

# BPLN0039\_SKNK8

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# Circular Public Housing

**Enabling circular strategies in public housing estates in the UK for environmental, social and economic benefits**

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**University College London**  
**Faculty of the Built Environment**  
**The Bartlett School of Planning**

**Circular Public Housing:**  
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**UK for environmental, social and economic benefits**

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Being a major research project submitted to the faculty of The Built Environment as part of the requirements for the award of MSc Urban Design and City Planning at University College London.

I declare that this major research project is entirely my own work and that ideas, data, and images, as well as direct quotations, drawn from elsewhere are identified and referenced.

# Acknowledgement

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# Abstract

As the world faces resource scarcity, there is a need to move from the wasteful linear economy to a resource-efficient circular economy, which is not only beneficial for the environment, but also for the economy and the society. To accommodate a circular economic system, circularity principles should be applied to our urban built environment. Public housing estates in the UK, being economically and socially deprived, can adopt circular strategies at household, estate and neighbourhood level for economic, environmental and social benefits. Thus, a key research question emerges: **How to enable circular strategies in public housing estates in the UK for environmental, social and economic benefits?**

With insights gained from literature review and field research, a circular framework with four principles and circular systems with physical space, programming, stakeholders and enablers are proposed. A framework for benefits and measurement is also developed. The circular framework and systems are then applied in South Bermondsey, one of most deprived neighbourhoods with a high percentage of public housing estates in Southwark, London. Circular strategies like Circular Hubs and Circular Hood are deployed.

Environmental, economic and social benefits from the circular systems are then estimated to evaluate the design application. To scale up the circular framework, recommendations for local authorities and developers are provided for applying the circular framework and systems in future new development, either smaller urban development projects or larger scale masterplan type projects to build a sustainable future for cities with circular neighbourhoods.

Keywords: Circular Cities | Circular Neighbourhoods | Circular Strategies | Public Housing | Sustainability Benefits | Sustainable Development



# Table of Content

Acknowledgement	3
Abstract	4
Table of Content	5
List of Figures and Tables	6

<b>01 Introduction</b>	<b>7</b>
1.1 Paradigm shift needed – From linear consumption to circular economy	8
1.2 Adopting circularity to benefit deprived public housing estates	9
1.3 Research question and objectives	10
<b>02 Methodology</b>	<b>11</b>
2.1 Research-led design approach	12
2.2 Scope of study	13
2.3 Risk assessment and ethical statement	13
<b>03 Research</b>	<b>14</b>
3.1 Circular frameworks	15
3.2 Challenges	16
3.3 Circular strategies	18
3.4 Stakeholders and enablers	21
3.5 Environmental, social and economic benefits	22
<b>04 Design - Circular Framework &amp; Systems</b>	<b>23</b>
4.1 Key research takeaways	24
4.2 Conceptual model – How do materials flow through the city at different level?	24
4.3 Circular framework and systems	25
4.4 Framework for benefits and measurements	30
<b>05 Design - Application</b>	<b>31</b>
5.1 Rationale of site selection	32
5.2 Site analysis	33
5.3 Social demographic profile	34
5.4 Current waste management system in Southwark	35
5.5 Opportunity areas	36
5.6 Design proposal	37
<b>06 Evaluate</b>	<b>45</b>
6.1 Impact assessment	46
6.2 Scaling up	47
6.3 Conclusion	50
<b>References</b>	<b>51</b>
<b>Appendix</b>	<b>52</b>



# List of Figures and Tables

Figure 1: Global waste generation per capita (Source: O'Donnell and Pranger, 2020)	8
Figure 2: Methodology Framework (Source: Author's own)	12
Figure 3: Circular Economy Framework by EMF (Source: EMF, 2019)	15
Figure 4: Circular Cities Framework by Jo Williams (Source: Williams, 2019)	15
Figure 5: Site design challenges for circularity in public housing in the UK (Source: Author's own)	17
Figure 6: Stakeholders according to function and interaction for Dutch social housing (Source: Eikelenboom et al., 2021)	21
Figure 7: Levers / enablers for circular development (Source: Williams, 2021)	21
Figure 8: Framework of benefits for circular cities (Source: Williams, 2021)	22
Figure 9: Conceptual model of material flows and circularity (Source: Author's own)	24
Figure 10: Circular framework for public housing in the UK (Source: Author's own)	25
Figure 11: Key components of circular systems (Source: Author's own)	26
Figure 12a: Linear and circular systems of three select materials (Source: Author's own)	27
Figure 12b: Linear and circular systems of three select materials (Source: Author's own)	28
Figure 12c: Linear and circular systems of three select materials (Source: Author's own)	29
Table 1: Framework for benefits and measurement for circular strategies in public housing estates in the UK (Source: Author's own)	30
Figure 13: Map of most deprived neighbourhoods and their public housing estates in Southwark Borough (Source: Author's own)	32
Figure 14: Site analysis map of South Bermondsey (Source: Author's own)	33
Figure 15: Socio-economic demographic profile of South Bermondsey (Source: Author's own; Data from Southwark Council, no date)	34
Figure 16: Current waste management system in Southwark (Source: Author's own)	35
Figure 17: Opportunity map for circular strategies in South Bermondsey (Source: Author's own)	36
Figure 18: Intervention map for circular systems in South Bermondsey (Source: Author's own)	37
Figure 19: Schematic and illustration of Sorted Bins (Source: Author's own)	38
Figure 20: Essential components and their associated circular principles of Circular Hubs (Source: Author's own)	39
Figure 21: Illustration of Circular Hub (Source : Author's own)	40
Figure 22: Essential components and their associated circular principles of Circular Hood (Source: Author's own)	41
Figure 21: Illustration of Circular Hood (Source : Author's own)	42
Table 2: Key stakeholders and their roles and responsibilities (Source: Author's own)	44
Table 3: Enablers for circular strategies in South Bermondsey (Source: Author's own)	44
Figure 22: Estimated benefits generated from circular systems in South Bermondsey (Source: Author's own)	46
Figure 23: Recommended configurations and dimensions of kitchen for dwellings of different sizes (Source: London Plan Guidance: Housing Design Standards Consultation Draft, 2022)	47
Figure 24: Changes in streetscape in new build development before and after the implementation of circular systems (Source: Author's own)	48
Figure 25: Schematic of shaping circular cities with circular neighbourhoods and its effect on resources and sustainability aspects (Source: Author's own)	49
Figure 26: ICLEI Circular City Action Framework (Source: Novak et al., 2021)	52
Figure 27: UNEP Circular Neighbourhood Framework (Source: United Nations Environment Programme, 2021)	52
Table 4: List of housing association partners in Southwark (Source: Southwark Homeseach, no date)	53
Table 5: Detailed assumptions and calculation of benefits and measurements (Source: Author's own)	53



# 01 Introduction





## 1.1 Paradigm shift needed – From linear consumption to circular economy

In the 21<sup>st</sup> century, the world is inundated with consumer goods as most humans in more developed countries live a consumerist lifestyle with material abundance. As countries urbanise and adopt a disposable culture, and develop a linear mode of production and consumption, waste generation tends to increase, resulting in people from most countries in the global north generating more than 1 kg of waste everyday (O'Donnell and Pranger, 2020).

The problem of linear economy has been the inefficient use of limited resources and the destruction of the natural world by pollution from waste. Living within the system of linear economy, consumers are often unaware of the hidden environmental and social impacts from their products that are impulse-bought online, mass-produced in factories with poor working conditions and shipped to their home across the world via a carbon-intensive journey.

A paradigm shift is needed for the world to move from a linear mode of production and consumption to a circular economy. Circular economy is a model for production and consumption with an ultimate goal of achieving the decoupling of economic growth from natural resource depletion and environmental degradation (Jackson, 2009). All actors and stakeholders need to rethink and reprogramme the current wasteful linear economic system into a circular one that is resource efficient, ecologically regenerative and resilient to future changes (Williams, 2021).

To accommodate a circular economic system, similar circularity principles should be applied to our urban built environment. As natural resources are finite, our cities must operate within the ecological carrying capacity (Williams, 2021). One measure of success is diversion rate (i.e. recycling and composting). Although UK's rate has improved from 11% to 43.5% from 2000 to 2020, UK still lags behind its European peers like Germany, which has a rate of 66% (O'Donnell and Pranger, 2020).

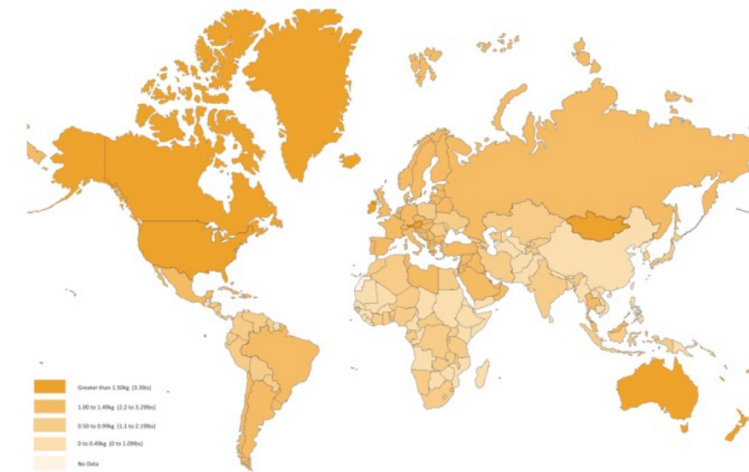


Figure 1: Global waste generation per capita (Source: O'Donnell and Pranger, 2020)

## 1.2 Adopting circularity to benefit deprived public housing estates

Public housing estates, which account for 10% of homes in the UK (Woodard and Rossouw, 2021), have always been stigmatised to be 'sink estates' with high crime rate, poverty, unemployment and poor health (Johnston and Mooney, 2007). Poor waste management has contributed to the urban decay problem in public housing. Yet, waste management in public housing is under-researched in academia (Woodard and Rossouw, 2021). There is room for improvement for the system and user experience of waste disposal and recycling in public housing to encourage more pro-environmental behaviours. By deploying circular strategies, public housing estates in the UK can efficiently (re)use their resources and build local resilience for material needs at different scales – household, estate, neighbourhood and beyond. This contributes to boosting UK's waste diversion rate, while tackling the global problems of climate crisis and resource depletion.

Since 1980s, councils in the UK have been regenerating their dilapidated post-war public housing estates to meet housing needs and to improve the living conditions and social deprivation of the neighbourhoods (Watt, 2021). Deploying circular strategies as a regeneration approach would be a viable option, as research suggests that circularity can create economic and social benefits (Williams, 2021). For instance, an urban farm as a circular strategy creates loops for organic matters with composting, generates economic value from the sales of farm produce and the jobs created, and fosters a sense of community. Such strategies benefit

the local residents and community, and would help with the sustainable regeneration of deprived estates and neighbourhoods. This presents an opportunity for circularity as a tool to bring about economic, social and environmental values in neighbourhoods and cities. To quantify these intangible benefits, measurements should be developed to track the impacts of circular strategies.



## 1.3 Research question and objectives

### Key question

Considering the urgent need of the promotion of circular economy and the regeneration of deprived public housing estates, a key research question emerges:

**How to enable circular strategies in public housing estates in the UK for environmental, social and economic benefits?**

### Sub-questions

In order to dissect the complex research question, several sub-questions are to be explored, which are:

**1 How to design a good circular framework that work in public housing estates in the UK?**

There is a lack of research into implementing circular strategies in the context of public housing estates in the UK. A suitable circular framework that works in this context is to be developed.

**2 How to implement circular framework and systems for existing public housing estates and scale them up for new residential developments in other neighbourhoods?**

Circular framework and systems for existing public housing estates are to be designed. In order to scale up the project, recommendations to local authorities and developers for applying circular strategies to new residential developments are to be explored.

**3 What are the enablers and stakeholders involved?**

Implementing circular strategies involves various enablers and a network of stakeholders. Identifying and analysing such enablers and stakeholders would be the key to success for the circular strategies.

**4 What are the environmental, social and economic benefits, and measurements of the proposed interventions?**

Apart from the more obvious environmental benefits from circular strategies, associated social and economic benefits are to be examined. A framework for measuring the benefits is to be developed and benefits from the proposed interventions are to be estimated using the framework.

### Objectives

This research project aims at developing practical circular systems for urban planners/designers, developers and community organisers to implement circular strategies for existing public housing projects. It helps practitioners to recognise circular cities strategies can deliver environmental benefits, as well as socio-economic values. This can be applicable to public housing in the UK and shows that the concept of circular can be a viable and effective smaller-scale interventions at household, estate or neighbourhood level. This project also offers imagination of ways to scale up the proposed framework and systems beyond existing public housing estates, and inspires local councils and developers to rethink their approaches to waste management in new build residential developments in other neighbourhoods.



# 02 Methodology



## 2.1 Research-led design approach

A research-led design approach is adopted. Findings from the research process inform the design process. Insights gained from the design process prompt the need to conduct additional research to enrich the design. Through trial and error, and reiteration of design, the circular framework and systems and the proposal for the design application can be continuously improved. The figure below illustrates the interactions of the research process and the design process.

**Literature review:** Academic literatures are reviewed to understand the existing circular frameworks, circular applications in public housing and the possible benefits. Grey literatures are reviewed to identify exemplars of circular projects in public housing and examine the existing housing design policies and guidelines.

**Field research:** Site visits to public housing estates in Southwark, London are conducted to understand the current waste management practices. Informal dialogues were carried out with residents during the site visits to gain better insights.

**Develop circular framework and systems:** After distilling the findings from the research process, a new framework for circularity in public housing is proposed. It includes circular principles, processes, stakeholders, benefits and measurements. After developing the framework, circular systems with strategies and components of different scales are designed. Three materials (e.g. clothing, electronic, food) are selected to visualise a "before and after" flow of material, which illustrate how the material flow and loops from its origin to its cradle through the different scales (i.e. household, estate and neighbourhood).

**Application:** A study area in South Bermondsey in Southwark is selected for design application. Site analysis is conducted. Circular systems and strategies are localised, which are illustrated by urban design graphics. System of enablers and stakeholder involvement are proposed.

**Impact assessment:** Environmental, economic and social impacts are estimated according to the framework for benefits and measurements.

**Scaling up:** Future possibilities for scaling up the circular framework and systems beyond neighbourhoods with existing public housing into different types of development projects and neighbourhoods are discussed.

**Conclusion:** The importance and limitations of the project are reflected upon. Future research opportunities are suggested.

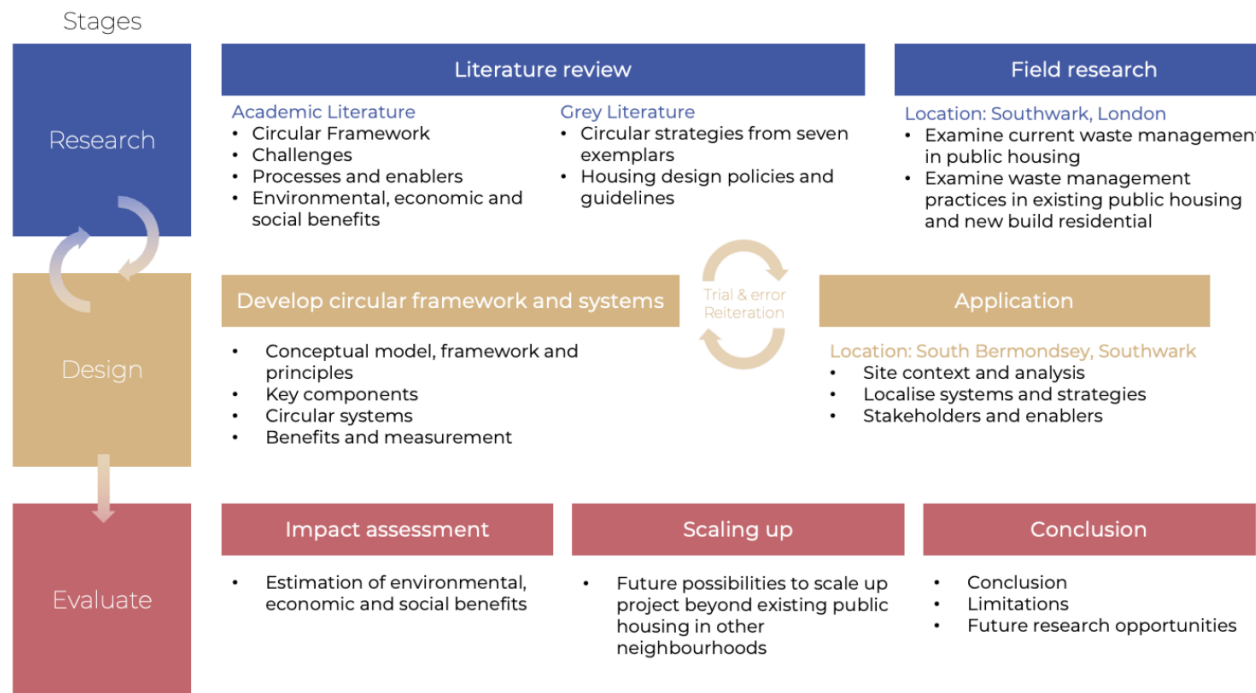


Figure 2: Methodology Framework (Source: Author's own)

## 2.2 Scope of study

This research examines how materials flow through the different scales of a city. To achieve an in-depth look into this topic, the scope of study is limited to the following aspects:

- Material flows:
  - Organic renewable materials (i.e. food, food waste, etc.)
  - Inorganic finite materials (i.e. clothing, electronics, home furniture, home appliances, etc.)
- Scale: Household, estate and neighbourhood level interventions.

However, household, estate and neighbourhood level interventions would require coordination beyond neighbourhood level, which is discussed in the Design stage. Future possibilities and interventions of scale beyond neighbourhood are also discussed in the Scaling up section.

Some aspects that are often considered in circular cities framework are excluded from the research, which include water, energy, heating and construction waste. Nevertheless, the water, energy and carbon footprint of the material flows are examined as benefits and measurements for the circular strategies.

## 2.3 Risk assessment and ethical statement

Various risks are assessed and precautions are taken to prevent ethical issues while collecting information and interacting with the community. Measures taken are:

- **Risk:** Field research involves low level of outdoor safety risks for conducting the field research (i.e. transport, personal safety, COVID). Appropriate mitigation measures are adopted.
- **Data protection:** Seek consent of participants. Anonymise interviewees in informal interviews. During photo-taking in field research, avoid including faces of individuals in pictures.
- **Equality and diversity:** Reflect on the context of different literature during literature review and keep in mind of the demographics of the study area.





# 03 Research

Literature Review, Exemplars and Field Research

### 3.1 Circular frameworks

#### Circular economy

The most widely referenced circular economy framework is from the 'butterfly diagram' by the Ellen MacArthur Foundation ('EMF'), which focuses on the flows of organic materials and inorganic materials (EMF, 2019). Loops are created within the biological and technical cycles through different processes or economic activities. It provided a foundation for different disciplines to develop their specific circular framework.

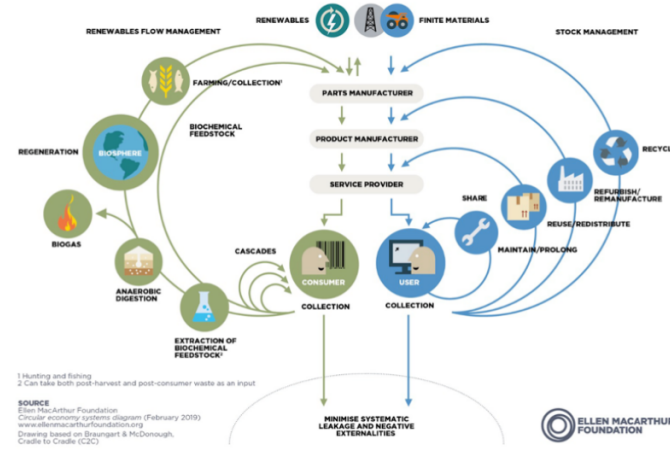


Figure 3: Circular Economy Framework by EMF (Source: EMF, 2019)

#### Circular cities

Various frameworks on circular cities have been developed by different international organisations and academics. ICLEI – Local Governments for Sustainability, an international NGO, co-developed and published a Circular City Actions Framework<sup>1</sup> with Circle Economy, Metabolic and EMF, outlining a 5R approach of *Rethink, Regenerate, Reduce, Reuse and Recover* (Novaketal.,2021).United Nations Environment Programme ('UNEP') also published a circular neighbourhood framework<sup>2</sup> with a range of organisations, promoting three focus areas of *circular construction, servitisation and circular food system* (UNEP, 2021). However, these two frameworks may not be readily applicable to public housing estates in the UK. ICLEI's 5R framework, albeit easy to understand and remember, is too generic, while UNEP's framework provides specific strategies, rather than high level principles, for neighbourhoods.

The Circular Cities Framework by Jo Williams (2019) is more suitable, useful and meaningful for applying in public housing estates. It outlines seven 'principles', which she describes as 'circular actions' and 'support actions'. They include *Looping, Adapt, Regeneration of the urban ecosystem, Localise, Substitute, Share and Optimise*. The framework is developed with a system approach, illustrating the flow of resources into, within and out of the urban system. The principles of Loop, Adapt, Regenerate and Share are most appropriate for a circular framework for public housing estates in the UK, considering the scope of study.

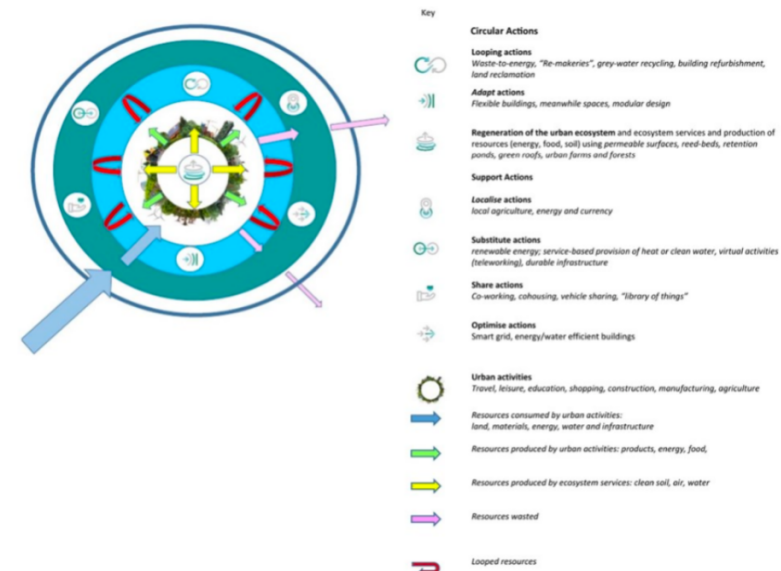


Figure 4: Circular Cities Framework by Jo Williams (Source: Williams, 2019)

1 See figure in Appendix  
2 See figure in Appendix



## 3.2 Challenges

Through academic research and site visits, the challenges for adopting circularity in public housing can be categorised into socio-economic, policy and system, and site design challenges.

### Socio-economic

Çetin et al (2021) interviewed experts from Dutch social housing organisations and found that the top five challenges for circularity in social housing are: (1) Higher priority on other issues; (2) Operating in a linear system; (3) Lack of awareness, knowledge and experience; (4) High costs of circular materials; and (5) Unclear business case. Further studies should be conducted in the UK context to compare results.

### Policy and system

According to Defra (2018), the current waste collection system in the UK is 'confusing' for households, as different local authorities adopt their own waste collection system. The Household Waste Recycling Act 2003 has required local authorities to provide households with separate collection of at least two types of recyclable materials (O'Donnell and Pranger, 2020). Some local authorities like Southwark Council adopts a system to collect mixed dry recyclables and food waste separately, while some areas like Newcastle-under-Lyme adopts a multi-stream waste collection system where food waste, garden waste, metal/plastic, glass/cans, cardboard, paper, textiles, and plastic bottles are separated in the households (O'Donnell and Pranger, 2020). This creates confusion for households, especially for those who move to different local authorities.

A multi-stream system is a better choice. It results in a higher recycling rate and reduced contamination of recyclables as consumers are more involved with sorting their wastes (O'Donnell and Pranger, 2020). Evidence supports this - fewer items are disposed of incorrectly by households who are living in areas that have multi-stream recycling (Roberts and Downing, 2021); and Newcastle-under-Lyme's multi-stream system results in an increase of recycling rate from 27% in 2009 to 50% in 2012 (O'Donnell and Pranger, 2020). The UK is in need to 'upgrade' the double-stream systems of some local authorities (e.g. Southwark) to the better multi-stream systems.

'Double-stream' system



Multi-stream system

### 3.2 Challenges

#### Site design

From observations during field research, there are mainly two types of waste collection systems for existing public housing estates, which are kerbside/open system and chute system. Estates with either system lack appropriate space for recycling or circular processes and activities. Some estates with kerbside/open system have disorganised bins, which block pedestrian and vehicular movement. Chute systems discourages recycling activities and are prone to blockages (Moore, 2017). Some of them also lack step-free access for all users.

For new build residential buildings with kerbside/open system, their recycling facilities are inconvenient and undesirable, as dirty environment discourages recycling activities. Their bin storages often take up street frontages, causing the streetscape to appear unattractive and unsafe.

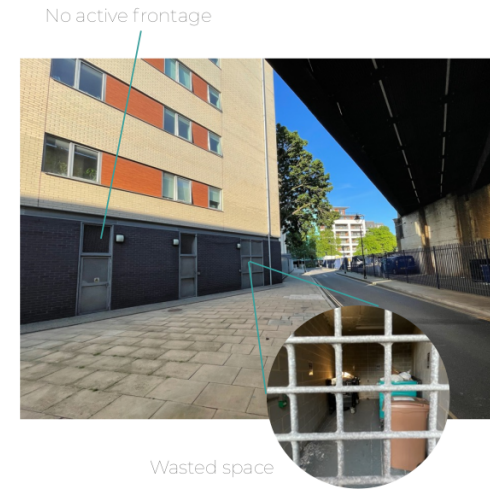
Existing public housing - Chute system



For G/F flat



New build residential - Bin storage



Existing public housing - Kerbside/open system



New build residential - Kerbside/open system



Figure 5: Site design challenges for circularity in public housing in the UK (Source: Author's own)

### 3.3 Circular strategies

Seven exemplars from around the world are studied to classify different circular strategies at different level of scale and understand their pros and cons.

The seven exemplars are analysed and classified under four common circular principles, which are Loop, Regenerate, Share and Adapt. Their effectiveness is also evaluated. The definitions of the four common principles are adapted from Williams (2019) and listed below.



#### Loop

Creating material loops by reuse, recycle, recover and repair



#### Regenerate

Regenerating urban ecosystem and ecosystem services



#### Share

Sharing resources by swap, exchange, leasing and co-owning



#### Adapt

Creating adaptive capacity for change in community and promoting the adaptive use of space

#### 1. Kamikatsu Waste Station, Japan



TYPE | Physical space  
SCALE | Neighbourhood / City

Kamikatsu was the first municipality in Japan to adopt a Zero Waste policy. 1,580 residents from 800 households sort waste into 45 types in 13 categories. Kamikatsu's Waste Station serves as a communal recycling and educational space for the region. (Nippon.com, 2018)

#### STRATEGIES USED



#### Loop

Sort and recycle 45 types of waste



#### Regenerate

Food waste composting



#### Share

Space for community to swap goods



#### Adapt

Act as a community space for people to share knowledge

#### EVALUATE

##### + Pros

Able to nurture a highly engaged community to sustain a zero-waste village.

Created a system to meticulously sort and recycle 45 types of waste, which helps to retain the economic value of the resources.

##### - Cons

Takes years and a lot of resources to create behavioural change at a communal level.

Maybe difficult to replicate in denser urban area.

#### 2. Recycling Stores, Hong Kong



TYPE | Network of physical space  
SCALE | Neighbourhood

Since 2020, the Hong Kong government has engaged non-profit making organizations in setting up a network of Recycling Stores at convenient locations. The Stores are usually located in shopfronts in mixed used area where recycling facilities are limited. They feature sleek multi-stream waste collection interface with wash basin for clean recycling. Users can earn points to be rewarded with food and other necessities by recycling. (Environmental Protection Department of Hong Kong, no date)

#### STRATEGIES USED



#### Loop

Clean recycling of multiple types of waste



#### Regenerate



#### Share

Space for community to swap goods



#### Adapt

Use gamification to encourage recycling

#### EVALUATE

##### + Pros

Operate in mixed-used neighbourhoods where recycling services are limited.

Sleek and modern design of the 'store' attracts users to visit and recycle.

Provide washing area to encourage clean recycling.

Households can save up points through recycling and reward with food and other necessity goods, which benefits low-income families.



##### - Cons

Recycling stores are operated in ground level retail shopfronts, which result in high rental cost.

### 3.3 Circular strategies

#### 3. Library of Things, London



TYPE | Network of physical space  
SCALE | Neighbourhood

Library of Things operate in 10 locations in London. They offer borrowing services of DIY, kitchen and gardening tools, and entertainment equipment to local communities. Their 'things' are stored in smart lockers for users to pick up after pre-ordering them online. (Library of Things, no date)

##### STRATEGIES USED



Loop



Regenerate



Share

Allow community to share tools



Adapt

Educate users and create a community network

##### EVALUATE

###### + Pros

Only require a small space. Can be deployed in different types of neighbourhoods.

###### - Cons

Require hi-tech system with higher costs to track the rental status of the tools.

Require maintenance of the tools.

#### 4. Repair Cafe, Worldwide



TYPE | Network of physical space  
SCALE | Neighbourhood

Repair Café is a global initiative to create a network of 'cafes' that offers workshops and tools for visitors to drop by to fix their household items. It is a decentralised movement which people can start their own 'cafes' with the aid of the Repair Café toolkit. (Repair Café, 2021)

##### STRATEGIES USED



Loop

Repair and refurbish inorganic materials (clothes, furniture, appliances, etc.)



Regenerate



Share

Share tools for repairing



Adapt

Educate and train community on practical skills

##### EVALUATE

###### + Pros

Decentralised open-source network allows interested businesses and communities to join.

###### - Cons

Decentralised open-source network also means fewer regular services in less optimal locations.

#### 5. Sutton Community Farm, London



TYPE | Physical space  
SCALE | Neighbourhood / Borough

Sutton Community Farm is a community-owned urban farm that grows 15+ tonnes of fresh produce every year with sustainable farming practices and the help of 80 volunteers. It is a viable business with 500 VegBox subscriptions from local residents. In 2021, they co-created with the community a strategy that planned their activities to deliver long term environmental, social and economic benefits. (Sutton Community Farm, no date)

##### STRATEGIES USED



Loop

Compost food waste and produce fresh food locally



Regenerate

Regenerate natural resources like soil



Share



Adapt

Create connections between farmers and community members through vegbox and volunteering

##### EVALUATE

###### + Pros

Conducted strategy workshops to empower farmers to community to manage the farm's activities more economically, socially and environmentally sustainable.

###### - Cons

Requires commitment and support from farmers, volunteers and community.

### 3.3 Circular strategies

#### 6. Collection Blueprints, Wales



TYPE | Policies and interventions (systems and physical spaces)  
SCALE | Household to National

The Collections Blueprint is the Welsh Government's recommended service profile for the collection of household waste to achieve high rate of high-quality recycling. It was launched in 2011 as part of the Municipal Sector Plan. It promotes multi-stream recycling with local authorities adopting various strategies to meet their 2050 zero waste target. (Collections Blueprint, no date)

##### STRATEGIES USED



##### Loop

Adopt multi-stream recycling nationally and refurbish inorganic resources



##### Regenerate



##### Share



##### Adapt

Educate community on recycling with clear signages and communications

##### EVALUATE

##### + Pros

Top-down policies and the 2050 zero waste target can help to pressure local authorities to adopt circularity strategies.

##### - Cons

Require visions and ambitions from the Welsh national government.

#### 7. Green Delights in Estates, Hong Kong



TYPE | Programming  
SCALE | Neighbourhood / City

Green Delights in Estates is a community engagement programme targeting residents in public estates in Hong Kong. It is an annual programme, which dozens of public estates are chosen to participate every year. Programmes include upcycling workshops, green carnivals, green outreach teams, volunteering, tours to eco facilities, et cetera. (Hong Kong Housing Authority, no date)

##### STRATEGIES USED



##### Loop

Temporary collection point in estates and upcycle inorganic materials



##### Regenerate



##### Share

Swap clothes and household items



##### Adapt

Educate public estate residents on recycling and eco-living through various programmes

##### EVALUATE

##### + Pros

A wide range of activities attract different groups of residents in public estates.

##### - Cons

Only a few estates are selected annually for the programme.

### 3.4 Stakeholders and enablers

#### Stakeholders

Implementing circular strategies requires integration of social elements, creating a network of community relationships and strategising stakeholder engagement (Eikelenboom et al., 2021). Eikelenboom et al. (2021) identified stakeholders by four functions and level of interaction within the Dutch social housing context. Such model can be adapted to the UK context.

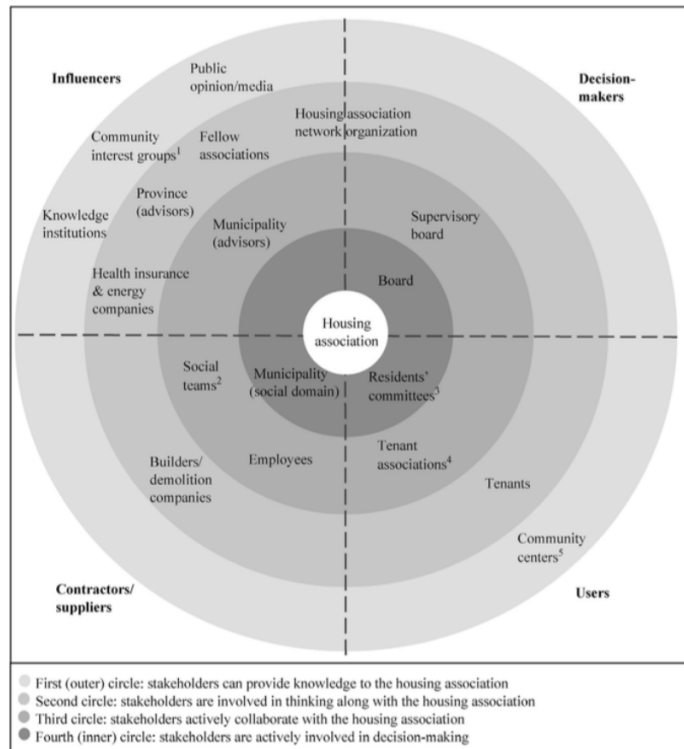


Figure 6: Stakeholders according to function and interaction for Dutch social housing (Source: Eikelenboom et al., 2021)

CIRCULAR PUBLIC HOUSING

#### Enablers

To enable the successful implementation of circular strategies, various levers or enablers can be utilised, which includes regulations, provisions, financial incentives and capacity building. These high-level policies and goals can provide a strategic vision for pathways and actions for circularity, and aid local decision making (Williams, 2021). Relevant enablers should be identified for different local projects.

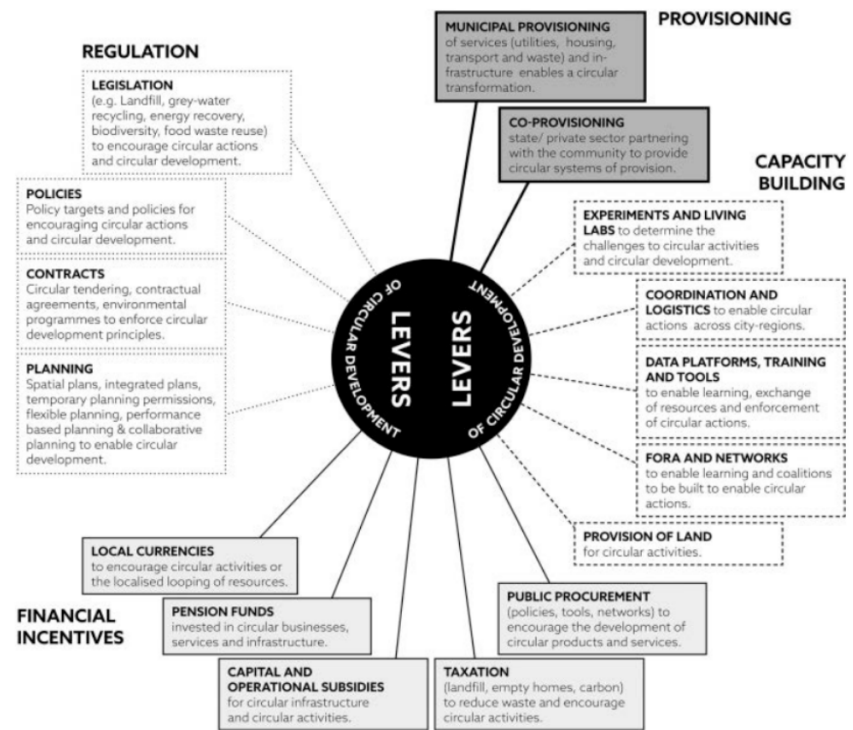


Figure 7: Levers/enablers for circular development (Source: Williams, 2021)

### 3.5 Environmental, social and economic benefits

Other than the obvious environmental benefits, Williams (2021) identified additional health, economic and community benefits brought by circular cities strategies. These benefits are mapped with the three relevant circular principles, which are Loop, Adapt and Regenerate.

As implementing circular strategies requires investment, political support and public engagement, identifying and presenting the associated environmental, social and economic benefit can build the case to gain support. Continuous monitoring and reporting of the benefits would also keep all stakeholders engaged. Williams' framework of benefits for circular cities serves as a useful foundation for developing a more specific framework for circular public housing in the UK.

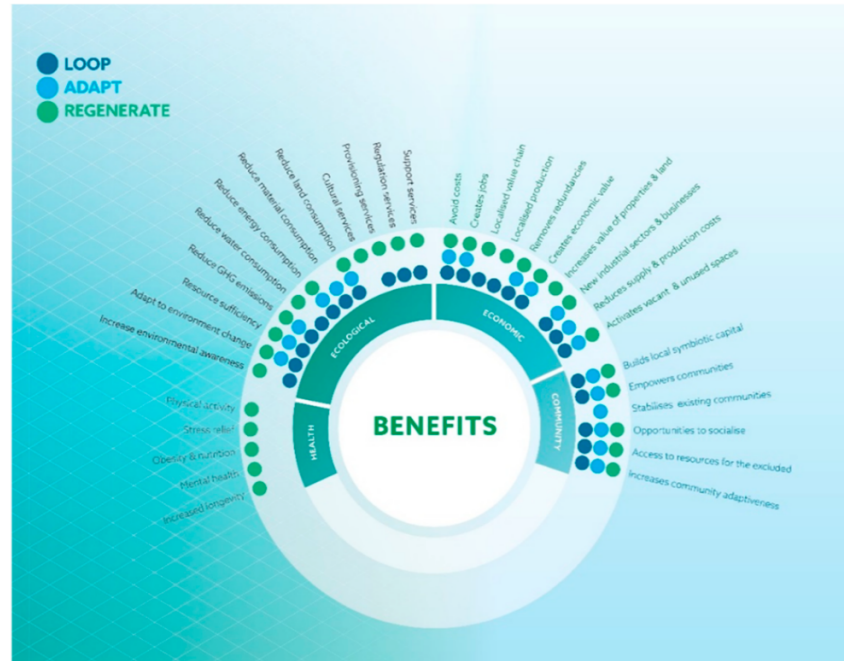


Figure 8: Framework of benefits for circular cities (Source: Williams, 2021)



# 04 Design - Circular Framework & Systems



## 4.1 Key research takeaways

Key insights are gained from the research stage and are taken into account in the design stage when proposing circular framework and systems for public housing in the UK.

- 1 There are a lot of circular economy or circular cities frameworks developed by academia and organisations. A more specific circular framework should be developed to cater for the context of public housing estates.
- 2 To set up circular systems, a hard approach of altering physical spaces like setting up recycling centres are not enough. It should be accompanied by softer measures like programming. Key stakeholders and enablers should be identified. Strategies for stakeholder engagement and activating enablers should be developed to ensure success.
- 3 The current waste collection system in public housing estates lacks appropriate space for circular activities and social interactions. Local authorities with 'double-stream' recyclable collection system should be upgraded to multi-stream system.

## 4.2 Conceptual model – How do materials flow through the city at different level?

Taking inspiration from Williams' circular cities framework (2019), a conceptual model of material flows and circularity through household, estate and neighbourhood levels is developed.

Red lines represent organic and inorganic materials flowing through households, estates, neighbourhoods, and eventually to borough level waste facilities. Some materials are output to landfills or for energy recovery, which are less environmentally sustainable options. Some are output to circular processes like recycling and remanufacturing beyond borough level. However, the further the material outputs travel, the higher the environmental footprint.

Green lines represent material circularity at different level. When more 'loops' (i.e. circular strategies/actions) are created within the system, material input and output of the system can be reduced, hence increasing the system resilience on material demands. The aim of this design project is to create more 'loops' at household, estate and neighbourhood level to lower material reliance from outside the neighbourhood systems.

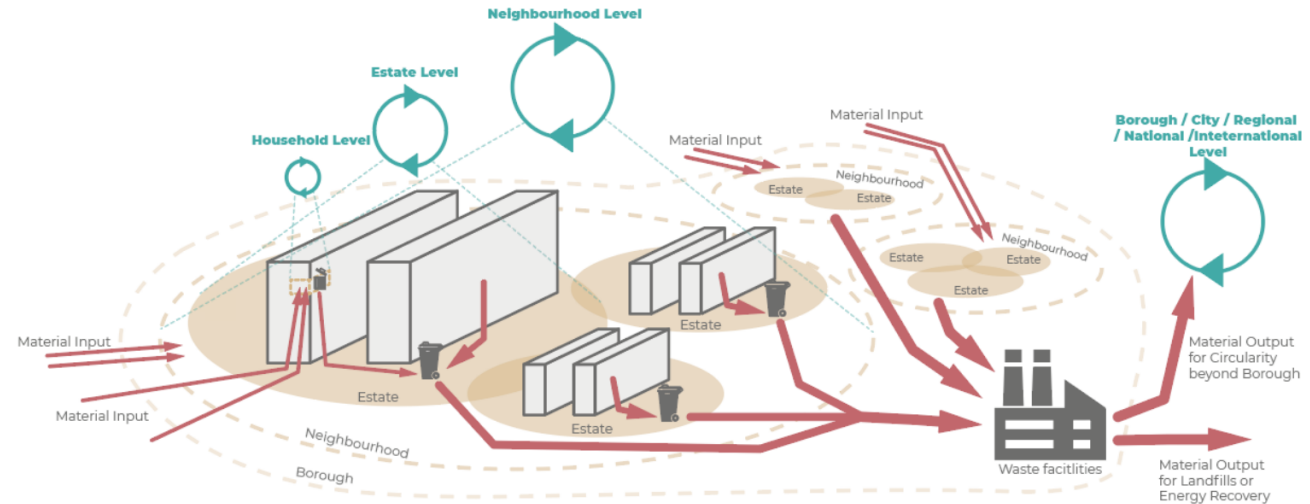


Figure 9: Conceptual model of material flows and circularity (Source: Author's own)

## 4.3 Circular framework and systems

### Overview and four circular principles

A circular framework for public housing is proposed. Circular systems of different materials should be implemented across different scale (i.e. household, estate and neighbourhood). Each circular system involves alteration of physical spaces, programming, stakeholders and enablers. These aspects are essential for the success of the circular systems. By implementing circular systems, environmental, economic and social benefits can be generated for the estates / neighbourhood, enhancing the sustainable regeneration and development of the area.

Circular systems are developed based on four circular principles, namely Loop, Regenerate, Share and Adapt. The definitions of the four principles are adapted from William (2019) and listed below.



#### Loop

Creating material loops by reuse, recycle, recover and repair



#### Regenerate

Regenerating urban ecosystem and ecosystem services



#### Share

Sharing resources by swap, exchange, leasing and co-owning



#### Adapt

Creating adaptive capacity for change in community and promoting the adaptive use of space

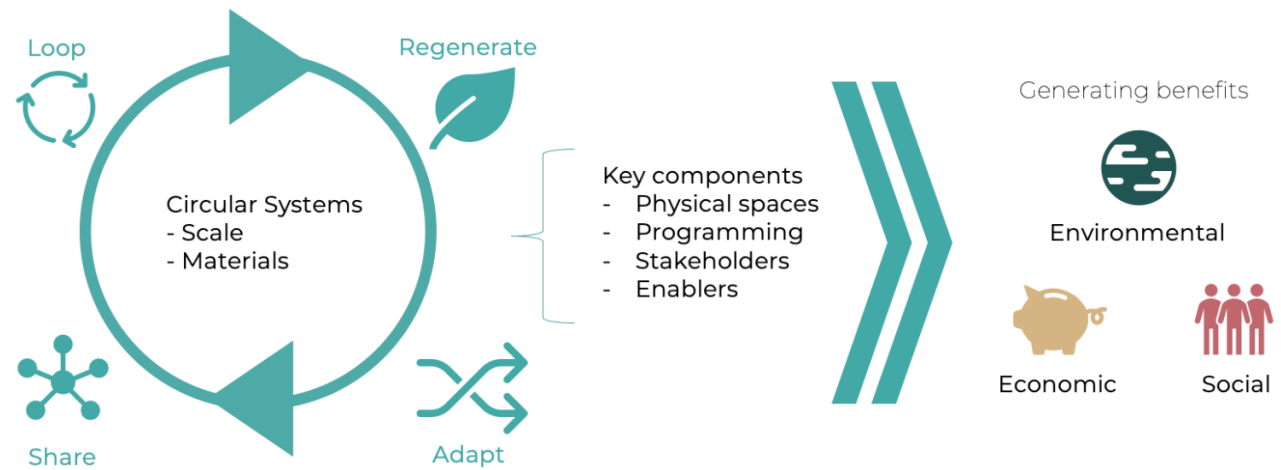


Figure 10: Circular framework for public housing in the UK (Source: Author's own)

### 4.3 Circular framework and systems

#### Key components of circular systems

Key components of circular systems include (a) Physical Spaces, (b) Programming, (c) Stakeholders and (d) Enablers. Physical Space interventions plus Programming at household, estate and neighbourhood level form systems of material flows. Circular systems also involve stakeholders who may have overlapping roles, and the activation of multiple enablers.

The framework of stakeholders and enablers are developed by adapting frameworks by Eikelenboom et al. (2021) and Williams (2021) (on page 21) to the context of public housing in the UK.

#### Definitions of (c) stakeholders

**Coordinator:** Strategise and coordinate circular systems

**Operator:** Implement and operate circular systems

**Influencer:** Advocate and influence circular actions

**User:** Use circular systems and participate in circular activities

#### Definitions of (d) enablers

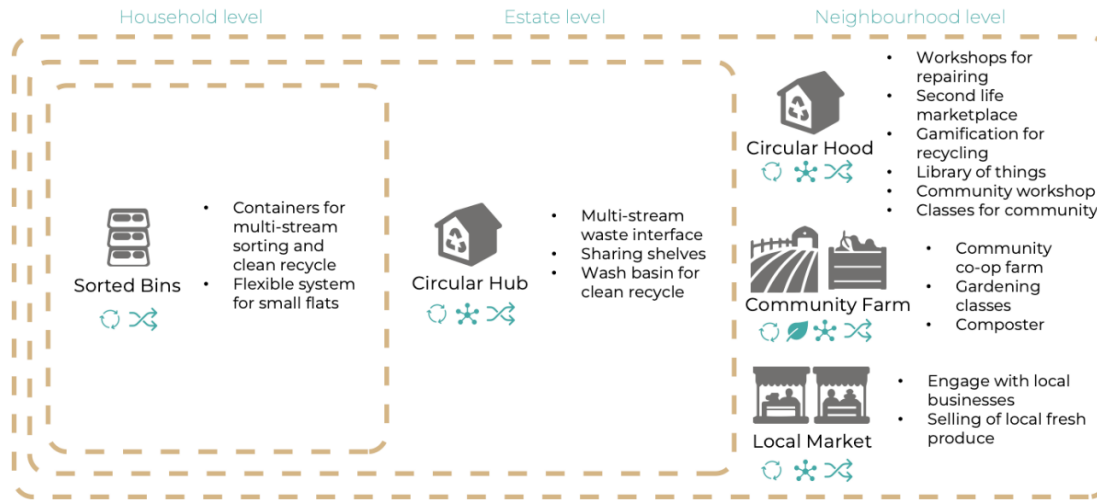
**Regulations:** Promote circularity through legislation, policies, contracts and planning

**Provisions:** Provide circular services

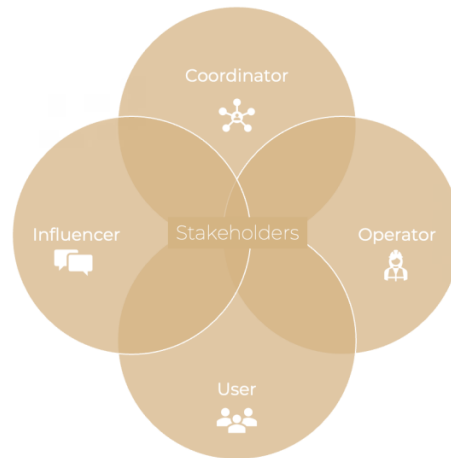
**Financial incentives:** Encourage and incentivise circularity with local currencies, pension funds, subsidies, taxation and public procurement

**Capacity building:** Promoting circularity through experiment, education, networking and provision of land

(a) Physical Spaces + (b) Programming



(c) Stakeholders



(d) Enablers

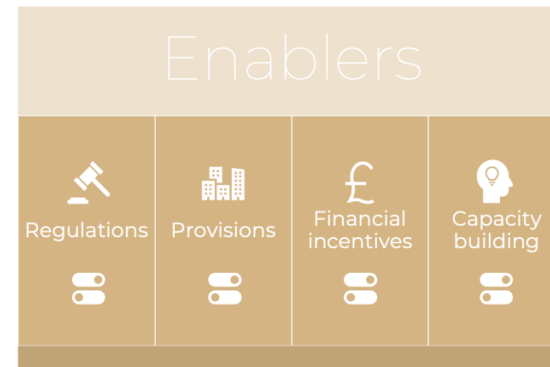


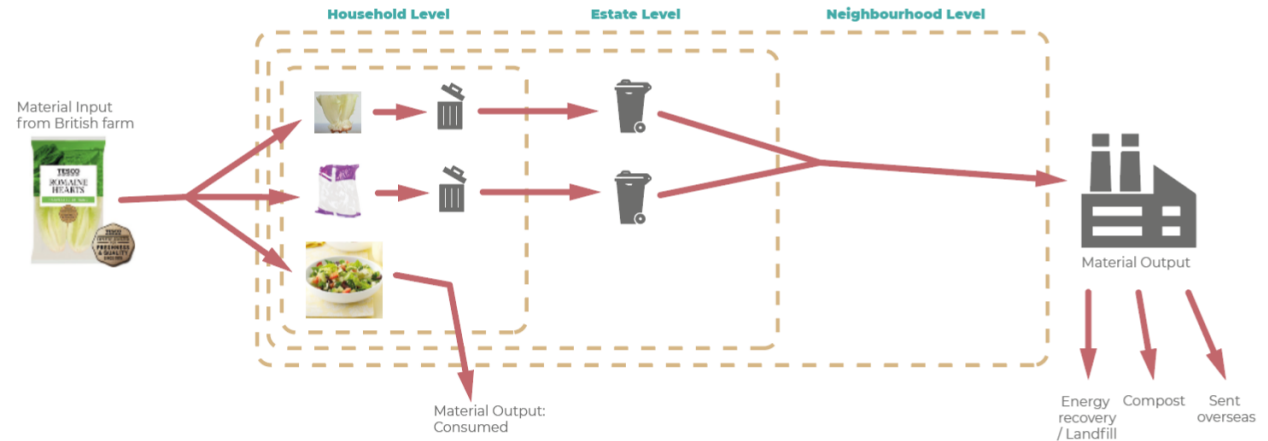
Figure 11: Key components of circular systems (Source: Author's own)

### 4.3 Circular framework and systems

#### Circular systems of three material flows

Three materials (i.e. romaine lettuce, jeans and TV) are selected to illustrate how materials flow through the different scale of places before and after the interventions. Material loops, as shown by green lines, are created after interventions, which help to reduce material input and output.

BEFORE - LINEAR SYSTEM



AFTER - CIRCULAR SYSTEM

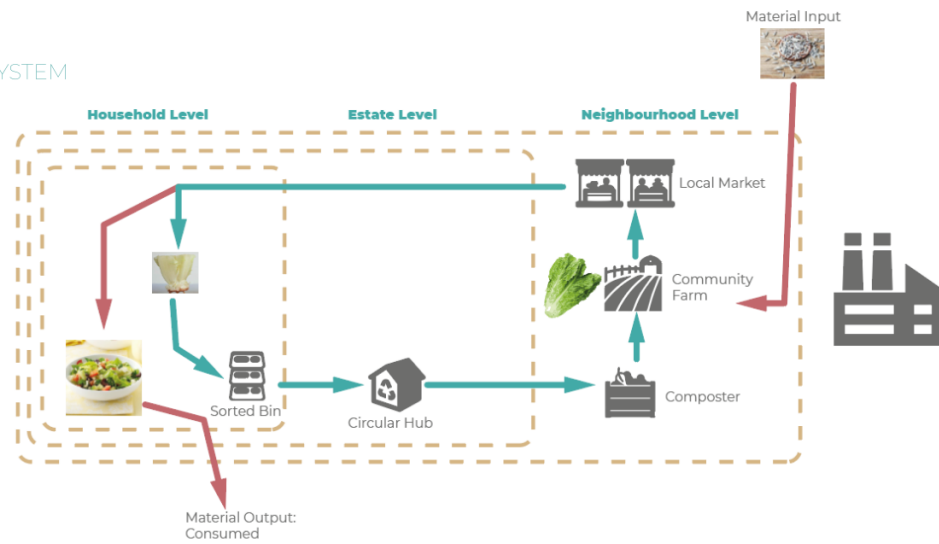
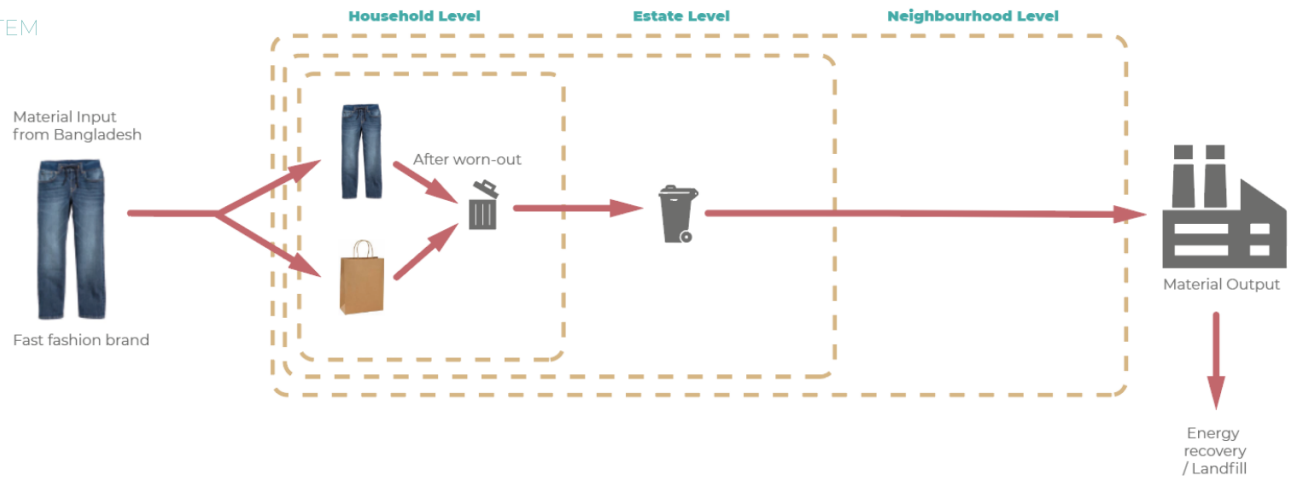


Figure 12a: Linear and circular systems of three select materials (Source: Author's own)

### 4.3 Circular framework and systems

#### Circular systems of three material flows

BEFORE - LINEAR SYSTEM



AFTER - CIRCULAR SYSTEM

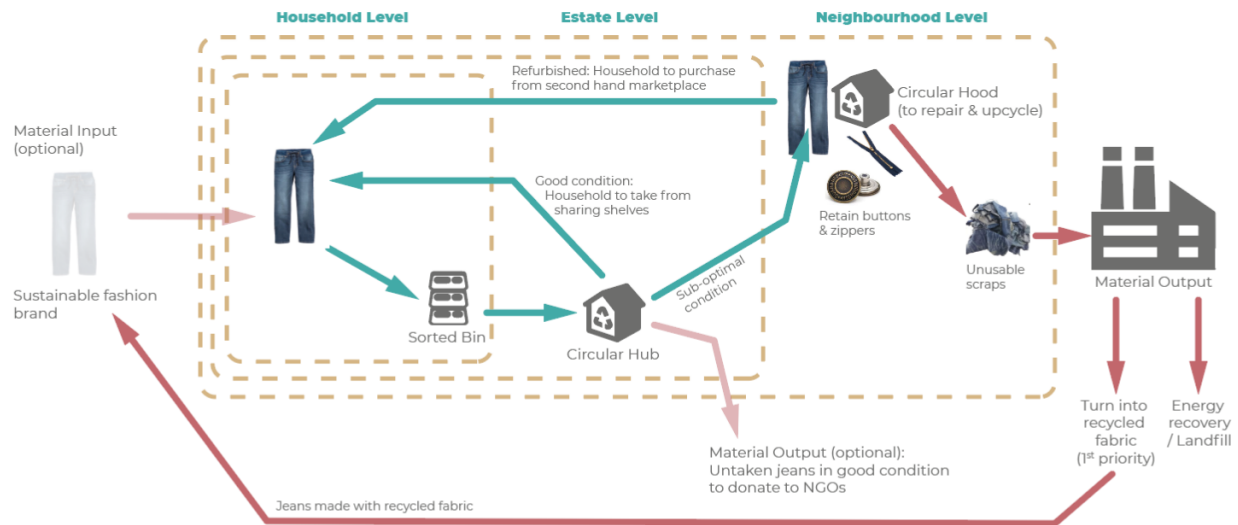
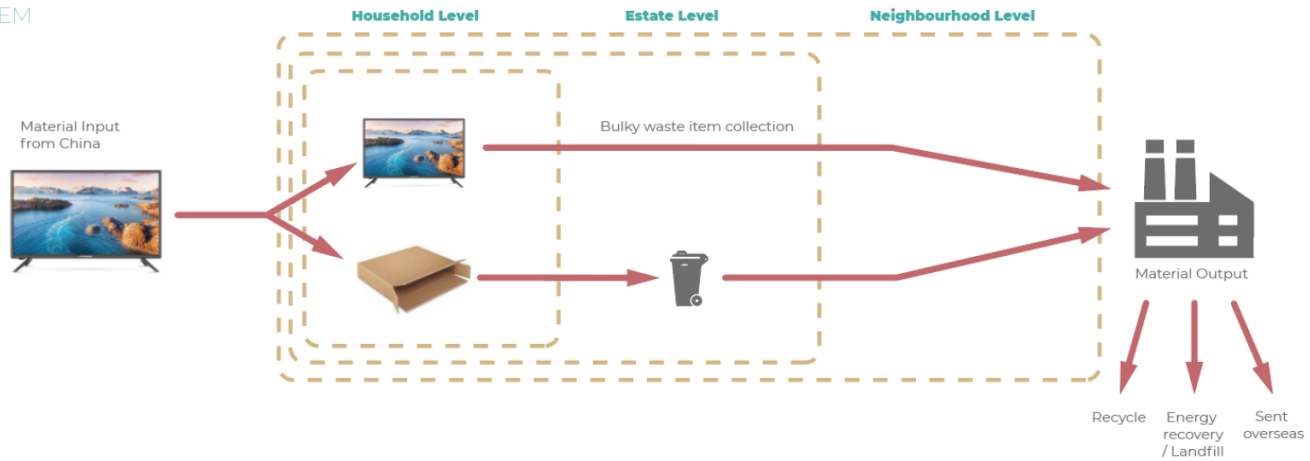


Figure 12b: Linear and circular systems of three select materials (Source: Author's own)

### 4.3 Circular framework and systems

#### Circular systems of three material flows

BEFORE - LINEAR SYSTEM



AFTER - CIRCULAR SYSTEM

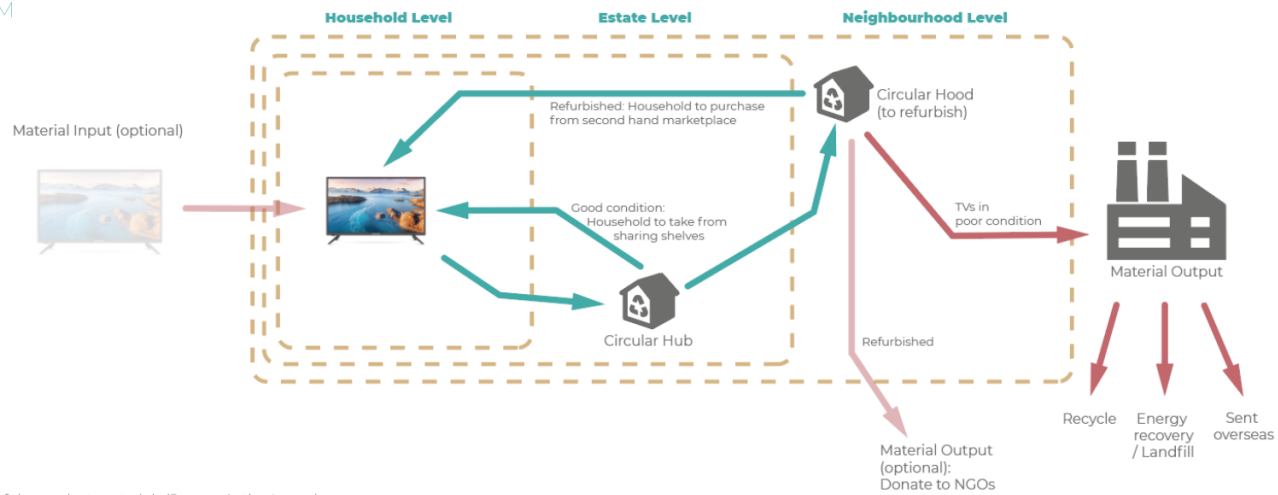


Figure 12c: Linear and circular systems of three select materials (Source: Author's own)

## 4.4 Framework for benefits and measurements

A framework for benefits and measurements is developed with reference to Williams (2021) framework of benefits. The five most relevant benefits under environmental, economic and social aspects are selected. Possible measurements for each benefit are proposed and each benefit are mapped to the associated circular principles.



### Environmental

	Benefits	Possible measurements	Circular principles
EN1	Reduce material consumptions	<ul style="list-style-type: none"> <li>• Tonnes of resources looped, regenerated and shared within the system</li> <li>• Tonnes of resources exited the system</li> </ul>	
EN2	Reduce carbon footprint	<ul style="list-style-type: none"> <li>• Scope 3 GHG emissions associated with material saved</li> </ul>	
EN3	Reduce water footprint	<ul style="list-style-type: none"> <li>• Water footprint associated with material saved</li> </ul>	
EN4	Provide ecosystem services	<ul style="list-style-type: none"> <li>• Provisioning services: Food provided from community farm</li> <li>• Regulating services: GHG avoidance from new trees</li> <li>• Support services: Compost produced</li> </ul>	
EN5	Increase environmental awareness	<ul style="list-style-type: none"> <li>• Number of volunteers and volunteering hours</li> <li>• Number of participants</li> <li>• Residents' surveys</li> </ul>	

Table 1: Framework for benefits and measurement for circular strategies in public housing estates in the UK (Source: Author's own)



### Economic

	Benefits	Possible measurements	Circular principles
EC1	Save costs	<ul style="list-style-type: none"> <li>• Residents' surveys: Cost-savings for household items per family</li> </ul>	
EC2	Create jobs	<ul style="list-style-type: none"> <li>• Number of new jobs</li> </ul>	
EC3	Create new businesses	<ul style="list-style-type: none"> <li>• Number of new businesses</li> </ul>	
EC4	Boost local economy	<ul style="list-style-type: none"> <li>• Revenue from interventions (Community farms, Circular Hubs, local markets, circular shops, etc.)</li> </ul>	
EC5	Activate underutilised land	<ul style="list-style-type: none"> <li>• Sqm of activated land</li> <li>• Economic value generated from activated land</li> </ul>	



### Social

	Benefits	Possible measurements	Circular principles
SO1	Improve health	<ul style="list-style-type: none"> <li>• Local fresh produce provided from community farm</li> <li>• Census data</li> <li>• Residents' surveys</li> </ul>	
SO2	Empower community	<ul style="list-style-type: none"> <li>• Number of participants in activities</li> <li>• Number of volunteers and volunteering hours</li> <li>• Residents' surveys</li> </ul>	
SO3	Build local social capital	<ul style="list-style-type: none"> <li>• Number of participants in activities</li> <li>• Number of volunteers and volunteering hours</li> <li>• Number of community groups supported</li> </ul>	
SO4	Enable equitable access to resources	<ul style="list-style-type: none"> <li>• Tonnes of resources looped, regenerated and shared within the system</li> </ul>	
SO5	Create communal spaces	<ul style="list-style-type: none"> <li>• Sqm of new communal space created</li> </ul>	



# 05

# Design - Application

 South Bermondsey, London, UK



## 5.1 Rationale of site selection

Southwark as a borough is selected to be studied further to identify a suitable neighbourhood as a study area. Southwark has the largest council housing stock of any borough in London and the highest proportion of council housing to homes of any council in the country (Independent Commission on the Future of Council Housing in Southwark, 2012). To narrow down the study area, four most deprived neighbourhoods, namely Elephant and Castle, Bermondsey, Walworth and Peckham, are mapped in pink while public housing estates managed by Southwark Council within Southwark Council within the most deprived neighbourhoods are in blue.

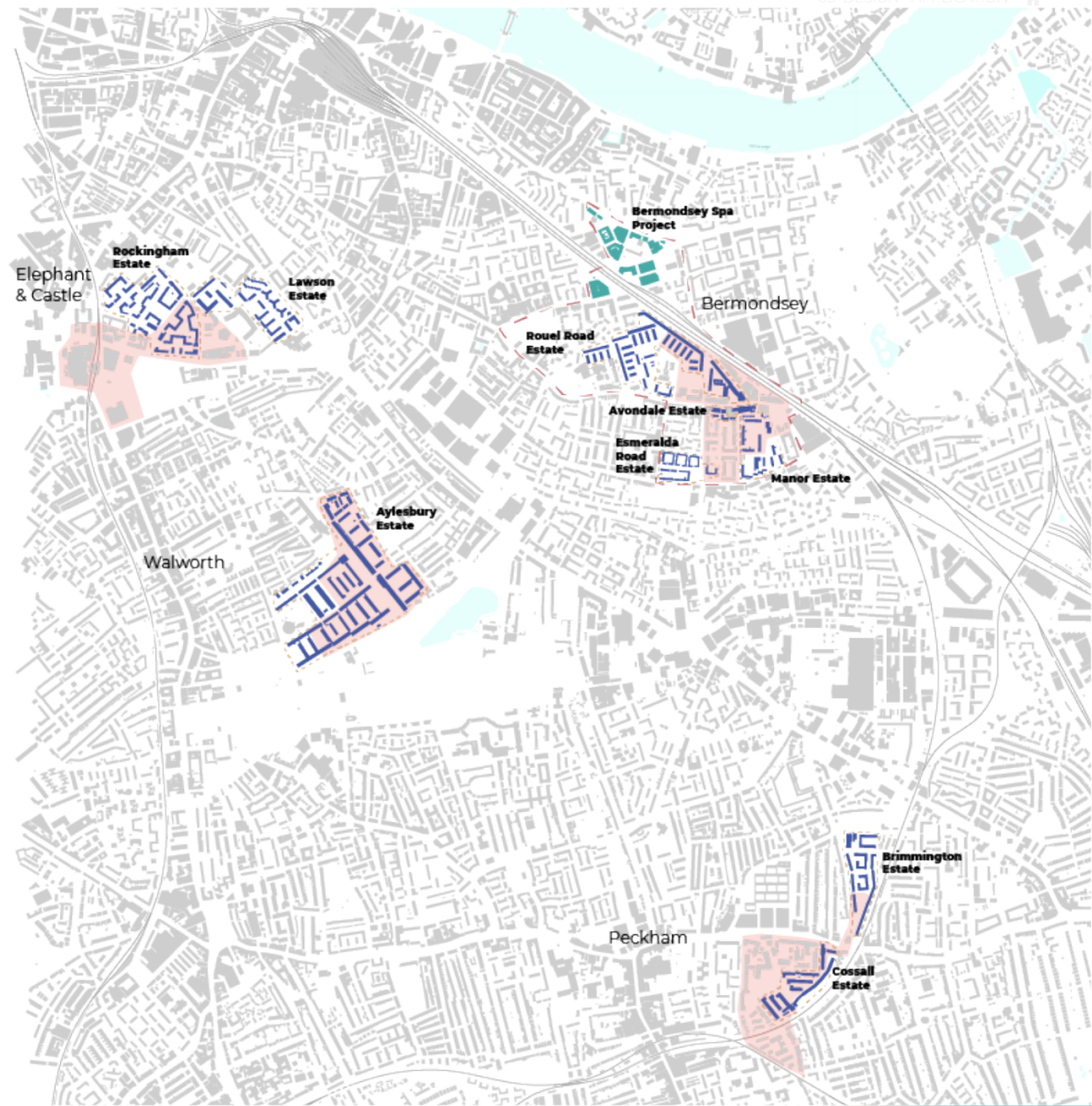
South Bermondsey is selected as the study area because of the following reasons:

- There are many existing public housing estates with diverse building typologies (i.e. slab, tower, external walkway, etc.).
- There is a new build residential development by Levitt Bernstein, which allows for contrasting between existing and new build estates.
- Southwark Plan 2022 does not include it as a "site allocation", which reflects that the area is understudied and neglected.

- Most deprived neighbourhood
- Public housing estates managed by Southwark council

Figure 13: Map of most deprived neighbourhoods and their public housing estates in Southwark Borough (Source: Author's own)

CIRCULAR PUBLIC HOUSING



## 5.2 Site analysis

Located in south London, South Bermondsey is a ward within London Borough of Southwark. The site is 54.3 hectare in size. It is dominated by four large public housing estates with diverse building typologies ranging from two-storey terraces to five-storey slabs and 11-storey towers. A railway viaduct with arches runs northwest southeast through the site, separating the Bermondsey Spa project in the northern part of the site, which is a new build residential regeneration project completed by Levitt Bernstein in 2014 (Levitt Bernstein, no date).



Figure 14: Site analysis map of South Bermondsey (Source: Author's own)

## 5.3 Social demographic profile

According to the 2011 Census (Southwark Council, no date), South Bermondsey<sup>1</sup> has a population of 13,760 with 52% of homes being social rented. It has a higher unemployment rate and economically inactive percentage than the London average. 41% of residents in social rented homes are BAME, while 8% thought that they were in bad or very bad health. Therefore, there are opportunities for the circular strategies to provide economic and social benefits for residents in South Bermondsey.

### South Bermondsey, London, UK



13,760 Population  
5,727 Households

	South Bermondsey	Southwark	England
<b>Age</b>			
0-24	35%	33%	31%
25-49	45%	46%	35%
50-64	13%	13%	18%
65+	7%	8%	16%
<b>Economy</b>			
Benefit claimants	17%	14%	14%
<b>Housing</b>			
Owned	25%	31%	64%
Private rented	23%	25%	18%
Social rented	52%	44%	18%



	Unemployed	Economically inactive
<b>London average</b>	4%	27%
<b>South Bermondsey - Social rented</b>	9%	38%

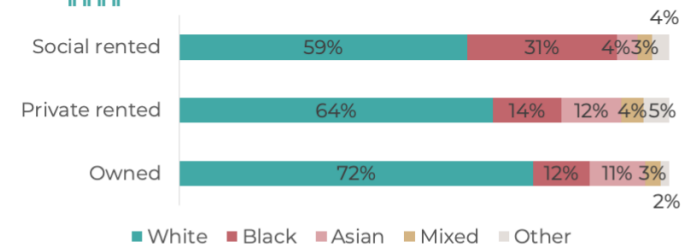
\* Economically inactive: retired, students, looking after family, long term sickness or disability

<sup>1</sup> Note that the 2011 Census boundary of South Bermondsey is not the same as the site boundary. Our study area covers around 50% of the area of South Bermondsey.

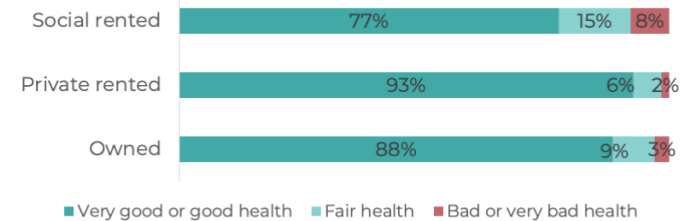
Figure 15: Socio-economic demographic profile of South Bermondsey (Source: Author's own; Data from Southwark Council, no date)



### Tenure & Ethnicity



### Tenure & Health



## 5.4 Current waste management system in Southwark

At present, Southwark operates a 'double-stream' recyclable collection system with mixed dry recyclables and food waste for households. Along with general waste, these three types of household wastes are collected weekly or bi-weekly, and transferred to Southwark Integrated Waste Management Facility ('IWF') operated by Veolia, where they are further sorted into different streams centrally by large scale industrial machinery. The residual wastes are biologically processed and turned into Solid Recovered Fuel ('SRF'). SRF is then transferred to an energy recovery facility in Deptford to burn off and generate electricity (Veolia, 2015).

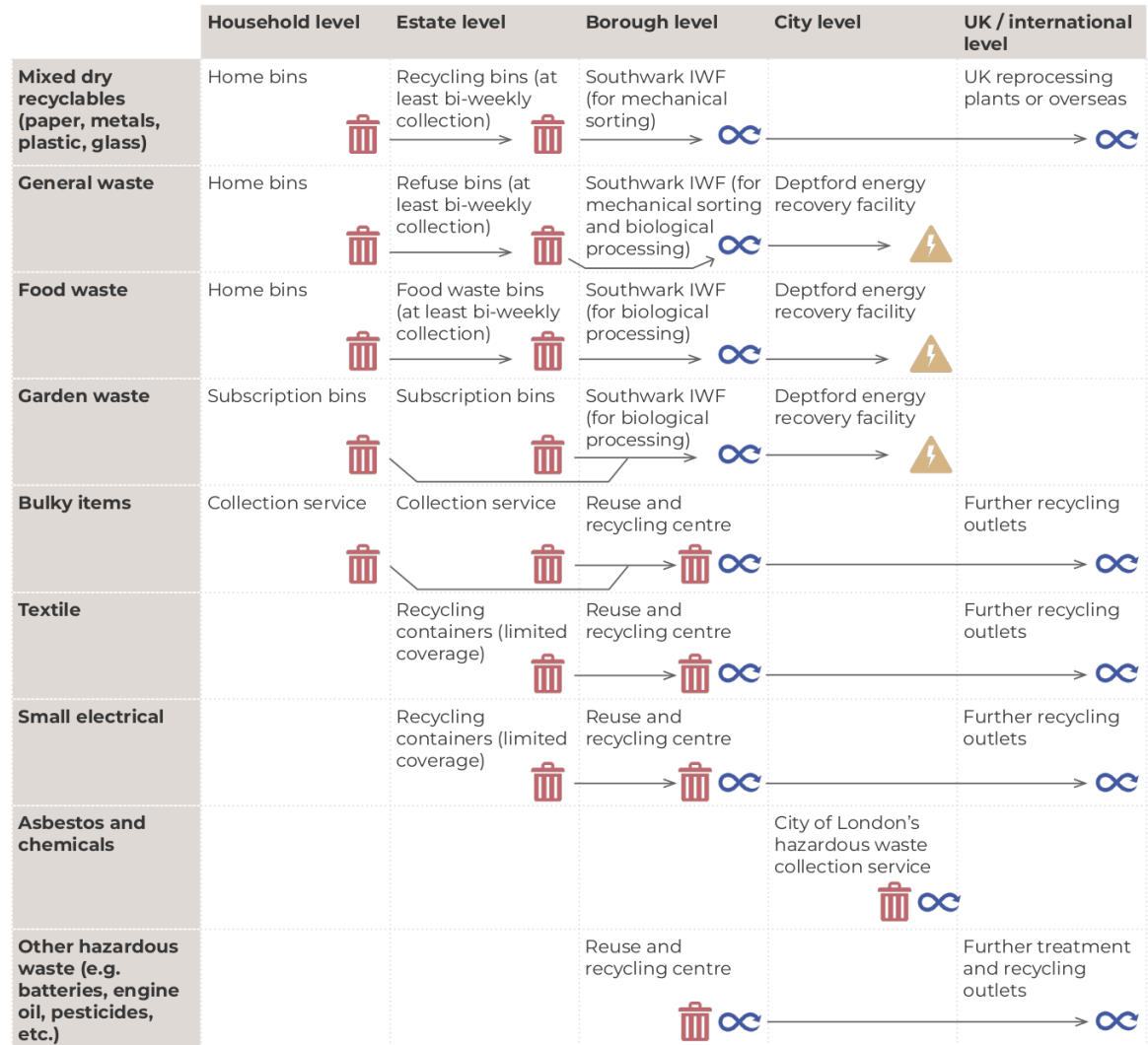


Figure 16: Current waste management system in Southwark (Source: Author's own)

## 5.5 Opportunity areas

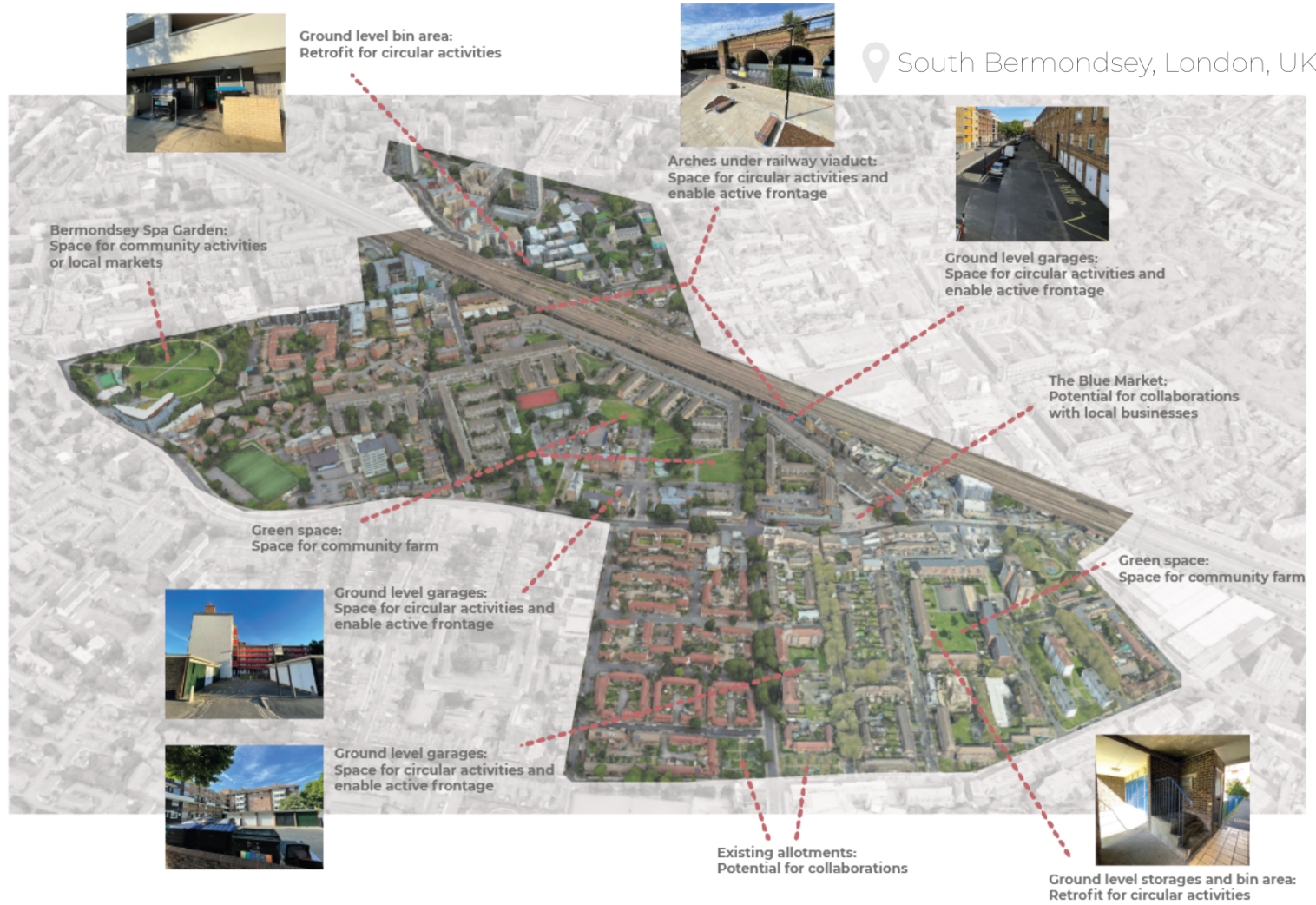


Figure 17: Opportunity map for circular strategies in South Bermondsey (Source: Author's own)

## 5.6 Design proposal

### Intervention map

A network that covers the study area is created with estate and neighbourhood level interventions.

Estate level: Circular Hubs are resource gathering points for multiple estates. They can be reached by two-minute walk from the surrounding estates.

Neighbourhood level: Circular Hood serves as a central place for a wide range of circular activities for the neighbourhoods. It can be reached by five-minute walk by most estates in the area.

Finite inorganic material flows are created from Circular Hubs to Circular Hood. For instance, furniture in Circular Hubs is transported to communal workshop in Circular Hood to be refurbished and sold in second life marketplace.

A renewable material flow network is formed between all circular facilities. Food waste collected from Circular Hubs and Circular Hood is transported to community farms for composting. Fresh produce from community farms is sold in local markets.

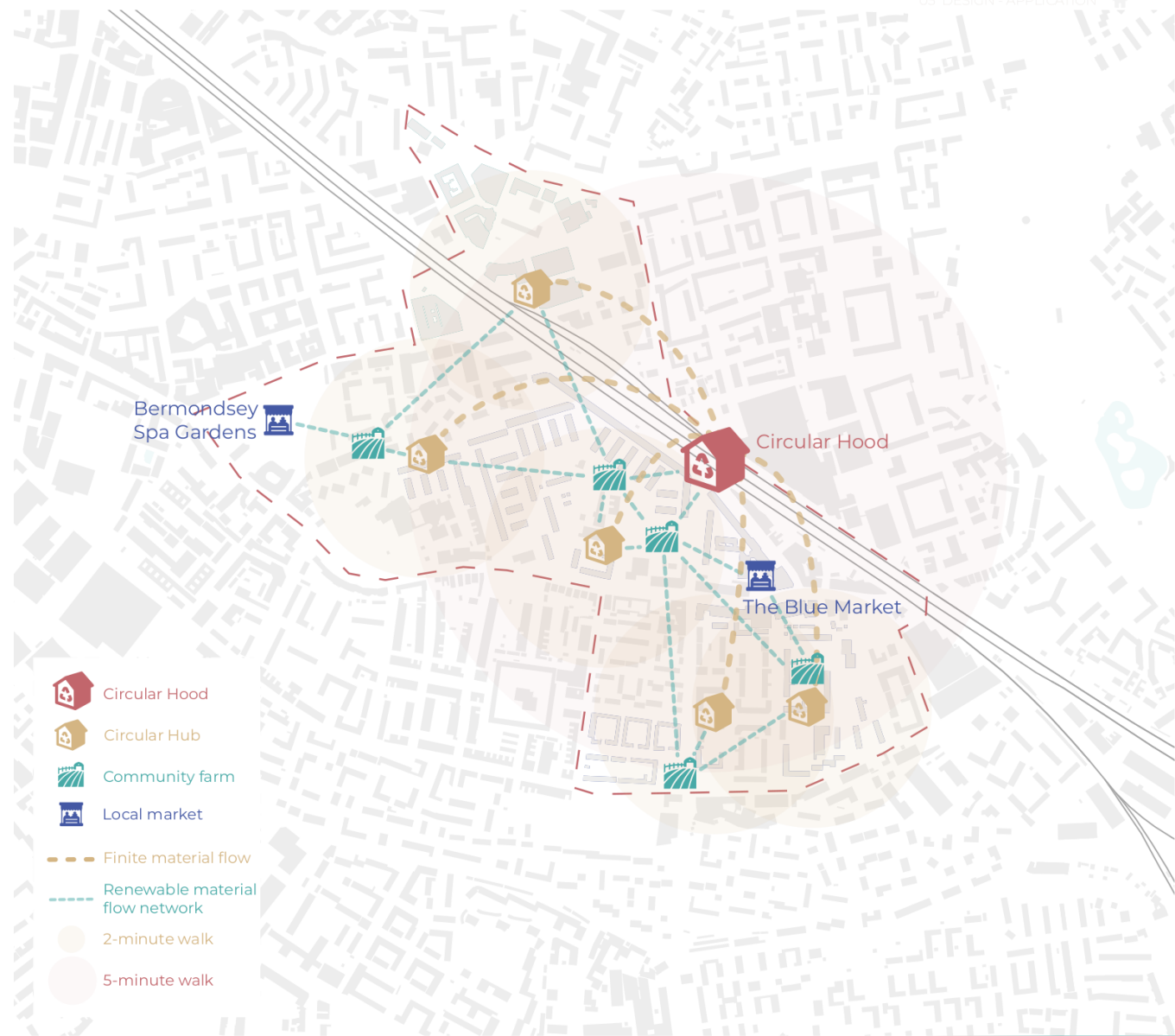


Figure 18: Intervention map for circular systems in South Bermondsey (Source: Author's own)

## 5.6 Design proposal

### Household level – Sorted Bins

At the household level, it is important for occupants to have ample storage for recyclables and general waste to encourage waste sorting and clean recycling. As most flats are small, a stackable solution called Sorted Bins is proposed to save precious space. With the help of this solution, occupants can start building up their habit of sorting and clean recycling at home. As there are similar products available on the market, users can choose suitable readily available products with dimensions that work for their own flats.

#### INTERVENTION PROFILE

Name: Sorted Bins

Scale: Household

Number of facilities: Every household

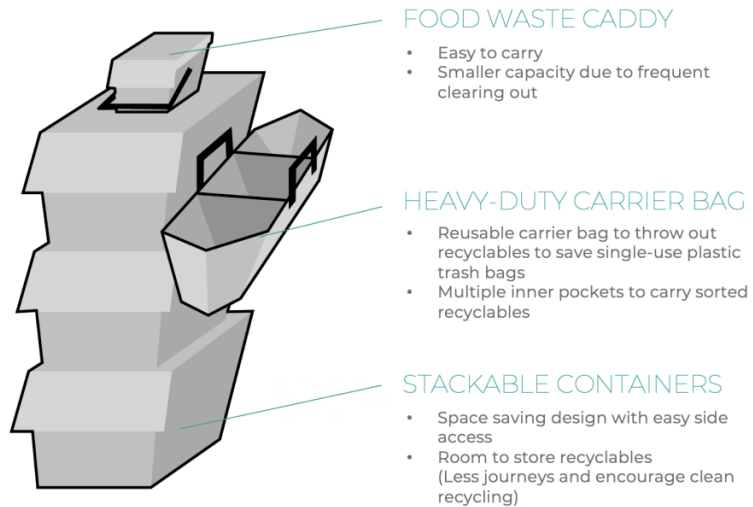


Figure 19: Schematic and illustration of Sorted Bins (Source: Author's own)

## 5.6 Design proposal

### Estate level – Circular Hub

#### INTERVENTION PROFILE

Name: Circular Hubs  
Scale: Estate  
Number of facilities: 5  
Total area: 1,873 sqm

Circular Hubs allow for residents from multiple estates to gather and share resources and experiences. Underutilised spaces are transformed to provide residents with circular facilities maintained by Circular Hub Managers and volunteers for circular activities in a communal and inclusive way.

Requirements of site selection for Circular Hubs are:

- Garages or lockers of public housing estates that are infrequently used; or
- Existing waste collection facilities; and
- Reachable by 2-minute walk from multiple housing estates.

Circular Hub Managers are hired to manage multiple hubs in the neighbourhood. Their responsibilities include:

- Maintenance of multi-stream waste collection systems;
- Maintenance of sharing shelves;
- Organising circular programmes for estate residents;
- Organising regular weekly outreach to educate residents on recycling; and
- Building network of volunteers to nurture ownership so that volunteers can help to maintain the Hubs.

#### PHYSICAL SPACE



Multi-stream waste collection interface



Wash basin



Sharing shelves



Social corners



#### PROGRAMMING



Weekly outreach by Circular Hub Manager



Upcycling workshops

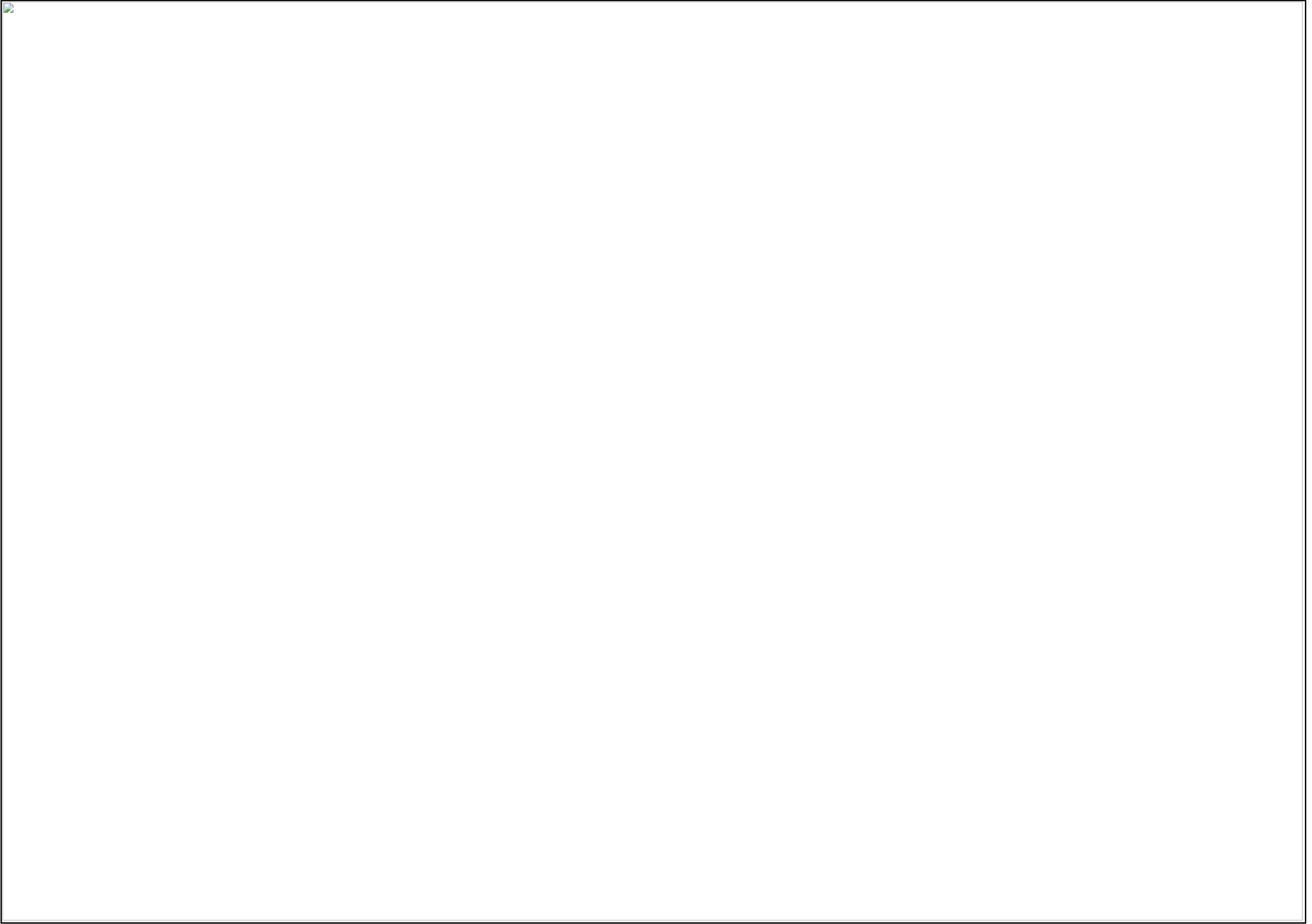


Volunteering programme



Figure 20: Essential components and their associated circular principles of Circular Hubs (Source: Author's own)





## 5.6 Design proposal

### Neighbourhood level – Circular Hood

#### INTERVENTION PROFILE

Name: Circular Hood  
Scale: Neighbourhood  
Number of facilities: 1  
Total area: 3,463 sqm

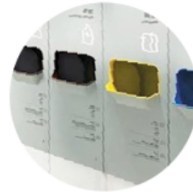
Circular Hood acts as a centre point for the network of material flows. It has a recycle point for residents to drop off their recyclables and earn reward points. Its Library of Things, communal workshop and second life marketplace allow residents to engage in higher level and less frequent circular activities, such as repairing and purchasing of refurbished items. Spaces are provided for incubating new sustainable and circular businesses. Some spaces can be rented to new businesses at an affordable rate. Various activities like Circular Fest and education programmes inject vibrancy, making it an attractive communal place for the neighbourhood.

Requirements of site selection for Circular Hood are:

- Underutilised or unused spaces such as railway arches and vacant shops; and
- Reachable by 5-minute walk from most housing estates.

#### PHYSICAL SPACE

##### MUST-HAVE



Multi-stream waste collection interface



Library of Things



Communal workshop



Second life marketplace



##### GOOD-TO-HAVE



Zero waste shop



Green incubator



Affordable offices for green businesses



Education centre



#### PROGRAMMING



Reward system



Circular Fest



Classes and apprenticeship



Education programme



Figure 22: Essential components and their associated circular principles of Circular Hood (Source: Author's own)

## 5.6 Design proposal

### Neighbourhood level – Circular Hood

#### SITE PROFILE

Location: Blue Anchor Lane  
Address: Blue Anchor Ln, London SE16 3UL  
Site area: 3,463 sqm

#### CURRENT VIEW



#### MULTI-STREAM WASTE COLLECTION INTERFACE

A sleek interface with wash basin for residents to clean and insert pre-sorted recyclables

#### LIBRARY OF THINGS

Offers a range of tools for residents to borrow short-term

#### SECOND LIFE MARKETPLACE

Refurbished and pre-owned goods are sold here

#### ZERO WASTE SHOP

Encourages consumers to purchased goods with zero packaging

#### GREEN INCUBATOR

Incubator space for sustainable start-ups and makers to benefit from agglomeration of ideas

#### AFFORDABLE SPACE FOR GREEN BUSINESSES

Green businesses can rent the space at a discounted rate

#### EDUCATION CENTRE AND EVENT SPACE

Spaces for visitors to learn about circularity and green NGOs to host events

#### LOADING ZONE FOR CARGO BIKES

Allows cargo bikes to transport resources between circular facilities

#### REWARD SYSTEM

Users gain points for recyclables or participation in circular activities and can use points for rewards like daily necessities

#### CLASSES AND APPRENTICESHIP

Allow residents to learn a trade and upskill for new job opportunities

#### COMMUNITY HERB GARDEN

#### CIRCULAR FEST

Regular pop-ups to allow sustainable businesses to promote eco-living to residents

#### EDUCATION PROGRAMME

Tours and workshops co-organised with schools to instil a sense of stewardship in young people

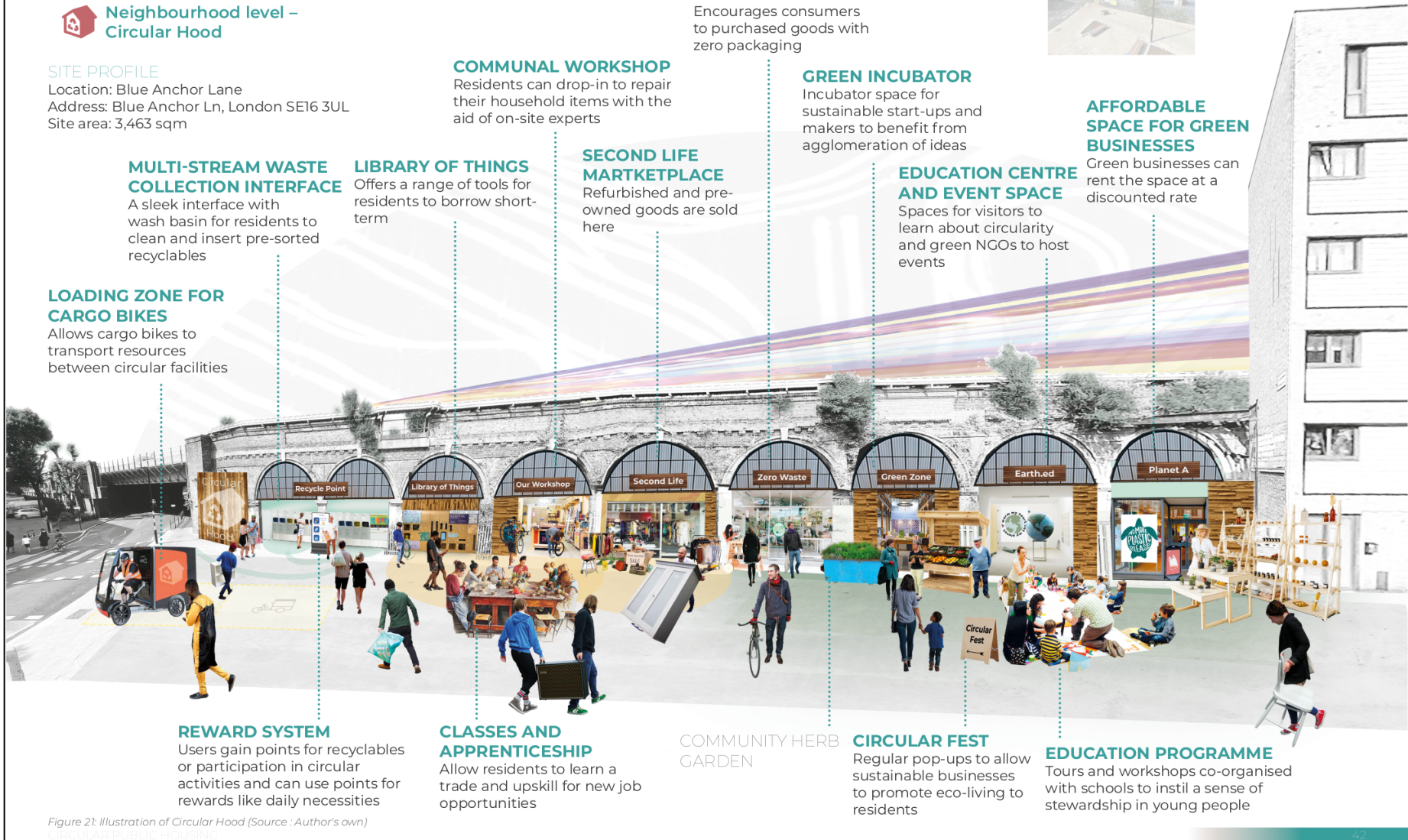


Figure 21: Illustration of Circular Hood (Source : Author's own)  
CIRCULAR PUBLIC HOUSING

## 5.6 Design proposal



### Neighbourhood level – Community farm

#### INTERVENTION PROFILE

Name: Community farm  
Scale: Neighbourhood  
Number of facilities: 5  
Total area: 10,390 sqm

Underused green spaces within the study area should be utilised for communal farms. These are different from allotments as community farms should be accessible by the public. A major function of community farms is to enhance urban metabolism to 'digest' food waste into useful compost, and thus, to regenerate the ecosystem.

Community farms can be run by community groups or organisations and managed by hired professionals along with community volunteers. They can be financially supported by subscription of 'vegbox', which subscribers get a box of veggies once a month. This secures income streams for the farms. Programming of the farms includes gardening classes and volunteer programmes.



### Neighbourhood level – Local Market

#### INTERVENTION PROFILE

Name: Local market  
Scale: Neighbourhood  
Number of facilities: 2

Fresh produce from community farms can be sold in local markets during weekends. Outreach programmes or pop-ups that promote circular economy and eco-living can be introduced. This is an important component of the circular system to boost local economy and build local resilience.

The existing Blue Market, where traders operate daily or weekly on Saturdays, can allow more sustainable businesses to trade there. The popular Bermondsey Spa Gardens is a potential new spot for another weekly local market to serve communities in the west of the study area.



Underutilised green space in South Bermondsey



Spitalfield City Farm

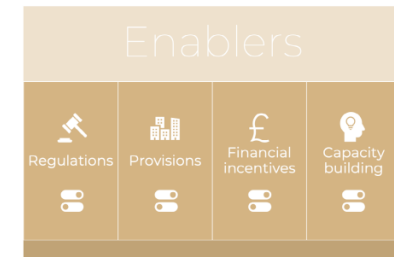
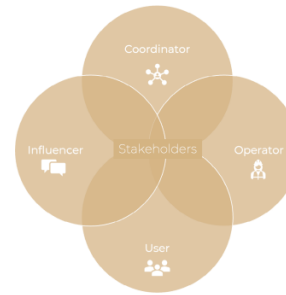


The Blue Market

## 5.6 Design proposal

### Stakeholders and enablers

The success of the project depends on the involvement of the key stakeholders. The roles and responsibilities of the stakeholders should be clear to avoid confusion and enhance collaboration. Local authority should take a leadership and coordinating role in promoting and implementing circularity in their borough. Different stakeholders should also explore and activate various enablers to create a more favourable environment for circular strategies.



### Stakeholders

	Roles	Organisation(s)	Responsibilities
<b>Local authority</b>	Coordinator Influencer Operator	<ul style="list-style-type: none"> <li>Southwark Council</li> </ul>	<ul style="list-style-type: none"> <li>Rethinks Southwark's circular economy and waste management policies</li> <li>Consults and engages with stakeholders</li> <li>Coordinates and implements circular framework and systems within borough</li> <li>Develops service-level agreements and service charters for circular facilities and monitors quality of service delivery by operators</li> </ul>
<b>Housing associations</b>	Influencer Operator	<ul style="list-style-type: none"> <li>Various (See list in appendix)</li> </ul>	<ul style="list-style-type: none"> <li>Work with local authorities to plan and implement circular systems in their managed properties</li> <li>Become a circular facility operator or collaborate with circular facility operators</li> <li>Manage and communicate facility changes with residents</li> </ul>
<b>Service provider</b>	Influencer Operator	<ul style="list-style-type: none"> <li>Veolia</li> </ul>	<ul style="list-style-type: none"> <li>Works with council to reconfigure existing waste management system</li> </ul>
<b>Local community</b>	Influencer Operator User	<ul style="list-style-type: none"> <li>The Blue Market</li> <li>WISE16</li> <li>Bermondsey Community Kitchen</li> <li>The Salmon Youth Centre in Bermondsey</li> <li>Big Local Works Bermondsey</li> <li>Community Southwark</li> </ul>	<ul style="list-style-type: none"> <li>Provide local knowledge and insights</li> <li>Work with local council and participate in circular programmes</li> <li>Become a circular facility operator or collaborate with circular facility operators</li> </ul>
<b>Interest groups / NGOs</b>	Influencer Operator User	<ul style="list-style-type: none"> <li>Business in the Community</li> <li>ReLondon</li> <li>Library of Things</li> <li>Community Supported Agriculture (CSA)</li> </ul>	<ul style="list-style-type: none"> <li>Provide professional advice to stakeholders</li> <li>Work with local council and participate in circular programmes</li> <li>Become a circular facility operator or collaborate with circular facility operators</li> </ul>
<b>Private sector</b>	Influencer Operator User	<ul style="list-style-type: none"> <li>Big chain supermarkets</li> <li>Local businesses</li> <li>Sustainable start-ups</li> </ul>	<ul style="list-style-type: none"> <li>Participate in circular programmes</li> </ul>

Table 2: Key stakeholders and their roles and responsibilities (Source: Author's own)

### Enablers

<b>Regulations</b>	<p><b>Southwark local plan:</b> Southwark Council to include circular policies and guidance in local plan</p> <p><b>Southwark's Waste management guidance notes for residential developments:</b> Southwark Council to amend to allow for a more community-oriented and circular approach to waste management</p>
<b>Provisions</b>	<p><b>Southwark's waste collection and management services:</b> Southwark Council to renegotiate or review its contract with service provider Veolia to reconfigure waste collection and management</p> <p><b>Partnership with circular facility operators and local community groups:</b> Southwark Council to develop service-level agreements and service charters for circular facilities and work closely with them to ensure proper delivery of services</p>
<b>Financial incentives</b>	<p><b>Section 106:</b> Southwark Council to negotiate Section 106 agreements with developers to provide circular facilities</p> <p><b>Community infrastructure levy (CIL):</b> Supporting new circular facilities and services with funding from CIL, which is a levy on new development that can be used for community facilities</p>
<b>Capacity building</b>	<p><b>Circular Space as a living lab:</b> Circular Space provides spaces for experimental learning for different community groups and organisations, which is great for incubating new ideas and approaches for circular economy</p> <p><b>Circular Hubs to build networks:</b> Circular Hubs are spaces for residents of the same estates to get together. Through communal sharing, swapping and programming, residents can bond and build networks of local support and eco-action</p>

Table 3: Enablers for circular strategies in South Bermondsey (Source: Author's own)



# 06

## Evaluate

## 6.1 Impact assessment

Based on the proposed framework for benefits and measurements, estimation models are developed to quantify the select environmental, economic and social benefits from the circular interventions. Key assumptions<sup>1</sup> are applied in the estimation process, thus, the results below are very likely to vary in real life situation. Detailed assumptions and calculations are available in Appendix (page 53).



REDUCE MATERIAL CONSUMPTIONS (EN1)

175 tonnes

Resources looped, regenerated and shared within the system annually

Equivalent to weight of 14 London buses



REDUCE CARBON FOOTPRINT (EN2)

9.4 tonnes

Scope 3 GHG emissions avoided from resources saved and general waste diverted from combustion annually

Equivalent to planting 376 trees



PROVIDE ECOSYSTEM SERVICES (EN4)

25.1 tonnes

Food produced from community farms

Equivalent to 24 servings of salad per resident in South Bermondsey



BENEFITS GENERATED FROM

- 1 X Circular Hood
- 5 X Circular Hub
- 5 X Community farm



CREATE JOBS (EC2)

20

New core jobs created

CREATE NEW BUSINESSES (EC3)

15

New businesses created

ACTIVATE UNDERUTILISED LAND (EC5)

11,449 sqm

Area of newly activated land



EMPOWER COMMUNITY (SO2)

105

Number of volunteers

BUILD LOCAL SOCIAL CAPITAL (SO3)

10

Number of community groups supported

CREATE COMMUNAL SPACE (SO5)

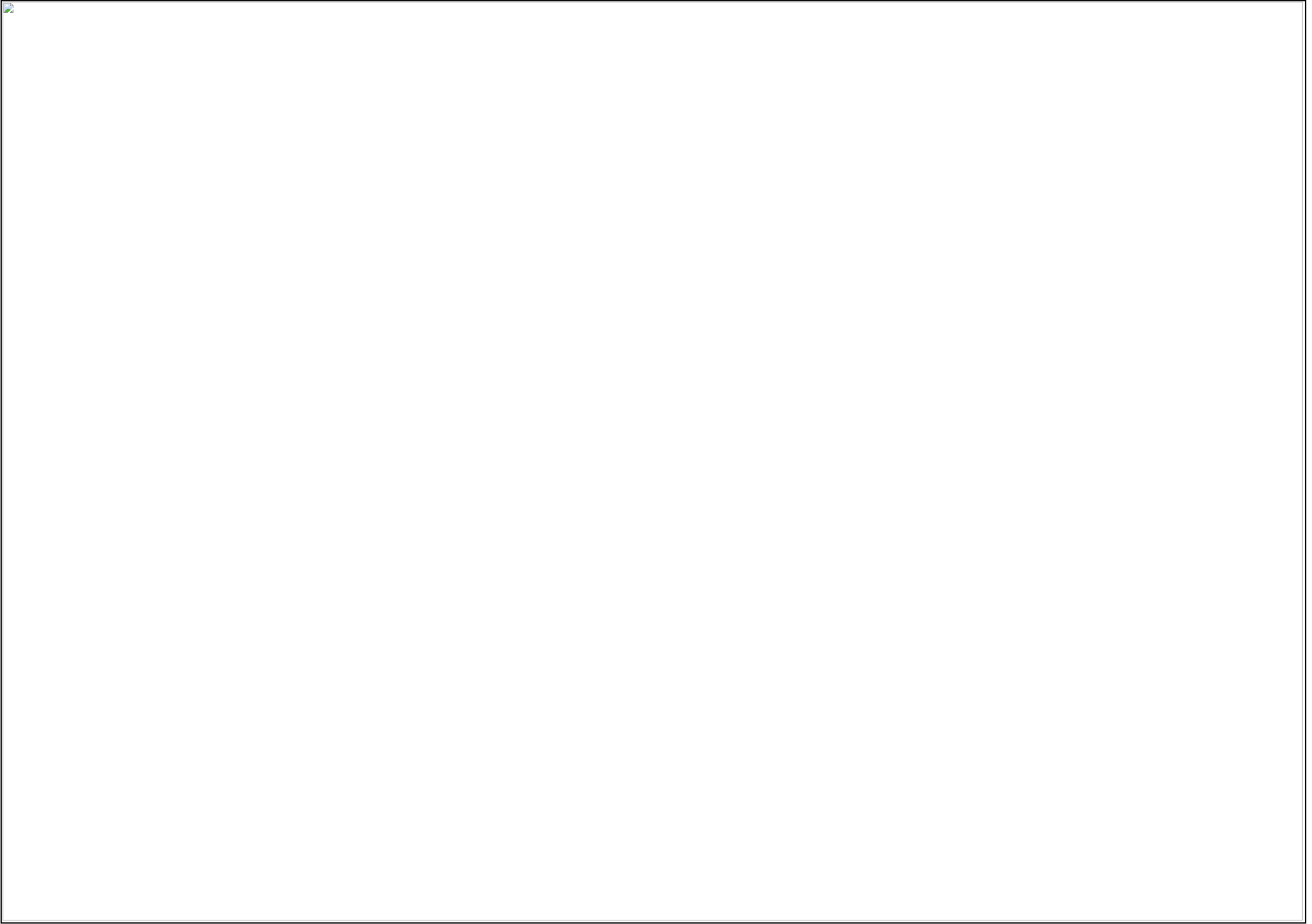
6,029 sqm

New communal space created

<sup>1</sup> Key assumptions:

- The circular facilities cover a total of 2100 households. 10% of their resources/wastes are looped within the system.
- 10% of covered households' resources/wastes are looped within the system.
- Resources looped, regenerated and shared within the system are diverted from combustion for energy recovery.
- Covered households' recycling rate increases from 35% to 50%.
- Only lettuce, potatoes, tomatoes and cucumbers are planted in community farms.
- 5% of covered households generate 1 volunteer.

Figure 22: Estimated benefits generated from circular systems in South Bermondsey (Source: Author's own)





## 6.2 Scaling up

### Estate / Neighbourhood level – Creating better streetscapes and neighbourhoods

Other than the importance of providing clean and accessible multi-stream waste collection interface with wash basin and communal space for circular activities, the research and design stage also suggest the potential of creating a more vibrant and attractive streetscape and neighbourhood with circular systems. Workshops and communal spaces replace dead frontages. As circular systems become more established, waste can be reduced per household. Vehicles used for transporting wastes and materials can be downscaled from waste trucks to smaller vans or cargo bikes, which contribute to lighter traffic.

Recommendations	Rationale / business case
<p><b>To local authorities</b></p> <ul style="list-style-type: none"> <li>Short term: Amend design guidance for waste and recycling facilities to promote communal space, active frontage, universal design. Add specifications on multi-stream waste collection interface and minimum space for communal space (e.g. sharing shelves)</li> <li>Short term: For smaller urban development projects, recognise the potential for the site to be a Circular Hood for the existing neighbourhood</li> <li>Long term: Review road layout and waste facilities (i.e. dragging distance of bins) requirements as waste generation decreases and smaller vehicles replace conventional waste trucks</li> </ul> <p><b>To developers</b></p> <ul style="list-style-type: none"> <li>For smaller urban development projects: Reserve ground frontages for Circular Hubs or Circular Hood functions</li> <li>For larger masterplan type new development: incorporate circular systems in masterplan and use it as a placemaking strategy</li> </ul>	<ul style="list-style-type: none"> <li>Circular Hubs and Circular Hood can create more vibrant and safer streets and neighbourhoods</li> <li>Circular Hubs and Circular Hood can be incorporated into commercial spaces as part of a placemaking strategy to help to increase footfall</li> <li>Circular systems work with new development's sustainability priorities. It helps to promote sustainable lifestyle and improves marketability of the development</li> </ul>

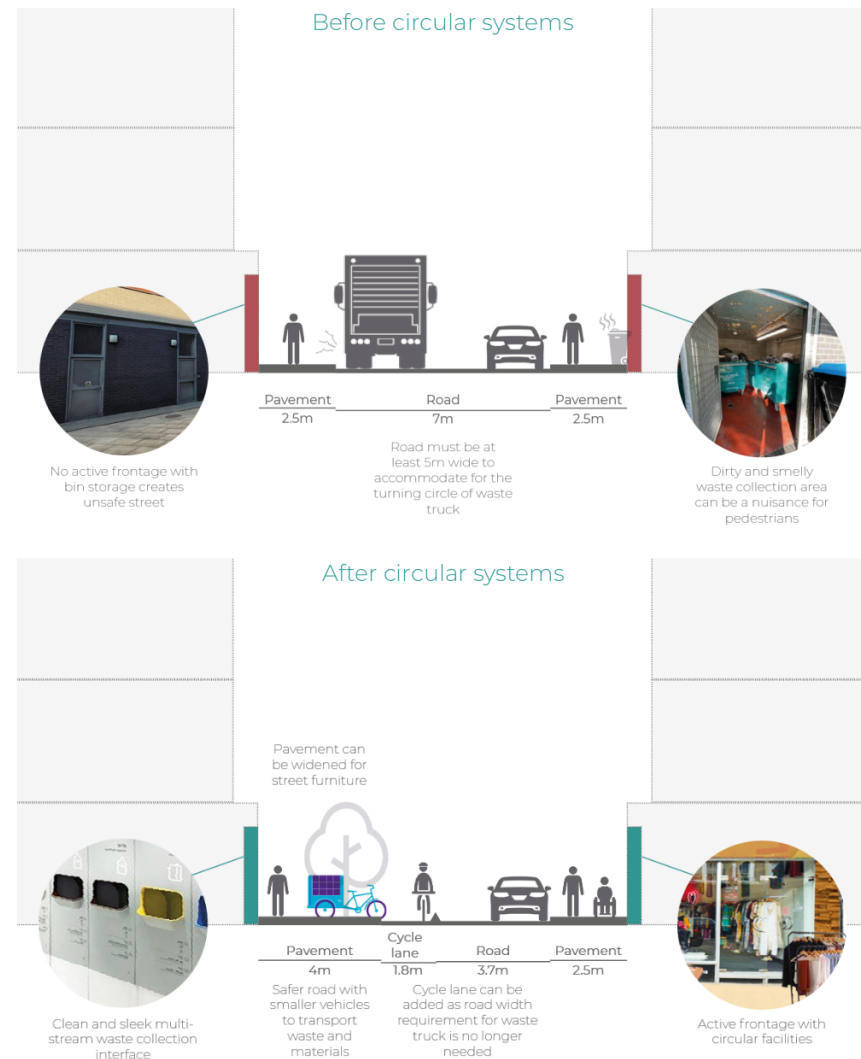


Figure 24: Changes in streetscape in new build development before and after the implementation of circular systems (Source: Author's own)

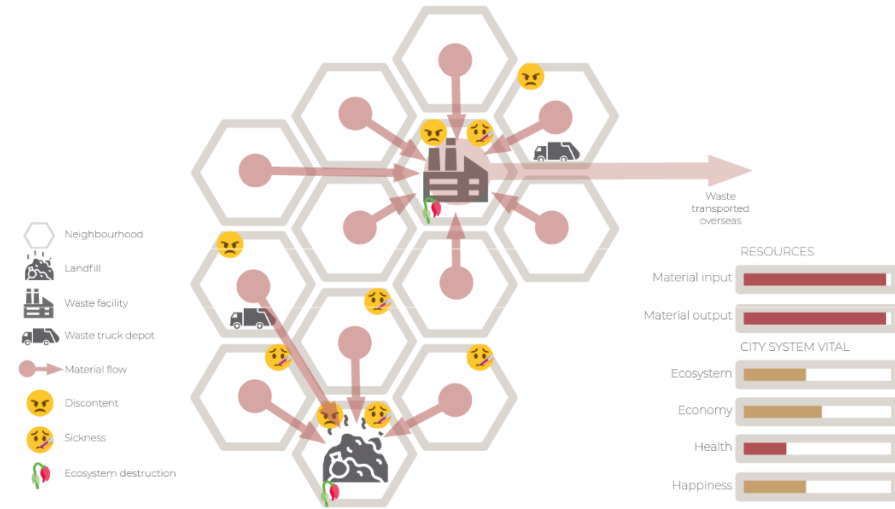
## 6.2 Scaling up

### City level – Shaping circular cities with circular neighbourhoods

Creating circular neighbourhoods contributes to the formation of circular cities. Creating more material loops within neighbourhood level results in less output of wasteful material to the borough/city level, enhancing the overall urban metabolism. There is also less waste to be exported overseas to be further processed. Precious land resources can be saved in the city as there is less demand for waste facilities, such as waste truck depots, landfills and incinerators, to handle and process waste. This brings about indirect benefits, such as better health and saving cost. Ultimately, circular neighbourhoods become building blocks that form circular cities, which support sustainable development.

Recommendations	Rationale / business case
<p><b>To local authorities</b></p> <ul style="list-style-type: none"> <li>Review and enhance resource management / circular economy policies and operations</li> <li>Incorporate circular cities vision and targets into local plan</li> <li>Integrate circular cities strategies as part of the policies and plans for climate change mitigation and resilience</li> <li>Identify potential neighbourhoods and develop roadmap to implement circular systems</li> <li>Work with neighbouring local authorities to consolidate waste facilities and circular systems</li> </ul> <p><b>To developers</b></p> <ul style="list-style-type: none"> <li>For larger masterplan type new development: incorporate circular design at household, estate and neighbourhood level</li> </ul>	<ul style="list-style-type: none"> <li>Less landfills and incinerators in cities can be beneficial to the health of surrounding residents and environment</li> <li>Local councils can save on operation cost for waste facilities and waste collection as waste generation decreases</li> <li>Freed-up land can be used for generating higher economic value or restoring ecological value</li> </ul>

### Before creating circular neighbourhoods



### After creating circular neighbourhoods

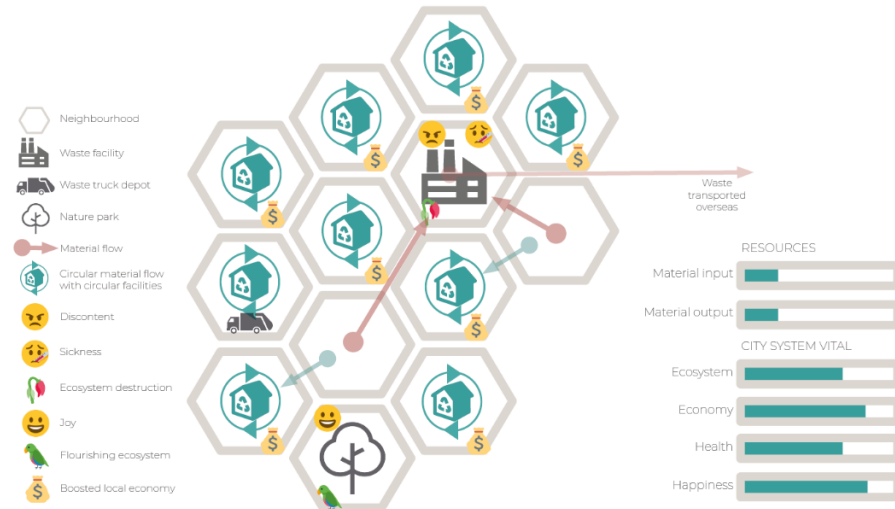


Figure 25: Schematic of shaping circular cities with circular neighbourhoods and its effect on resources and sustainability aspects (Source: Author's own)

## 6.3 Conclusion

This research project started with exploring the question of 'How to enable circular strategies in public housing estates in the UK for environmental, social and economic benefits?'. After conducting literature review and field research, insights gained are inputted to develop a circular framework and circular systems that work in public housing estates in the UK context. This framework is based upon creating circular systems at household, estate and neighbourhood level with four circular principles, namely Loop, Regenerate, Share and Adapt.

It is then tested and applied in South Bermondsey, one of the most deprived neighbourhoods in Southwark, London. Design of circular strategies like Circular Hubs and Circular Hood are developed. The environmental, economic and social benefits generated from the circular strategies are estimated in accordance with the proposed framework of benefits and measurements. By going through the stages of research, design and evaluate, it is concluded that the proposed circular framework is viable for local authorities and developers to apply to existing public housing estates in the UK to bring about sustainability benefits.

Yet, the true potential of this circular framework lays in its ability to scale up and to be applied in new housing development, either smaller urban development projects or larger masterplan type development. Recommendations for local authorities and developers are provided to create circular neighbourhoods in new development, which ultimately become the building blocks for shaping circular cities that contribute to sustainable development.

### Limitations and critical reflections

- Private sector like online retail giants, grocers and fashion brands also plays a major role in circular economy. They are influential in advocating for consumerism and deciding on the production, material used, packaging and logistics of their products. Intervention in built environment alone is not enough in bringing about a paradigm shift towards circular economy.
- It would be challenging to implement multi-stream waste collection in Southwark. Southwark has an integrated waste management facility that uses advanced technology to sort and process mixed dry recyclables. Huge upfront investment in the facility has been made. It would take political capital and a culture shift to move from adopting a technological waste treatment approach to a community-oriented circular economy approach.

### Future research

- Future research can be conducted to continue the development of the circular framework. Topics include:
- Adapting circular systems in different kinds of neighbourhoods (e.g. suburbs) or urban environments of different global context (e.g. global south)
  - The scale of settlement (i.e. population, urban density, etc.) needed for adopting circular systems



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# Appendix

## Supplementary information

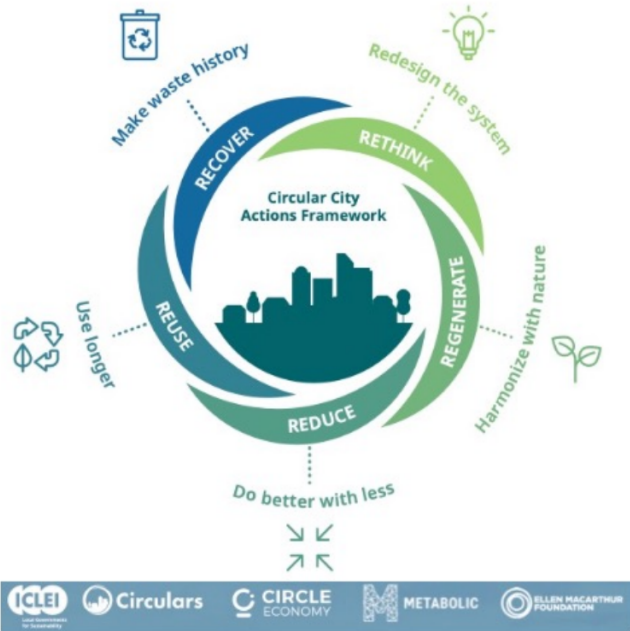


Figure 26: ICLEI Circular City Action Framework (Source: Novak et al., 2021)

Focus area	Potential impact	Neighbourhood action
<b>Circular construction</b>	Promote local and community-led construction and repair.	Establish neighbourhoods material banks.
		Invest in training of people in building repair.
<b>Servitisation</b>	Generate critical mass demand for making the offering of products-as-a-service attractive to providers. Accelerate transition to renewables. Reduce overall energy demand with associated cost savings for households. Incentivise behavior change.	Transition to cooling, heating and other appliances as a service.
		Collectively lease rooftops to solar energy companies.
		Explore decentralised energy options (solar PV and thermal). Establish the use of shared facilities (e.g. laundry rooms).
<b>Circular food systems</b>	Strengthen environmental education. Reduce food waste.	Establish community gardens.
		Supporting local food systems. Create links with peri-urban farmers. Composting or create links with bio industrial facility.

Figure 27: UNEP Circular Neighbourhood Framework (Source: United Nations Environment Programme, 2021)

## Supplementary information

- Anchor Trust
- Arundel Buildings Housing Co-operative Limited
- Coin Street Secondary Housing Co-operative Limited
- Co-operative Development Society Limited
- East Homes Limited
- Ekaya Housing Association Limited
- Housing 21
- Housing For Women
- Keniston Housing Association Limited
- Lambeth & Southwark Housing Association Limited
- Look Ahead Housing and Care Limited
- New World Housing Association Limited
- Octavia Housing
- Orbit Group Limited
- Orbit South Housing Association Limited
- Places for People Homes Limited
- Salvation Army Housing Association
- Sanctuary Housing Association
- Southwark and London Diocesan Housing Assoc Ltd
- The Abbeyfield Rotherhithe Society Limited
- The Industrial Dwellings Society (1885) Ltd
- The Riverside Group Housing Limited

Table 4: List of housing association partners in Southwark (Source: Southwark Homesearch, no date)

	Benefits	Measurements	Estimations	Assumptions	Data sources
EN1	Reduce material consumptions	Tonnes of resources looped, regenerated and shared within the system	175 tonnes	The 2-minute walk catchment area for each Circular Hub and Circular Hood includes 350 households. The circular facilities cover a total of 2100 households. 10% of their resources/wastes are looped within the system. (Note that the study area covers around 50% of South Bermondsey, which has 5727 households in 2011 Census)	Household waste data: <a href="https://lginform.local.gov.uk">https://lginform.local.gov.uk</a>
EN2	Reduce carbon footprint	Scope 3 GHG emissions avoided from resources saved and general waste diverted from combustion	9.4 tonnes	Resources looped, regenerated and shared within the system are diverted from combustion for energy recovery, and engaged households' recycling rate increases from 35% to 50%.	GHG emission factor: <a href="https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2022">https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2022</a>
EN4	Provide ecosystem services	Food produced from community farms	25.1 tonnes	60% of community farm is growable area. Only lettuce, potatoes, tomatoes and cucumbers are grown. Each vegetable account of 25% of total yield.	Farm product yield ratio: <a href="https://static-content.springer.com/esm/art%3A10.1038%2F941598-020-62126-4/MediaObjects/41598_2020_62126_MOESM1_ESM.pdf">https://static-content.springer.com/esm/art%3A10.1038%2F941598-020-62126-4/MediaObjects/41598_2020_62126_MOESM1_ESM.pdf</a>
EC2	Create jobs	New core jobs created	20	8 full-time jobs are created for 5 Circular Hubs and 5 community farms. 12 new core jobs are created in Circular Hood for recycle point, Library of Things, communal workshop and second life marketplace.	/
EC3	Create new businesses	New businesses created	15	15 new green businesses to be incubated in Circular Hood and local markets the first year.	/
EC5	Activate underutilised land	Area of newly activated land	11,449 sqm	Two of the community farms are existing allotments, which are not counted as newly activated land.	/
SO2	Empower community	Number of volunteers	105	5% of covered households generate 1 volunteer.	/
SO3	Build local social capital	Number of community groups supported	10	6 identified local community groups plus 4 other community groups supported.	/
SO5	Create communal space	New communal space created	6,029 sqm	New communal spaces comprise of Circular Hubs, 40% area of community farm and 70% area of Circular Place.	/

Table 5: Detailed assumptions and calculation of benefits and measurements (Source: Author's own)

## Risk assessment

The Bartlett School of Planning



BPLN0052: Major Research Project

MRP Proposal – Risk Assessment

Your details:

Name:	Marco Mak
Programme:	MSc Urban Design and City Planning
Supervisor:	Judith Loesing

Supervisor sign-off for Ethical Clearance Forms and Risk Assessment Forms

*(For supervisor completion only BEFORE submission via Moodle)*

Are you satisfied with the risk assessment form (yes/~~no~~)?

Please provide any additional comments about the form that may help the student.  
*(If the form is missing, the proposal must be given a mark of 0, and the student will have 48 hours to resubmit the complete proposal. If the form is unsatisfactory, the student must amend their ethical questionnaire to your satisfaction before they can proceed with their research)*

## RISK ASSESSMENT FORM FIELD / LOCATION WORK



DEPARTMENT/SECTION: BARTLETT SCHOOL OF PLANNING

LOCATION(S): LONDON

PERSONS COVERED BY THE RISK ASSESSMENT: Marco Mak

BRIEF DESCRIPTION OF FIELDWORK (including geographic location): **Field research in public housing estates in London**

### COVID-19 RELATED GENERIC RISK ASSESSMENT STATEMENT:

Coronavirus disease (COVID-19) is an infectious disease caused by coronavirus SARS-CoV-2. The virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes. Droplets fall on people in the vicinity and can be directly inhaled or picked up on the hands and transferred when someone touches their face. This risk assessment documents key risks associated with fieldwork during a pandemic, but it is not exhaustive and will not be able to cover all known risks, globally. This assessment outlines principles adopted by UCL at an institutional level and it is necessarily general. Please use the open text box 'Other' to indicate any contingent risk factors and control measures you might encounter during the course of your dissertation research and writing.

Please refer to the Dissertation in Planning Guidance Document (available on Moodle) to help you complete this form.

**Hazard 1: Risk of Covid -19 infection during research related travel and research related interactions with others (when face-to-face is possible and/or unavoidable)**  
**Risk Level - Medium /Moderate**

**Existing Advisable Control Measures:** Do not travel if you are unwell, particularly if you have COVID-19 symptoms. Self-isolate in line with NHS (or country-specific) guidance.

Avoid travelling and face-to-face interactions; if you need to travel and meet with others:

- If possible, avoid using public transport and cycle or walk instead.
- If you need to use public transport travel in off-peak times and follow transport provider's and governmental guidelines.
- Maintain (2 metre) social distancing where possible and where 2 metre social distancing is not achievable, wear face covering.
- Wear face covering at all times in enclosed or indoor spaces.
- Use hand sanitiser prior to and after journey.
- Avoid consuming food or drinks, if possible, during journey.
- Avoid, if possible, interchanges when travelling - choose direct route.
- Face away from other persons. If you have to face a person ensure that the duration is as short as possible.
- Do not share any items i.e. stationary, tablets, laptops etc. If items need to be shared use

disinfectant wipes to disinfect items prior to and after sharing.

- If meeting in a group for research purposes ensure you are following current country specific guidance on face-to-face meetings (i.e rule of 6 etc.)
- If and when possible meet outside and when not possible meet in venues with good ventilation (e.g. open a window)
- If you feel unwell during or after a meeting with others, inform others you have interacted with, self-isolate and get tested for Covid-19
- Avoid high noise areas as this mean the need to shout which increases risk of aerosol transmission of the virus.
- Follow one way circulation systems, if in place. Make sure to check before you visit a building.
- Always read and follow the visitors policy for the organisation you will be visiting.
- Flush toilets with toilet lid closed.
- 'Other' Control Measures you will take (specify):

**NOTE: The hazards and existing control measures above pertain to Covid-19 infection risks only. More generalised health and safety risk may exist due to remote field work activities and these are outlined in your Dissertation in Planning Guidance document. Please consider these as possible 'risk' factors in completing the remainder of this standard form. For more information also see: [Guidance Framework for Fieldwork in Taught and MRes Programmes, 2021-22](#)**

Consider, in turn, each hazard (white on black). If **NO** hazard exists select **NO** and move to next hazard section.

If a hazard does exist select **YES** and assess the risks that could arise from that hazard in the risk assessment box.

**Where risks are identified that are not adequately controlled they must be brought to the attention of your Departmental Management who should put temporary control measures in place or stop the work. Detail such risks in the final section.**

#### ENVIRONMENT

*e.g. location, climate, terrain, neighbourhood, in outside organizations, pollution, animals.*

**The environment always represents a safety hazard. Use space below to identify and assess any risks associated with this hazard**

Examples of risk: adverse weather, illness, hypothermia, assault, getting lost. Is the risk high / medium / low ?

Low – Personal safety: Field research will be conducted in public housing estates, which may be located in areas with higher crime rate

#### CONTROL MEASURES Indicate which procedures are in place to control the identified risk

- |                                     |   |
|-------------------------------------|---|
| <input type="checkbox"/>            | work abroad incorporates Foreign Office advice  |
| <input type="checkbox"/>            | only accredited centres are used for rural field work   |
| <input type="checkbox"/>            | participants will wear appropriate clothing and footwear for the specified environment        |
| <input type="checkbox"/>            | refuge is available   |
| <input type="checkbox"/>            | work in outside organisations is subject to their having satisfactory H&S procedures in place |
| <input checked="" type="checkbox"/> | OTHER CONTROL MEASURES: please specify any other control measures you have implemented:       |
- Stay vigilant and report status regularly to a friend while during field research

#### EMERGENCIES

*e.g. fire, accidents*

**Where emergencies may arise use space below to identify and assess any risks**

Examples of risk: loss of property, loss of life

Nil

#### CONTROL MEASURES Indicate which procedures are in place to control the identified risk

- |                          |   |
|--------------------------|---|
| <input type="checkbox"/> | participants have registered with LOCATE at <a href="http://www.fco.gov.uk/en/travel-and-living-abroad/">http://www.fco.gov.uk/en/travel-and-living-abroad/</a> |
| <input type="checkbox"/> | contact numbers for emergency services are known to all participants  |
| <input type="checkbox"/> | participants have means of contacting emergency services  |
| <input type="checkbox"/> | a plan for rescue has been formulated, all parties understand the procedure   |
| <input type="checkbox"/> | the plan for rescue /emergency has a reciprocal element   |
| <input type="checkbox"/> | OTHER CONTROL MEASURES: please specify any other control measures you have implemented:   |

FIELDWORK 1

May 2010

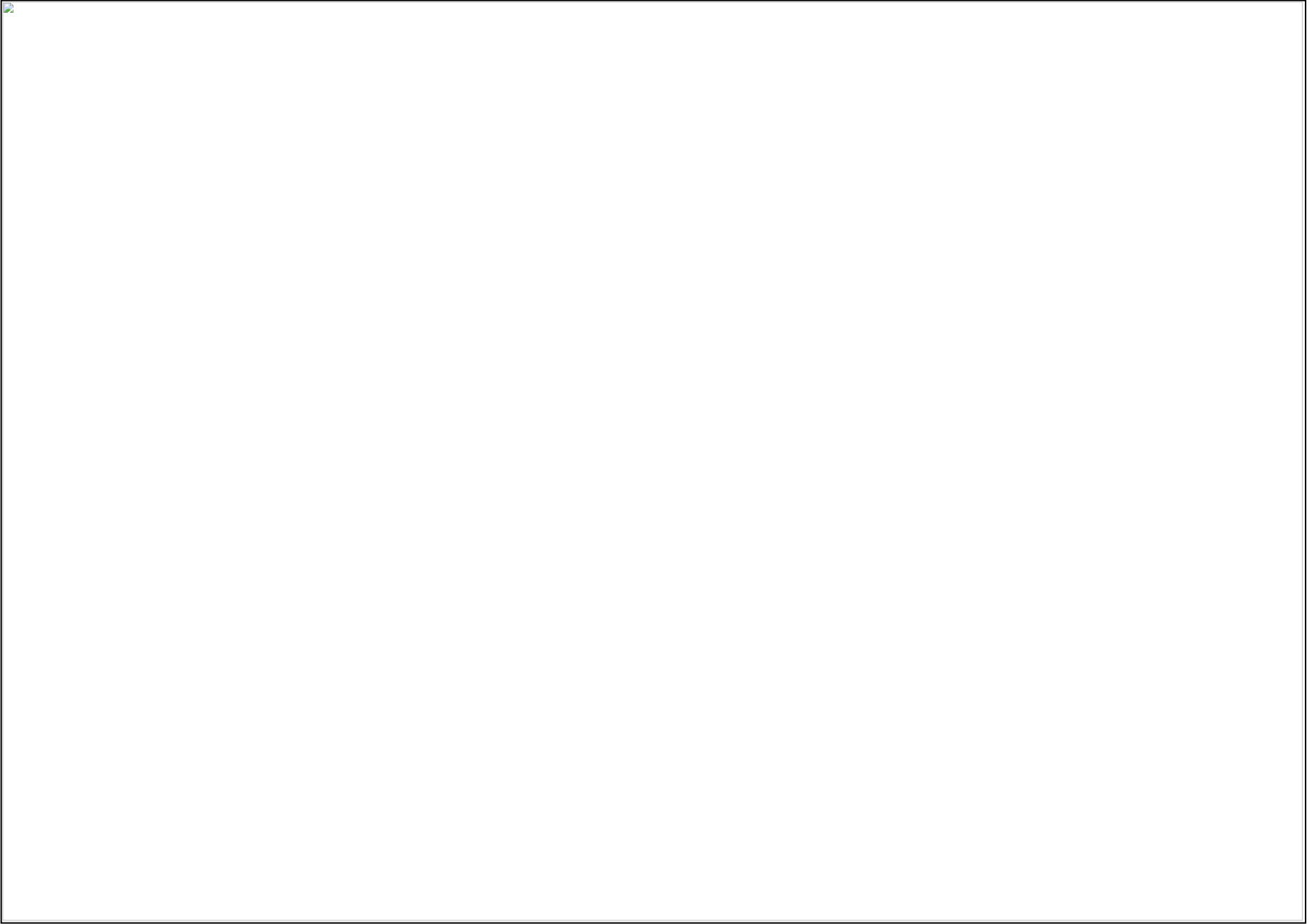


<b>EQUIPMENT</b>	Is equipment used?	YES	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
<i>e.g. clothing, outboard motors.</i>	Examples of risk: inappropriate, failure, insufficient training to use or repair, injury. Is the risk high / medium / low?		
Camera – No risk			
<b>CONTROL MEASURES</b> Indicate which procedures are in place to control the identified risk			
<input type="checkbox"/>	the departmental written Arrangement for equipment is followed		
<input type="checkbox"/>	participants have been provided with any necessary equipment appropriate for the work		
<input type="checkbox"/>	all equipment has been inspected, before issue, by a competent person		
<input type="checkbox"/>	all users have been advised of correct use		
<input type="checkbox"/>	special equipment is only issued to persons trained in its use by a competent person		
<input type="checkbox"/>	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:		
<hr/>			
<b>LONE WORKING</b>	Is lone working a possibility?	YES	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
<i>e.g. alone or in isolation lone interviews.</i>	Examples of risk: difficult to summon help. Is the risk high / medium / low?		
No risk			
<b>CONTROL MEASURES</b> Indicate which procedures are in place to control the identified risk			
<input type="checkbox"/>	the departmental written Arrangement for lone/out of hours working for field work is followed		
<input type="checkbox"/>	lone or isolated working is not allowed		
<input type="checkbox"/>	location, route and expected time of return of lone workers is logged daily before work commences		
<input type="checkbox"/>	all workers have the means of raising an alarm in the event of an emergency, e.g. phone, flare, whistle		
<input type="checkbox"/>	all workers are fully familiar with emergency procedures		
<input type="checkbox"/>	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:		
<hr/>			
<b>FIELDWORK</b>	<b>2</b>	May 2010	

<b>ILL HEALTH</b>	The possibility of ill health always represents a safety hazard. Use space below to identify and assess any risks associated with this Hazard.		
<i>e.g. accident, illness, personal attack, special personal considerations or vulnerabilities.</i>	Examples of risk: injury, asthma, allergies. Is the risk high / medium / low?		
No risk			
<b>CONTROL MEASURES</b> Indicate which procedures are in place to control the identified risk			
<input type="checkbox"/>	all participants have had the necessary inoculations/ carry appropriate prophylactics		
<input type="checkbox"/>	participants have been advised of the physical demands of the research and are deemed to be physically suited		
<input type="checkbox"/>	participants have been adequate advice on harmful plants, animals and substances they may encounter		
<input type="checkbox"/>	participants who require medication should carry sufficient medication for their needs		
<input type="checkbox"/>	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:		
<hr/>			
<b>TRANSPORT</b>	Will transport be required	NO YES	Move to next hazard Use space below to identify and assess any risks
<i>e.g. hired vehicles</i>	Examples of risk: accidents arising from lack of maintenance, suitability or training		Is the risk high / medium / low?
Travel to research sites – No risk			
<b>CONTROL MEASURES</b> Indicate which procedures are in place to control the identified risk			
<input checked="" type="checkbox"/>	only public transport will be used		
<input type="checkbox"/>	the vehicle will be hired from a reputable supplier		
<input type="checkbox"/>	transport must be properly maintained in compliance with relevant national regulations		
<input type="checkbox"/>	drivers comply with UCL Policy on Drivers <a href="http://www.ucl.ac.uk/hr/docs/college_drivers.php">http://www.ucl.ac.uk/hr/docs/college_drivers.php</a>		
<input type="checkbox"/>	drivers have been trained and hold the appropriate licence		
<input type="checkbox"/>	there will be more than one driver to prevent driver/operator fatigue, and there will be adequate rest periods		
<input type="checkbox"/>	sufficient spare parts carried to meet foreseeable emergencies		
<input type="checkbox"/>	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:		

<b>DEALING WITH THE PUBLIC</b> <i>e.g. interviews, observing</i>	Will people be dealing with public	<input type="checkbox"/> YES	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
	Examples of risk: personal attack, causing offence, being misinterpreted. Is the risk high / medium / low?  Casual interviews with the public – Low risk: receive impolite response		
<b>CONTROL MEASURES</b>	Indicate which procedures are in place to control the identified risk		
<input type="checkbox"/>	all participants are trained in interviewing techniques		
<input type="checkbox"/>	advice and support from local groups has been sought		
<input checked="" type="checkbox"/> x	participants do not wear clothes that might cause offence or attract unwanted attention		
<input checked="" type="checkbox"/> x	interviews are conducted at neutral locations or where neither party could be at risk		
<input type="checkbox"/>	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:		
<b>FIELDWORK</b>	<b>3</b>	May 2010	

<b>WORKING ON OR NEAR WATER</b> <i>e.g. rivers, marshland, sea.</i>	Will people work on or near water?	<input type="checkbox"/> NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
	Examples of risk: drowning, malaria, hepatitis A, parasites. Is the risk high / medium / low?		
<b>CONTROL MEASURES</b>	Indicate which procedures are in place to control the identified risk		
<input type="checkbox"/>	none working on or near water will not be allowed		
<input type="checkbox"/>	coastguard information is understood; all work takes place outside those times when tides could prove a threat		
<input type="checkbox"/>	all participants are competent swimmers		
<input type="checkbox"/>	participants always wear adequate protective equipment, e.g. buoyancy aids, wellingtons		
<input type="checkbox"/>	boat is operated by a competent person		
<input type="checkbox"/>	all boats are equipped with an alternative means of propulsion e.g. oars		
<input type="checkbox"/>	participants have received any appropriate inoculations		
<input type="checkbox"/>	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:		
<b>MANUAL HANDLING (MH)</b>	Do MH activities take place?	<input type="checkbox"/> NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
<i>e.g. lifting, carrying, moving large or heavy equipment, physical unsuitability for the task.</i>			
Examples of risk: strain, cuts, broken bones. Is the risk high / medium / low?			
<b>CONTROL MEASURES</b>	Indicate which procedures are in place to control the identified risk		
<input type="checkbox"/>	the departmental written Arrangement for MH is followed		
<input type="checkbox"/>	the supervisor has attended a MH risk assessment course		
<input type="checkbox"/>	all tasks are within reasonable limits, persons physically unsuited to the MH task are prohibited from such activities		
<input type="checkbox"/>	all persons performing MH tasks are adequately trained		
<input type="checkbox"/>	equipment components will be assembled on site		
<input type="checkbox"/>	any MH task outside the competence of staff will be done by contractors		
<input type="checkbox"/>	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:		
<b>FIELDWORK</b>	<b>4</b>	May 2010	



## Ethical clearance

The Bartlett School of Planning



BPLN0052: Major Research Project

MRP Proposal – Ethical Clearance

Your details:

Name:	Marco Mak
Programme:	MSc Urban Design and City Planning
Supervisor:	Judith Loesing

Supervisor sign-off for Ethical Clearance Forms and Risk Assessment Forms

(For supervisor completion only BEFORE submission via Moodle)

Are you satisfied with the ethical clearance form (yes/~~no~~)?

Please provide any additional comments about the form that may help the student.  
 (If the form is missing, the proposal must be given a mark of 0, and the student will have 48 hours to resubmit the complete proposal. If the form is unsatisfactory, the student must amend their ethical questionnaire to your satisfaction before they can proceed with their research)

**Note: this is a copy of the proforma that each student MUST complete and submit directly on Moodle. Please reproduce your submission here for the purpose of your supervisor signing off on its review and approval.**

### Ethical Clearance Pro Forma

It is important for you to include all relevant information about your research in this form, so that your supervisor can give you the best advice on how to proceed with your research.

You are advised to read though the relevant sections of [UCL's Research Integrity guidance](#) to learn more about your ethical obligations.

#### Submission Details

**1. Name of programme of study:**

MSc Urban Design and City Planning

**2. Please indicate the type of research work you are doing (Delete that which do not apply):**

Dissertation in Planning (MSc)

Dissertation in City Planning (MPlan)

Major Research Project

**3. Please provide the current working title of your research:**

Circularity for Public Housing:  
 Adopting circularity strategies in public housing in the UK for environmental, social and economic benefits

**4. Please indicate your supervisor's name:**

Judith Loesing

#### Research Details

**5. Please indicate here which data collection methods you expect to use. (Tick all that apply/or delete those which do not apply.)**

- Interviews
- Focus Groups
- Questionnaires (including oral questions)
- Action research
- Observation / participant observation
- Documentary analysis (including use of personal records)
- Audio-visual recordings (including photographs)
- Collection/use of sensor or locational data
- Controlled trial
- Intervention study (including changing environments)
- Systematic review
- Secondary data analysis
- Advisory/consultation groups

**6. Please indicate where your research will take place (delete that which does not apply):**

- UK only
- Overseas only
- UK and overseas

**7. Does your project involve the recruitment of participants?**

'Participants' means human participants and their data (including sensor/locational data and observational notes/images.)

Yes/ ~~No~~ (Please delete as applicable)

#### Appropriate Safeguard, Data Storage and Security

**8. Will your research involve the collection and/or use of personal data?**

Personal data is data which relates to a living individual who can be identified from that data or from the data and other information that is either currently held, or will be held by the data controller (you, as the researcher).

This includes:

- Any expression of opinion about the individual and any intentions of the data controller or any other person toward the individual.
- Sensor, location or visual data which may reveal information that enables the identification of a face, address etc. (some post codes cover only one property).
- Combinations of data which may reveal identifiable data, such as names, email/postal addresses, date of birth, ethnicity, descriptions of health diagnosis or conditions, computer IP address (of relating to a device with a single user).

Yes/~~No~~ (Please delete as applicable)

**9. Is your research using or collecting:**

- special category data as defined by the General Data Protection Regulation\*, and/or
- data which might be considered sensitive in some countries, cultures or contexts?

\*Examples of special category data are data:

- which reveals racial or ethnic origin, political opinions, religious or philosophical beliefs, trade union membership;
- concerning health (the physical or mental health of a person, including the provision of health care services);
- concerning sex life or sexual orientation;
- genetic or biometric data processed to uniquely identify a natural person.

~~Yes~~/No (Please delete as applicable)

**10. Do you confirm that all personal data will be stored and processed in compliance with the General Data Protection Regulation (GDPR 2018)? (Choose one only, delete that which does not apply)**

- Yes
- ~~No~~
- ~~I will not be working with any personal data~~

**11. I confirm that:**

- The information in this form is accurate to the best of my knowledge.
- I will continue to reflect on and update these ethical considerations in consultation with my supervisor.

Yes/~~No~~ (Please delete as applicable)



FINAL GRADE

**/100**

GENERAL COMMENTS

**Instructor**

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PAGE 1

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PAGE 2

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PAGE 3

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PAGE 4

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PAGE 5

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PAGE 6

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PAGE 7

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PAGE 8

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PAGE 9

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PAGE 10

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PAGE 11

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PAGE 12

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PAGE 13

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PAGE 14

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PAGE 15

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PAGE 16

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PAGE 17

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PAGE 18

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PAGE 19

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PAGE 20

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PAGE 21

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PAGE 22

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PAGE 23

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PAGE 24

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PAGE 25

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PAGE 26

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PAGE 27

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PAGE 28

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PAGE 29

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PAGE 30

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PAGE 31

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PAGE 32

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PAGE 33

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PAGE 34

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PAGE 35

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PAGE 36

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PAGE 37

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PAGE 38

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PAGE 39

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PAGE 40

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PAGE 41

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PAGE 42

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PAGE 43

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PAGE 44

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PAGE 45

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PAGE 46

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PAGE 47

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PAGE 48

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PAGE 49

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PAGE 50

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PAGE 51

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PAGE 52

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PAGE 53

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PAGE 54

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PAGE 55

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PAGE 56

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PAGE 57

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PAGE 58

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PAGE 59

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PAGE 60

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PAGE 61

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