a ready reckoner of land use. The land use terms are those used commonly in the Queensland planning system and by local governments in planning schemes.

This matrix of land uses highlights the industrial nature of the enterprise sub-precinct, the supporting and mixed use nature of the enterprise support sub-precinct, and the environment and sustainability nature of the environmental sub-precinct.

Table 8.4 Preferred Land Use by Sub-Precinct

Land Use	Enterprise	Enterprise Support	Environmental
High impact industry	\checkmark		
Medium impact industry	\checkmark		
Low impact industry	\checkmark	\checkmark	
Special industry	\checkmark		
Warehouse		\checkmark	
Research and technology industry		✓	
Food and drink outlet		\checkmark	
Health care service		\checkmark	
Office	\checkmark	\checkmark	
Shop		\checkmark	
Park		\checkmark	\checkmark
Transport infrastructure	\checkmark	\checkmark	\checkmark
Utility installation	\checkmark	\checkmark	
Environmental land			\checkmark

(NOTE: environmental land is not a term used in the Planning Regulations, but its intent is to reflect a mix of land uses like open space, wetlands, retention basins and other passive uses that provide effective buffers for industrial and other enterprise uses)

8.7 Facilities Located Within Land Uses

To help aid interpretation of what occurs within a land use and how this shapes what happens in individual sub-precincts, the range of likely facilities that could be located in a recycling enterprise precinct are categorised against the common land use definitions that are used in the Queensland planning system. The different waste streams that are likely to be handled in a precinct have different types of facilities associated with them. In effect these facilities are the plain English terms that people are most likely to associate with when they think about materials recovery and the operations that occur as part of that process. Examples of the types of facilities in a precinct and which land use they would fall into is set out in Table 8.5. The types of facilities listed against each land use is intended to be illustrative and not exhaustive.

Table 8.5	Example Facilities in Different Land Us	es
-----------	------------------------------------------------	----

Land Use	Facilities Examples
High impact industry	Glass recycling
	Concrete crushing
	Tyre recycling and processing
Medium impact industry	Green waste processing
	Plastic recycling
	Paper recycling
	Solar panel recycling and processing

Land Use	Facilities Examples
	Timber recycling and processing
Low impact industry	Service industry -tool repair, instrument repair
Special industry	Energy from waste facility
	Animal organic processing facility
Warehouse	Freight and logistics
	Bale storage facility
	Storage building
Research and technology industry	High tech start up industry
	New experimental industrial processing
	Research laboratory
	Trials facility
Food and drink outlet	Takeaway
	Café
Health care service	Medical centre
Office	Office
	Innovation centre
	Training facility
Shop	General store
Park	Urban park
	Outdoor exercise area
Transport infrastructure	Road
	Rail
	Port facility
Utility installation	Materials recovery facility
	Power sub-station
	Water storage facility
	Land fill
	Pumping station
Environmental land	Open space
(NOTE: environmental land is not a term used in the Planning Regulations, but its intent is to reflect a mix of land uses like	Wetland
open space, wetlands, retention basins and other passive uses	Environmental reserve
that provide effective buffers for industrial and other enterprise uses)	Riparian corridors
	Water retention basin

(NOTE: this list of facilities examples is provided as illustrative guidance only and is not intended to be exhaustive)

9 Planning Pathways

Precincts as envisaged under this guideline will need to be developed under a planning framework. Queensland has three principal planning frameworks that govern land use plan making and development control. Each of these frameworks presents a pathway that can be followed to establish a recycling enterprise precinct.

The three pathways are established under three separate pieces of planning legislation that outline planning processes and regulate development:

- Pathway 1 *Economic Development Act 2012* which applies to land prescribed as Priority Development Areas (PDAs)
- Pathway 2 *State Development and Public Works Organisation Act 1971* which applies to lands prescribed as State Development Areas (SDAs)
- Pathway 3 *Planning Act 2016* which applies to all lands within Queensland unless within a PDA or an SDA.

Designing and establishing a recycling enterprise precinct can follow any one of the three planning pathways. The process under each pathway is similar, with two main parts to the planning process under each pathway –

- Plan Making establishing the overarching plan of how an area should be developed, to guide growth and development and manage impacts and the environment
- Development Assessment assessment of a proposed development against the 'plan' to ensure its location is aligned with the strategy and its impacts can be ameliorated.

9.1 Plan Making

Due to the size and scale of the envisaged precincts, they lend themselves to being handled under some form of master planning process, which is considered to be part of the plan making process.

The purpose of a master planning process is to establish a long term guiding master plan for a place.

The purpose of a master plan itself is to establish the overall vision for a place (such as a recycling enterprise precinct). This can be achieved by incorporating stakeholder ideas and investigation study outcomes into a plan that guides development of the place. A master plan for an individual recycling enterprise precinct would be expected to set out the development vision and concepts for the precinct over a longer period (20 years plus) and inform more detailed design of individual projects in the future. Typically, master plans are treated as evolving documents that inform further design and respond to opportunities and constraints that emerge over time.

Following endorsement of a master plan for a recycling enterprise precinct, this master plan could be integrated into one of three plan making schemes:

- a development scheme for a PDA (Pathway 1);
- a development scheme for a SDA (Pathway 2); or
- a planning scheme for a local government (Pathway 3).

Where a public sector entity is leading the development of a recycling enterprise precinct, the plan making process could follow any one of the three pathways. Depending on the pathway being followed, the plan

making process will need the approval of either the Minister for Economic Development Queensland (Pathway 1), the Coordinator General (Pathway 2) or the relevant Local Government (Pathway 3).

Where the private sector is leading the development of a recycling enterprise precinct, Pathway 3 provides the most logical framework for plan making for a precinct. If the private sector proponent seeks to have a site dealt with under the provisions applying to a PDA (pathway 1) or SDA (pathway 2), it may choose to work with government to determine the appropriateness of applying either of those mechanisms.

9.2 Development Assessment

Each planning pathway also has a development assessment process. The fundamentals of these processes are similar in each planning pathway, in that a development proponent lodges an application with the assessing authority who undertakes an assessment. The assessment authority has the ability to seek input from third parties in certain circumstances, and to seek clarification or further information from the development proponent. The assessment manager then issues its decision. The assessment manager under the different planning pathways is as follows:

- Pathway 1 *Economic Development Act 2012* the State (through Economic Development Queensland) is the assessment manager in some PDAs and in other PDAs, the relevant local government is the assessment manager.
- Pathway 2 *State Development and Public Works Organisation Act 1971* by and large the State Government through the Coordinator-General, is the assessment manager in SDAs throughout Queensland. Applications may be referred to relevant state government agencies and local government/s for comment. Accordingly, a proposed application may be assessed against other state or local statutory instruments (e.g. legislation, state policies and local planning schemes) as part of the referral process.
- Pathway 3 *Planning Act 2016* by and large local governments will be the assessment manager. However, in certain circumstances, the state may have an assessment manager role or a referral role, depending on whether the proposed activity is assessable under schedule 10 of the *Planning Regulation 2017*.

This assessment process may require referral to any or all of the levels of government dependent on the site and precinct specifics. These specifics will also determine the likely length of time required for this planning process. Beyond the planning approvals, further building, environmental and operational approvals may also be required.

While the processes followed are largely consistent, the overarching focus of each piece of legislation differs, and this manifests in specific development requirements or preferred land uses. PDAs for example have a heavy focus on economic development and development for community purposes, whilst SDAs have a focus on promoting economic development and industrial land and infrastructure projects of national, state and regional significance.

Choosing the right planning pathway to facilitate development of precincts will be dependent on the precinct that is being developed and the location of that precinct. This will be a matter that precinct developers will need to consider in consultation with State and local government planning authorities.

10 Investment Attraction Guidance

10.1 Why Investment Attraction Matters

Without investment, there is land, but there is not a precinct. The success of a recycling enterprise precinct requires the establishment of business and industry within the precinct. While these businesses and industry may be able to survive with limited or no interaction amongst themselves, this would not be considered a success of the precinct. True success will be considered by the establishment of an ecosystem of businesses trading and interacting on a regular and ongoing basis.

As such, investment into the precinct will need to be curated to ensure that it aligns to the overall intent of the precinct. In this sense, investment attraction and management will be key to the curation of the types of businesses and industries being sought to establish within the precinct.

Given that recycling enterprise precincts are seeking to establish places that are focussed on use of recovered materials to create products, it is important that investment in the precinct aligns with and reinforces this central purpose. Poorly aligned investment in uses that do not contribute to the aims of a precinct are counterproductive and will erode the value of a precinct. The choice of investment and the types of businesses that co-locate in the precinct are central to its success.

10.2 Investment Attraction Functions and Activities

In the early stages of a precinct's development, investment will largely be related to the physical establishment of the precinct including its enabling infrastructure and its early anchor tenants. Over time investment will transition to broader business investment and reinvestment.

Seeking to attract the right investment and then secure that investment involves considerable work on behalf of the parties seeking to develop the precinct. Having a clear and well crafted investment attraction prospectus that has a clear investment narrative is critical in establishing the investment patterns needed to be make the precinct a success. Success will come when investment is attracted that delivers the new jobs and new industries sought through the development of resource recovery precincts.

The OECD identifies that there are four main investment attraction related functions. Activity needs to occur across all of these functions. Much of this work should be led by the State's investment promotion agency or the agency or entity given clear responsibility for attracting investment into the precincts.

For the attraction of investment into precincts, there is considered to be a nuance to the OECD model which sees the investment functions being broken in six functions to better reflect the specific requirements of precinct development and investment attraction. The relationship between the 6 precinct related investment attraction functions and the OECD functions is outlined in Table 10.1.

Table 10.1 Investment Attraction Functions and Activities in Precinct Development

OECD – Investment Attraction Function	Precinct Investment Attraction Function	Precinct Investment Attraction Activities
Image Building Create awareness and generate positive feelings about a place as an	Create Message	Establish the precinct's value proposition and clearly define investment strategy messages and priority for the precinct.
investment destination	Sell Message	Use onshore and offshore networks to promote precincts as an attractive investment destination.
Investment Generation Reach out to investors and convince them to locate their investment in a particular place	Find Investors	Identify and then use onshore and offshore networks to reach out to investors and convince them to locate their investment in a recycling enterprise precinct.
Investment Facilitation and Aftercare Facilitate the implementation of	Attract Investment	Work to deliver investment ready places and work with investors to facilitate investment opportunities into precincts.
investment projects, maximise their economic benefits and generate follow-up investments	Secure Investment	Work with partners to develop investment packages, work with investors to close investment deals in precincts, and generate follow up investments through active aftercare.
Policy Advocacy Monitor investor's perception of the place's investment climate and propose changes to improve the investment policy	Policy Review	Support policy makers by evaluate precinct investment effectiveness and provide feedback to inform improvements to resource recover investment strategy and messages.

There are discrete activities within each investment attraction function. Each activity should be assigned a lead organisation and support organisations.

To establish and activate a recycling enterprise precinct, some activities are inherently more important than others. In particular, some early stage activities including development of a recycling enterprise precinct's investment direction statement are crucial in guiding the type of investment attraction that is pursued.

It is important to define a value proposition to guide recycling enterprise precinct investment attraction work – this should relate to the public value of the investment management activity and should be anchored in circular economy, jobs creation, economic growth and sustainability practices.

Bringing investment into precincts helps activate them as places that generate jobs and economic growth. Key to achieving this will be to convert investment opportunities into secured investment deals. The connection between place activation and securing investment is important for the realisation of precincts.

Suggested strategic focus areas for investment attraction activity in the early stages of a precinct development are to:

- Present a unified investment attraction approach and remove blockages to investment in precincts
- Activate precincts as catalysts for new industries and job creation
- Position precincts as strong private sector investment destinations

• Ensure investment in precincts is high quality and strongly aligned to recycling enterprise precinct core value propositions.

10.3 Investor Needs

In seeking to make decisions about whether to locate in a precinct, investors are likely to be looking for arrangements and characteristics that help to increase certainty and make the precinct a potentially more attractive destination. These matters include:

- The ability for opportunities to be commercially viable central to this is the cost of input materials and having end markets for output products
- Having transport costs for materials that maintain commerciality of ventures
- Having certainty from government on approvals and policy
- Having certainty on feedstock availability and long-term offtake agreements
- Having planning and environmental certainty for new developments
- Entities that benefit from co-location with other businesses, supply chains, and research entities are more likely to locate in a precinct
- Using land and infrastructure more efficiently and leveraging off existing waste infrastructure where possible is beneficial.

11 Implementation Guidance

11.1 Precinct Activation

11.1.1 How to Get Businesses in the Precinct Working Together

Two key activities are required to activate a precinct. The first relates to the development of the precinct itself, and the second relates to the collaboration of those tenants within the precinct.

11.1.2 Development of Precinct

Development of a functional precinct will take time. The scope of this exercise is represented in Figure 11. As such, a plan or approach to this development will be pivotal to ensure that development occurs in a coordinated and integrated fashion. To do this will require an understanding of the waste streams to be catered for in the precinct and an understanding of how those parts of the supply chain relate to each other to ensure they are all catered for in a coordinated way. At an early stage of development/design of a precinct, tried and tested planning approaches (such as enquiry by design, master planning) can be used to develop and test concepts of the "ultimate" development. These types of approaches are most effective when they are truly integrated with infrastructure and investment attraction planning. While these planning approaches work towards identifying the "ultimate" development, good investment attraction and asset and risk management principles identify that a staged approach to this "ultimate" is an appropriate way to undertake development.





11.1.3 Collaboration

The physical development of a precinct will need to be supported by collaboration and partnerships of tenants within the precinct. These collaborations and partnerships will help to realise the value of the development as a precinct, as distinct from the development of industrial land.

As part of this curation of a precinct, difficult decisions will need to be made such as which tenants to target for location within the precinct, as well as the rejection of other prospective tenants. This decision should be fundamentally driven by the strategic direction/objectives of the precinct itself. For example, there would be little utility in a vehicle recycler being in a precinct designed around organic waste streams, due to the lack of nexus between the uses. While the purchase of land and establishment of business is a right in the free market, precinct curation and investment attraction activities should be tailored towards those uses which will achieve the intended objectives of the precinct.

A precinct built on collaboration amongst the tenants is envisaged to grow innovation and reduce unnecessary transportation of goods and materials.

11.2 Operations and Maintenance

A successful precinct will require a long term commitment if the precinct is to continue to provide the services that tenants require. This is particularly the case with the operations and maintenance phase that starts once development construction activities are complete. Having well operated and maintained infrastructure assets and open spaces for example will enhance the place making quality of the precinct and help to continue to make it an attractive place for investment.

It is important in designing a precinct that consideration is given to who the long term owner of built assets like roads, sewers, water infrastructure and open spaces will be. If constructed by one entity with the intention of handing the assets to another party once complete, it is important to engage that second entity in the design of assets from the outset. This will ensure that appropriate design standards are followed and the accepting entity is able to accept and maintain the assets long term.

In designing assets as part of the precinct's development, having a whole of life view on the asset is important so that an appropriate balance between design cost and long term operations and maintenance costs can be achieved.

So that assets can be maintained long term and can be accepted by long term asset owners, it is important to be wary of bespoke assets or technologies. While demonstration of cutting edge technologies may be attractive and create a point of difference in the precinct, these may present long term maintenance and operation problems and liabilities in the future.

Finally, where common user infrastructure is proposed, consideration should be given to ownership of that infrastructure and how long term operations and maintenance requirements can be met and by whom.

11.3 Performance Evaluation

To determine whether a precinct is operating effectively, it is necessary to have a framework that measures performance in key areas of focus. Tracking progress against key performance indicators (KPIs) helps ascertain whether a precinct is delivering on its intended purposes.

While KPIs are aligned with key elements of the location and development guidance, they also align with the broad guiding principles for precincts. Monitoring performance of the precinct also aligns directly with the Excellence in Enterprise principle which establishes performance management and excellence as a core tenant of successful precincts.

This guideline establishes three indicator categories:

- Economic Development and Land Use Performance Indicators
- Place and Infrastructure Performance Indicators
- Environmental and Sustainability Performance Indicators.

These three indictor categories have direct alignment with the guiding principles related to economic growth, future industries jobs and skills, sustainability and locale development.

Good performance across these three indicator categories will demonstrate that the precinct has good governance operating and collaborative cultures which are helping to underpin success. Governance and collaboration along with excellence in enterprise are the remaining guiding principles.

Economic Development and Land Use Performance Indicators

These represent core operational areas in the physical and economic development of a precinct. Economic development highlights the growth of new opportunities within the precinct, which can range from innovation through to job creation. The effective allocation and use of land, which facilitates growth in the precinct and minimise impacts on their surroundings is crucial for successful precinct development.

Place and Infrastructure Performance Indicators

These are important indicators of place making and locale development. Having amenities and infrastructure that facilitate the growth of a precinct and its connection with the wider community are important to sustaining the character and vibrancy of a precinct. The development of amenities and infrastructure provides the platform for accessibility, mobility, connectivity, and precinct-readiness.

Environmental and Sustainability Performance Indicators

These are important indicators of a precinct's ability to act as a platform for circular economy and sustainable practices. Environmental and sustainability indicators allow the evaluation of progress towards sustainable market operations, which underpin good development and ensure long term community acceptance of a precinct.

Performance Category	Key Performance Indicators	
Economic Development and Land Use	Private sector investment	
	Research institution involvement	
	Job growth within the precinct	
	Diversity of inputs and outputs	
	Length of approval for development applications	
	Land uptake	
Place and Infrastructure	Efficiency of existing infrastructure use	
	Investment in public realm	
	Tenant satisfaction	
Environment and Sustainability	Emissions	
	Contribution to landfill diversion	
	Water quality	
	Green systems	
	Environmental licence compliance	
	Community sentiment	

Table 11.1 Precinct Key Performance Indicators

11.4 Remediation

Part of responsible practice in developing a precinct is recognising whole-of-life considerations. One of these considerations is remediation, which deals with the activities that occur after the useful life of the precinct has been reached. This may include precinct renewal, urban revitalisation, and other redevelopment programs that occur in changing the industrial and commercial character or use of the precinct's land. As precincts are expected to use significant sites, it is important to consider feasible outcomes for maintaining the economic, social and environmental value of precinct areas once the areas cease to be used for their original precinct purposes.

Precincts are expected to operate as a series of sub-precincts, each with their own unique form and function. Because of the variable nature of land uses likely to occur in each sub-precinct, remediation outcomes have been established for each of the sub-precincts.

Table 11.2 below depicts possible remediation approaches for the different sub-precincts. The outcome describes what an end-state remediated use the land could be.

Sub-Precinct	Remediation Strategy	Remediated Land Use Outcomes
Enterprise	Land and building repurposing	Light Industrial
		Recycling enterprise precinct based activities are largely higher impact industries. Factories, workshops and other industrial facilities can be repurposed towards lighter industrial and low impact industries.
		Commercial
		Those parts of a precinct that have been used for lighter impact industrial purposes can be repurposed towards commercial spaces and facilities. This can include office spaces and workshops.
		Mixed Use
		A combination of light industrial and commercial spaces can be established upon repurposing of land and facilities.
Enterprise	Land and building repurposing	Commercial
Support		The enterprise support areas which have been used for lower impact uses can be repurposed towards commercial working spaces, including office space, retail centres and workshops.
		Residential
		Land can also be repurposed for residential uses, subject to appropriate site investigations and undertaking any necessary site rehabilitation works.
		Mixed use: Commercial and residential
		A combination of commercial and residential uses within the area can be established.
Environmental	Habitat and nature conservation	Biodiversity
		Land that has been used for buffering or other environmental purpose can be used for recreation purposes, or higher quality land with better environmental values can be used for habitat and nature conservation purposes.

Table 11.2 Remediation Approaches for Different Sub-Precincts

11.5 Governance

Success of a recycling enterprise precinct will be dependent on partners working together to establish and then operate a precinct over the long haul. Establishing appropriate governance that endures throughout the life of the precinct is an important consideration. Different operating models, as highlighted earlier in the guideline also lend themselves to different types of governance models.

Precinct development and precinct operations have numerous and complex systems that need direction and oversight. This necessitates good governance. Governance plays are key factor in aligning stakeholders and steering the operations and management of a precinct towards its core objectives.

Given the scale of precincts, multiple parties are likely to be involved. Governance will be important in clarifying the roles and responsibilities of those parties. Additionally, precincts take time to establish and develop. As such the roles and responsibilities of those parties will also change over time as the precincts evolve. This requires a collaborative governance model that allows these shifts in roles and responsibilities of those model that allows these shifts in roles and responsibilities over time to be accommodated. Figure 12 below diagrammatically shows how this model needs to accommodate change as the precinct moves through three likely phases:

- Establish where the focus is on getting the foundations right, developing early tracts of land and attracting anchor investors
- Mature where the focus shifts to maturing the precinct and getting the precinct on a sustainable development pathway
- Normalise where the focus is integrating the precinct into the surrounding urban and regional fabric and having the precinct continue as a business as usual practice.

Figure 12: Collaborative Governance for Evolving Recycling Enterprise Precincts



In the collaborative governance model, where the public sector leads in the establish phase, this would see the public sector working with industry. If industry leads, then the public sector would most likely support. In the mature phase if public sector involvement is continued this would see the public sector and industry working in partnership. In the normalise phase, it would be expected that industry would lead this with public sector involvement largely being completed.

Finally, there are key principles that a governance model should consider for a precinct. The development of this is synonymous with the 'Governance' guiding principle, as it has a critical role in facilitating the development of a precinct.

The key principles in establishing a governance model are reflected in Table 11.3 below.

Governance Principle	Description
Executive-level Leadership	Leadership is a fundamental characteristic in the governance of a precinct. A leadership model should be reflective of partnerships, and facilitate collaborative governance.
Collaborative Leadership and Governance	Collaborative leadership and governance require establishment of a governing body involving private and public sector representatives, to facilitate eco-industrial development and drive community acceptance.
Performance Evaluation	The evaluation of performance is key in understanding and managing the precinct to deliver precinct value, and identify areas of improvement.
Definition of Strategic Direction	The wider-strategy and precinct objectives are required to be initially established with consultation between the governing body and its relevant stakeholders.
Strategic Direction and Alignment	Strategy direction is required to align stakeholders on purpose and drive a consistent operating model, but be agile enough to change as needed to facilitating an overall growth model.
Decision Making Framework	The establishment of an approvals framework for precinct wide decision making is essential in aligning the interests of all stakeholders and achieving the strategic objectives set out by the governing body.

 Table 11.3
 Key Governance Principles

11.6 Risk

11.6.1 Precinct Risks

All stages of a project and business lifecycle possess a number of risks that can influence whether a successful outcome is achieved. These outcomes can be regarding planning, operations, programs, social issues or the environment, reflecting a need for risk management processes to help resolve issues that may arise. There are various risks that exist in the development and operation of a precinct. Some key high-level risks have been identified in Table 11.4 below.

Table 11.4	High Level Risks in Precinct Development
------------	------------------------------------------

Risk	Description	Examples
Strategic	Risks associated with the authorising environment for a precinct –	Governance risks
		Political instability
		Partnership risks
		Reputational Risk

Risk	Description	Examples
Planning	Risks associated to the planning phase of precinct.	Surrounding population and land use issues
		Land title issues
		Economic rationale
Environmental	Risks associated with environmental impacts of a precinct	Environmental contamination
		Force majeure weather events
Development	Risks relevant to the development of precincts	Construction and delay risks
		Technological constraints
		Policy and regulatory constraints
Operational	Risks associated with the operations and maintenance of precinct	Labour force/Skilling constraints
		Supply chain constraints
		Infrastructure integrity
Market and Commercial	Risks associated with the general market and commercial environment for stakeholders	Competitors and market share
		Operations
		Commodity fluctuations

11.6.2 Risk Management

Clear governance and decision making processes help mitigate or minimise the impacts of risks that precinct activities may pose. As such a risk management model is important for appreciating and managing risks. Risk management is a cyclical process, which involves 6 elements has explained below. Table 11.5 describes these stages and their application to a precinct.

Activity	Description
Scoping	The process of critically understanding key precinct characteristics.
Identification	The process of identifying, recognising and describing risks that may impact recycling enterprise precinct development.
Analysis	The process of understanding and characterising the risk, particularly regarding probability, impact, complexity, correlation and current solutions/controls.
Evaluation	The process of verifying whether analysis conducted satisfies current contextual and scope settings, and the impact of controls on the precinct.
Treatment	The process of implementing solutions to either mitigate and control risk, and/or establish contingency plans to minimise consequences.
Monitoring and Review	The process of review and assurance of quality and effectiveness of the management of the risk.

Table 11.5	Risk Management Stages Applicable to a Precinct

Appendix Section

A	Processing, Land Use and Infrastructure Demand Characteristics of Different Material Types
В	Indicative Facility Throughput for Various Materials
	Recovery Activities

Appendix A

Processing, Land Use and Infrastructure Demand Characteristics of Different Material Types



	Process					Resource requirements							Imp	acts			Other Characteristics		
Waste	Characteristics	Types of facilities	Extraction Process	Potential Outputs	Labour (Skill Level)	Labour Intensity	Water	Electricity	Gas (LPG etc)	Comment	Noise	Dust	Traffic	Light	Vibration	Fluid (Gas and Liquid)	Industry Descriptor	Industrial Type	Potential Risks that require management
Construction and Demolition	Residual material from construction activity (Concrete, Brick, Masonry)	- Material Crusher	- Dropoff - Crush&Sort - Pickup - Reuse	- CBR80 - 2nd grade scalps - Recycled aggregates (7-75mm) - Crusher dust	Low	Low	Medium	Medium	N/A	-	High	High	Medium	Low	Medium	Low	Recycling, storing or reprocessing concrete products	High-Impact	Dust Pollution 108-120dBA Noise Pollution
Construction and Demolition	Timber	- Chipper/Shredder - Hammermill Grinder	- Collection - Sorting and Cleaning - Shredding/Chipping - Removal of impurities - Material Reuse or Biomass Energy	- Biomass - Mulch - Chipboard/Fibreboard - Animal bedding	Low	Low	Low	Medium	N/A	-	Medium	High	Medium	Low	Low	N/A	10. Sawmilling, wood chipping and kiln drying timber and logs, producing more than 500 tonnes per annum	High-Impact	Saw dust
Construction and Demolition	Soil	- Furnace - Thermal Oxidizer - Air compressor	- Dropoff - Decontamination Process including chemical stabilisation, and thermal desportion bioremediation - Sent out	- Decontaminated soil	Medium	Medium	Medium	Medium	Low	-	Low	High	Medium	Low	Low	N/A	Reprocessing soil	Medium-Impact	Dust Pollution
Construction and Demolition	Asbestos	- Furnace - Rotary Machine - Tank/Machine for washing asbestos	 Removal of asbestos containing material Washing with hot NaOH solution and acid Heating to form ceramic/glass Recycling glass/ceramic 	- Glass - Ceramic	Medium	Low	High	High	N/A	High Energy use in furnace	Medium	Low	Medium	Low	Low	Low	Treatment and chemical processing of asbestos products	High-Impact	Asbestos poisoning
Metals	Ferrous and Non- ferrous metals,	- Separation systems, crushers, sorters, smelting furnace, casting facility	- Collection - Crushing and Shredding - Separation (Magnetic Drums) - Impurity Removal (Hot air) - Melting and Purification	- Metal Ingots	Medium	Low	N/A	High	High	High Energy use in Smelting Furnace	High	Medium	Medium	Low	Medium	N/A	Scrap metal yard including fragmentiser	High-Impact	Metal objects which contained hazardous waste is a potential safety and quality risk
E-Waste	Lead Batteries	- Separation Systems, Sorters, Casting	- Device Collection - Disassembly and sorting - Lead parts into smelting furnace - Separation of impurities and Ingots	- Lead ingots for battery production	High	High	N/A	High	High	High Energy use in Smelting Furnace	Low	N/A	Low	Low	Low	Medium	17. Recycling and reprocessing batteries	Medium-Impact	Lead Pollution and Poisoning
E-Waste	Glass/Screens: LCDs, LEDs, Plasmas, CRTs etc	- Separation Systems, Sorters	- Device Collection - Disassembly and sorting - Removal of metals - Crushing and sorting of glass	Similar to glass waste	High	High	Low	Medium	N/A	-	Medium	Medium	Low	Low	Low	Low	Recycling, storing or reprocessing glass waste	High-Impact	CRTs contain lead, therefore over-band magnets are required to remove metals from the glass.
E-Waste	Plastics	similar to plastic waste	- Additional step involved in separating metals and glass from plastic, using magentic and water separation	Similar to plastic waste	High	High	Low	Medium	N/A	-	Low	Medium	Low	Low	Low	Low	Recycling, storing or reprocessing plastic waste	Medium-Impact	Plastic microfiber pollution into air and waterways
E-Waste	Metals	similar to metal waste	- similar to metal waste, additional step of magnetic and water separation for E-waste	similar to metal waste	High	High	Low	High	High	High Energy use in Smelting Furnace	High	Medium	Medium	Low	Medium	N/A	Scrap metal yard including fragmentiser	High-Impact	Metal objects which contained hazardous waste is a potential safety and quality risk
E-Waste	PCB/Circuit Boards	- Separation Systems, Sorters	Device Collection Disassembly and sorting Magnetic Separators Various recycling processes for ferrous, non-ferrous and non- magnetic waste includes pyrometallurgy, hydrometallurgy, electrochemical processes	- Precious metals such as gold, steel, nickel, cobalt	High	High	Medium	High	N/A	-	Low	Medium	Low	Low	Low	Low	Recycling and reprocessing of high-value metals	Medium-Impact	Toxic dust containing metals such as dioxin and lead

	Process					Resource requirements							Imp	pacts			Other Characteristics		
Waste	Characteristics	Types of facilities	Extraction Process	Potential Outputs	Labour (Skill Level)	Labour Intensity	Water	Electricity	Gas (LPG etc)	Comment	Noise	Dust	Traffic	Light	Vibration	Fluid (Gas and Liquid)	Industry Descriptor	Industrial Type	Potential Risks that require management
E-Waste	Solar Panels	- Separation Systems, Sorters	- Disassembly and shredding - Multiple detectors to sort and separate materials - Resulting material returned to manufacturers	Input materials for manufacturing - Glass - Cooper - Metals - Plastics	High	High	Low	High	N/A	Low water if water separation required.	Medium	Medium	Medium	Low	Low	N/A	Recycling and reprocessing of solar panels	High-Impact	Glass/Silica Dust (if managed inappropriately) and plastic microfiber pollution
E-Waste	Others: Ink Cartridges, Mercury, Hard disks	- Separation Systems, Sorters	Basic process: - Collection - Storage - Manual Sorting, Dismantling, Shredding - Mechanical Separation (Water, Magnetic) - Crushing to raw materials - Recovery	- Raw materials: Mercury, plastics, metals	High	High	Low	High	N/A	-	Low	Medium	Low	Low	Low	N/A	Recycling and reprocessing of miscellaneous E-waste	Medium-Impact	Mercury poisoning
Organic Waste	Green Waste	- Shredder, Composter, screening facility	Collection Decontamination Shredding and Staking Composting Screening and Grading Recycling Organics	- Soil Improvers - Topsoil Constituents - Biofuels	Low	Low	Low	Low	N/A	-	Low	Medium	Medium	Low	Low	Low	Storage, composting and reprocessing of green waste	Medium-Impact	Odour and Air Pollution
Organic Waste	Animal Waste	- Anaerobic Digestor - Rendering - Rapid thermophilic digestion - Immobilized enzyme reaction	- Collection - Decontamination - Preparation - Recycling Process - Screening and Grading	- Fertilizer - Animal Feed - Soil Amendments - Bedding - Biogas/Bio-Oil	Low	Low	High	Medium	N/A	-	Low	Medium	Medium	Low	Low	High	Reprocessing of animal waste	High-Impact/Special	Odour and Air Pollution Diseases? (if pathogen removal is unsuccessful)
Organic Waste	Food waste	- Anaerobic Digestor - Rapid thermophilic digestion - Immobilized enzyme reaction	- Collection - Decontamination - Preparation - Recycling Process - Screening and Grading	- Fertilizer - Animal Feed - Soil Amendments - Bedding - Biogas/Bio-Oil	Low	Low	High	Medium	N/A	-	Low	Low	Medium	Low	Low	High	Reprocessing of food waste	High-Impact	Odour and Air Pollution Diseases? (if pathogen removal is unsuccessful)
Plastic Waste	Plastic bottles, tubs, trays, packaging	- Shredder, extruder	- Collection - Sorting/Categorising - Washing - Shredding - Melted (sometimes) - Pelletised - Fiberised - Identification/Separation of Plastics - Extruding/Compounding	Different sizes and types of plastic elements suitable for: - Asphalt, - Plastic products	Low	Medium	Low	High	N/A	-	Medium	Medium	Low	Low	Low	Medium	Recycling, storing or reprocessing plastic waste	Medium-Impact	Plastic microfiber pollution into air and waterways
Glass	Household and industrial glass materials	- Crushers and Sorting - Pulverisers	- Collection - Inspection/Sorting Breaking/Crushing - Trommel (Sorting by Size) - Bed Drier Fluidisation - Rotary Screens and Pulveriser - Glass Culet Sorting	Pebbles, sand and powder Products such as glass containers, fiber glass, additives into metal foundry	Low	Medium	N/A	Medium	Medium	-	High	Low	Medium	Low	Low	N/A	32. Glass fibre manufacture more than 200t per annum Recycling, storing and reprocessing glass waste	High-Impact	Glass/Silica Dust (if managed inappropriately)

		Resource requirements								Im	pacts			Other Characteristics					
Waste	Characteristics	Types of facilities	Extraction Process	Potential Outputs	Labour (Skill Level)	Labour Intensity	Water	Electricity	Gas (LPG etc	Comment	Noise	Dust	Traffic	Light	Vibration	Fluid (Gas and Liquid)	Industry Descriptor	Industrial Type	Potential Risks that require management
Paper and Cardboard	Old newspapers, magazines, cardboard, print paper, packaging paper	- Shredders and Sorting - Floatation Tank	- Collection - Sorting - Shredding and Pulping - Floatation tank/De-inking - Drying and finishing for Reuse	- Recycled Paper - Moulded Pulp	Low	Low	High	Medium	N/A	-	Low	Low	Medium	Low	Low	N/A	Recycling and reprocessing of paper waste	Medium-Impact	
Tyres	All forms of tyres	- Rubber Powder Facility	Rubber Powder: - Collection and Sorting - Shredding - Metal Separator - Cooling - Granulation - Cooling - Powder Milling and Sifting - Reuse	Rubber Powder: - Aggregate in concrete and asphalt - Carbon and small steel products - Various rubber surfaces	Medium	Low	Medium	High	N/A	Cryogenic cooling involved, therefore cooling gases such as liquid nitrogen and solid CO2 required	Low	Medium	Low	Low	Low	Low	21. Recycling and reprocessing tyres including retreading	Medium-Impact	Fire in storage of tyres Rubber Powder dust
Tyres	All forms of tyres	- Rubber Tyre Shredders	Collection - De-beading tyres - 1st rubber shredding machine (Somm) - 2nd shredding machine (5-10mm) - Magnetic Separators to extract steel - Depending on granule size, either - word or areaset schedding moress	Rubber Granules: - Aggregate in concrete and asphalt - Carbon and small steel products - Various rubber suffaces	Low	Low	N/A	High	N/A	-	Low	Medium	Low	Low	Low	Low	21. Recycling and reprocessing tyres including retreading	Medium-Impact	Fire in storage of tyres
Textile	Clothing, mattress material, linens, draperies, cleaning materials, leisure equipment etc	- Shredding - Yarning	- Sorting - Shredding - Cleaning and Mixing - Re-spinning - Reuse	- Automobiles (Car seats, cushions?) - Mattresses - Wearable clothes	Low	Low	Low	Medium	N/A	-	Low	Low	Low	Low	Low	N/A	Recycling and reprocessing textiles	Medium-Impact	

Appendix B

Indicative Facility Throughput for Various Materials Recovery Activities



The following table outlines the indicative throughput of material that can achieved per hectare of built operating area in different materials processing streams. This information can be used to determine the likely size requirements of operating facilities needed to process the projected volumes of material that require processing. The information in this table is indicative only and is based on analysis of a cross section of exemplar facilities across Australia and internationally.

Indicative facility throughput for various material recovery activities										
Precinct material category	Types of materials processed	Activities conducted in precinct	Approximate tonnes of material processed per annum per hectare of operating facility built area							
Construction and	Concrete, brick,	Sorting, separating,	5,000 to 35,000							
demolition	masonry, timber, soil, some metals	crushing, shredding, chipping, grinding								
Metals	Ferrous and non- ferrous metals	Sorting, separating, crushing, smelting, casting	5,000 to 15,000							
E-waste	Lead batteries, litium- ion batteries, circuit boards, ink cartridges, hard disks	Sorting, separating, stripping, casting, melting	50,000 to 85,000							
Organic waste	Green and organic waste	Shredding, composting, screening, mulching	20,000 to 40,000							
Plastic	Plastic bottles, tubs, trays, packaging etc	Sorting, separating, washing, shredding, extruding	35,000 to 45,000							
Glass	Household and industrial glass materials	Sorting, separating, washing, crushing, pulverising	35,000 to 135,000							
Paper and cardboard	newspapers, paper, magazines, cardboard, print paper, packaging paper	Sorting, separating, shredding, flotation tanks	10,000 to 30,000							
Tyres	Tyres	Sorting, separating, rubber shredding	10,000 to 20,000							

e3advisory.com

Brisbane Level 2, 10 Eagle Street Brisbane QLD 4000 +61 7 3160 3150

Sydney Sydney NSW 2000 +61 2 8097 0790

Perth Level 22, 9 Castlereagh Street Level 11, 111 St Georges Terrace Perth WA 6000 +61 8 6110 1720