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VANTAGE DATA CENTER DUB 13
CIRCULAR ECONOMY TECHNICAL NOTE

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CONTENTS

EXECUTIVE SUMMARY

This Circular Economy Technical Note has been prepared by Ramboll UK Ltd. ('Ramboll') on behalf of Vantage Data Centers DUB 11 Ltd in support of a planning application for the redevelopment of DUB-13 ('the Site'). This note should be read in conjunction with the Environmental Impact Assessment also provided by Ramboll UK.

In summary, the proposed development would comprise the following:

- Demolition of the existing double-story dwelling;
- Erection of the proposed development along with associated emergency generators and flues with a gross floor area of approximately 12,893 m^2; and
- Provision of 60 car parking spaces and 34 bicycle parking spaces provision.

Vantage aspires to create an attractive built environment with a network of new and enhanced places, through a well-designed building that complement the surrounding Business Park area. Th proposed development is targeting high standards of environmental, social, and economic sustainability.

The proposed development will incorporate the following CE philosophies:

Table 1: Circular Economy Philosophies

CE Commitment	Strategy Examples
Reduce embodied carbon	Low impact elements specified where appropriate. Materials with EPDs prioritised over those without. Local supply chain prioritised to reduce transportation distances.
Conserving resources	Compact building form with uniform surfaces reduces allows for minimalist design and minimised material use. Using materials with recycled and reused content; concrete with cement replacement where structurally possible. Highly efficient building envelope and A++ rated systems.
Sustainable material sourcing	Sustainable material sourcing embedded in the contractor's brief. Transparent supply chain with recognised sustainability credentials. Materials used in superstructure, substructure, and hard landscaping, will come from suppliers with a positive track record who can provide certification for responsible sourcing.
Designing to eliminate waste	Use of prefab elements to move the production offsite, where material use, quality control and waste disposal are managed to industrial standards. Passive design strategies applied to optimise MEP system capacity.
Design for disassembly	External walls designed in metal framing with reversible, bolted fixings. Building skin is designed to be independent from the structure. Easy access to elements that may be replaced during building lifespan such as plant, services, façade cladding and interior walls.
Longevity	Robust and timeless building and landscape design. Draught-proof plant species prioritised in landscaping. Key exposed building elements designed to limit degradation. Easy access to long-life building layers for maintenance. Leak detection systems will be installed to monitor loss pressure in pipes.
Flexibility and adaptability	Building designed in layers. Designed for potential future change in use/tenancy. Layout design for flexibility and future adaptability.

CE Commitment	Strategy Examples
Managing construction waste sustainably	Separate demolition, excavation and construction waste into several appropriate streams. Reuse the excavation soils in building retaining wall structures in line with the landscaping strategy in the perimeter of the site.
Operational waste management	Separated waste streams. Clearly indicated path to waste refuges.

To be truly successful, a Circular Economy Strategy will require buy-in from all stakeholders and decision makers, with a requirement to a new integrated collaboration model. The table below outlines the work stage lifecycle for the future of the project.

Table 2: Key actions for coming work stages.

4	5	6	7
Engage with the design team to **address the end-of-life strategies of key material groups**	Ensure project **CE metrics are monitored** with the contractor and supply chain		**Review success** against agreed project KPIs
Consider hosting **CE design workshops** to explore additional CE approaches for the construction stages	Engage with **waste management contractors** and logistics contractors early to put a resource strategy in place Engage in manufacturers and suppliers who offer **product as a service**		
Work with contractors and the supply chain **to enable products to be reused** with higher quality segregation of materials being carried out	Prioritise suppliers who **operate 'take-back' schemes**		
Embed CE clauses within supply chain procurement to galvanise CE action			

1. INTRODUCTION

1.1 Background

This Circular Economy Technical Note has been prepared by Ramboll UK Ltd ('Ramboll') on behalf of Vantage Data Centers DUB 11 Ltd in support of a planning application for the redevelopment of the site. This note has been prepared to set out the circular economy philosophies of the proposed development in relation to EDE7 Objective 2 of the South Dublin County Council Development Plan 2022-2028 on *'measures to support the just transition to a circular economy'*. This note should be read in conjunction with the Environmental Impact Assessment also provided by Ramboll UK and other documentation accompanying the planning application.

1.2 Existing Site

The site is located in Profile Park, approximately 10 kilometres (km) to the south-west of Dublin city centre, within South Dublin County in an industrial area that houses several data centres, see Figure 1. The site's surrounding context predominantly comprises Profile Park and industrial development to the north, Grange Castle Golf Club to the east beyond which are residential properties, agricultural land and industrial development to the south and the permitted Vantage data center development to the west.

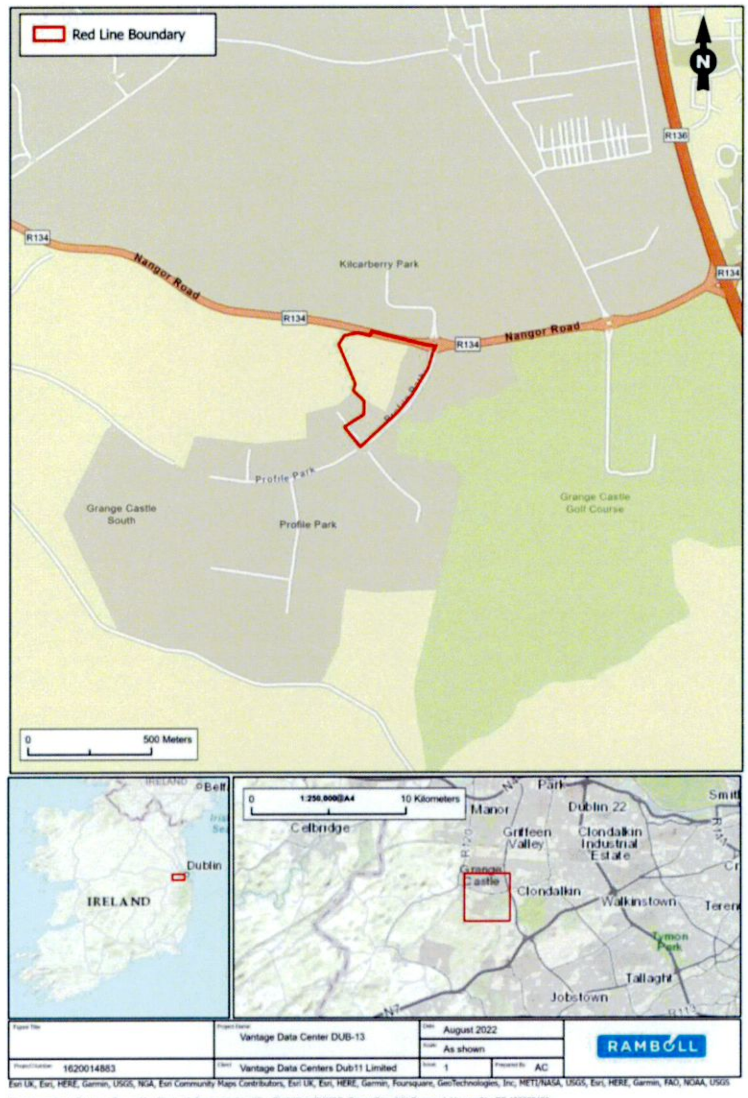


Figure 1: Site location plan

The site is a triangular parcel of agricultural land, with a residential dwelling located in the north-west corner of the site, and an area of hardstanding within the south-west of the site. The site covers a total area of 3.79 ha and lies at an elevation between approximately 74 and 75 m Above Ordnance Datum (m AOD).

1.3 Proposed Site

The proposed development will be located on a previously largely unoccupied agricultural land with a single residential dwelling adjacent to the Grange Castle Business Park that already contains several other data centres. Under the South Dublin County Council Development Plan the site is classified under Objective EE: to provide for enterprise and employment related uses. The proposed development will create a substantial economic opportunity by not only creating additional job opportunities, but also adding a high-quality built element to the Profile Park Business Park and adding environmental value by diversifying the habitat of the site. The proposed development will also add to the national data storage infrastructure and local electrical grid network capacity among other benefits.

The facility will house data processing equipment (telecommunications and computers), serving various businesses that deliver on-line data services to the local area. The building will have 24/7 operation with secure access, occasional visitors, and deliveries.

Most of the building area will be comprised of data processing equipment rooms, and the air-conditioning equipment which support the operation of those rooms. The uniform size of the data halls is a function of the tenant requirement for standardized space and to enable modular power and cooling plant to be used. There is also going to be a small administration component (offices and maintenance) for support personnel who operate and maintain the facility. The offices, staff facilities and storage rooms are in the east of the proposed development.

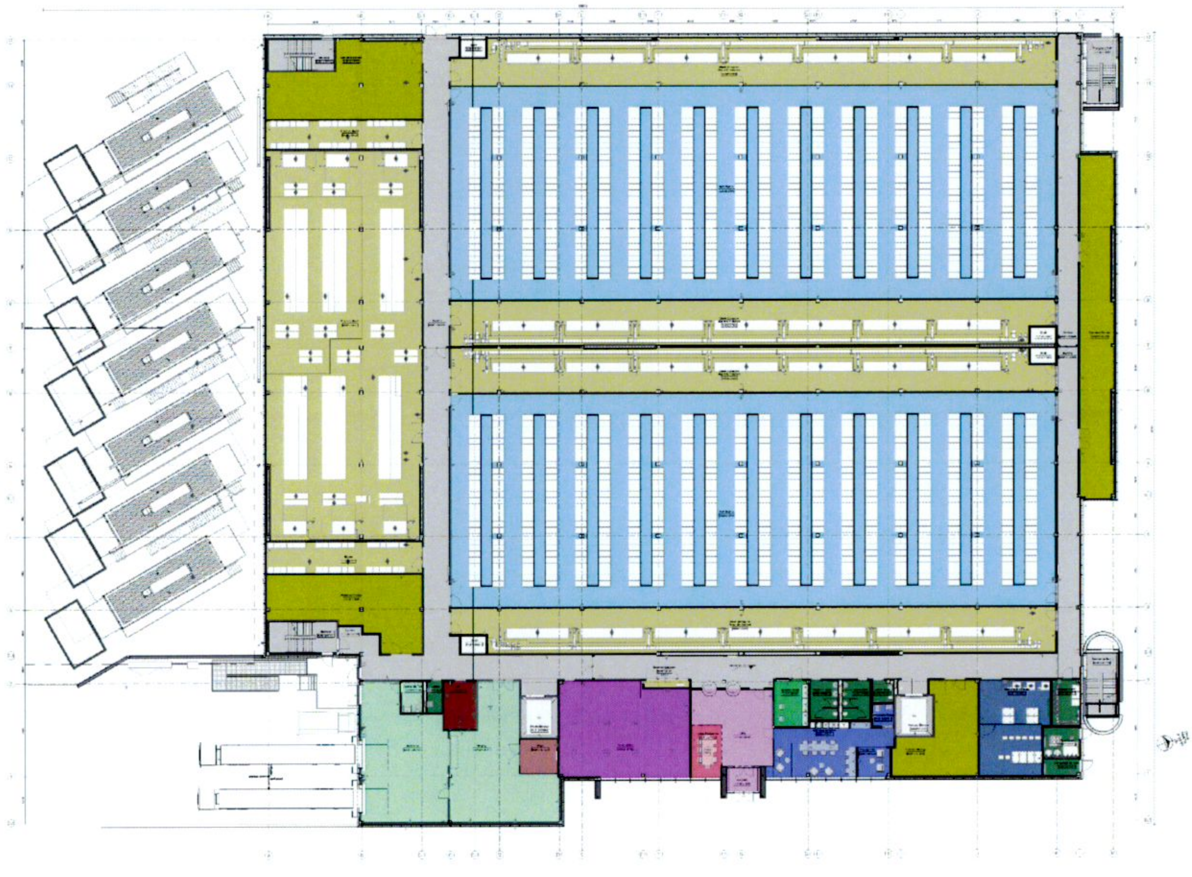


Figure 2: The proposed Ground floor plan

The remainder of the proposed development involves facilities such as car parks, operational areas and landscaping. There are a range of biodiversity measures incorporated within the proposed development, through wetland meadows, hedgerows, native tree planting and as well as attenuation ponds and SuDs features. All of these implemented measures will provide new habitats and biodiversity. In addition, the stream flowing along the south and west boundaries of the site will be retained and enhanced.

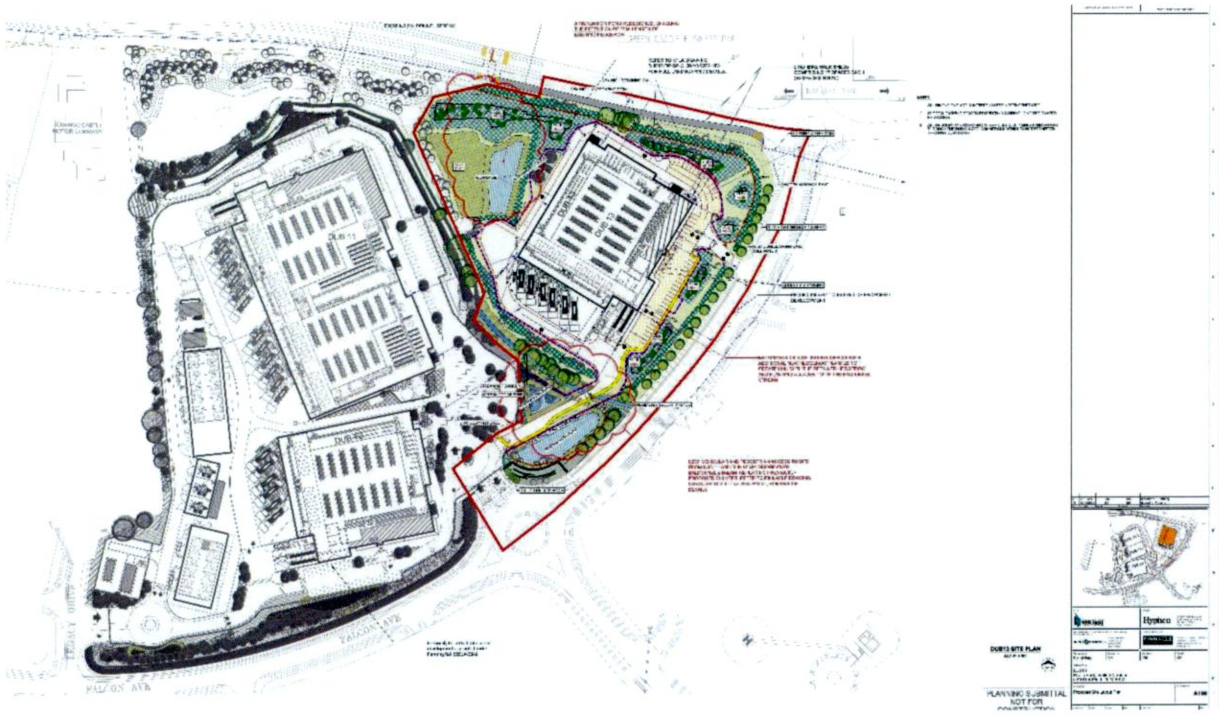


Figure 3A: Proposed development. Ref: Burns & McDonnell & Hyphen (not to scale)

The surface treatment of the outdoor areas is focused at being robust and highly durable, while being easy to maintain, given the industrial nature of the building. These are largely dominated by water permeable concrete pavers for both the pedestrian and vehicular routes. See the key pavement material types in the figure below.

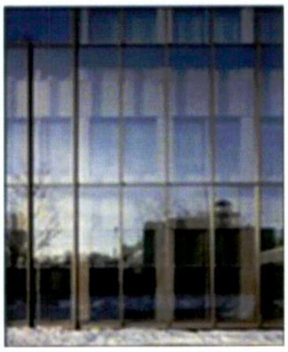
The overall architectural approach of the proposed development is a design of lean configuration of enclosure, structure, and circulation to meet the specific needs of the data module rooms split on two stacked levels. The exterior skin of the building is designed in high performance clad, insulated sandwich panels. Perforated metal panels used around the staircases and with stainless steel wire mesh will allow growing of vertical planting to grow up the façade, thus contributing to the biodiverse habitat of the landscaping. Living Green Walls are introduced from Ground level.

Rooftop plant screened by dark grey mesh panels with sedum "green" roof being introduced over the office and non-critical areas of the datacentres.

The structural system is described as concrete on composite steel deck support by steel beams, steel girders, and steel columns, with concentric steel braces to serve as the lateral force resisting system with metal panel wall cladding. The floor is a casted concrete slab on grade. The building foundations would be formed of pads and strips that would be founded on the bedrock underlying the site.

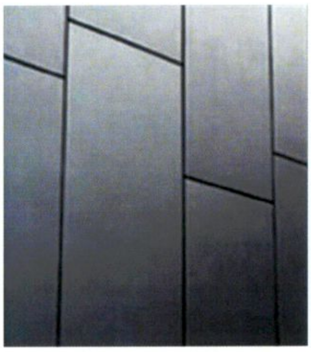
Figure 4A: Proposed development facade design, ref.: Burns & McDonnell & Hyphen

There are five façade panel types that characterise the design concept – white and grey insulated clad sandwich panel, curtainwall, acoustic louvers and perforated metal panels.



Curtain Wall

Mesh and Green wall – to external stair cove



Grey Metal Panel

White Metal Panel

Acoustic Louvers

Green Wall

Figure 5A: Key facade elements used in design, ref: Burns & McDonnell & Hyphen

The landscape architect has focused thoroughly on a progressive and dynamic landscape. There is a range of schemes and planting schedules associated with the development which will provide ecological enhancements, visual interest, and verdant setting. The design looks to incorporate vertical planting features to increase the planting area.

The hard surfaces are dominated by concrete and asphalt providing a high level of robustness and durability. Further details of the intended landscape design can be seen in the Landscape Design Strategy provided as part of the planning application.

The proposed building and site design shows a high-quality design standard, which sets high standards for sustainable, accessible, and inclusive data centre developments. This is credited to the client's aspiration to produce a built environment which is attractive and enhances the areas, enabling people to enjoy the outdoor amenities and well-designed buildings.

2. CIRCULAR ECONOMY DISCUSSION

2.1 Demolition Works

The site currently comprises a three-storey house and a garage, both built in concrete blockwork with brick and grey-rendered façade features and clay-tiled roofs.

In addition to the above there are also three sheds, made in low level concrete blockwork at the base and corrugated metal cladding or agricultural roof that appears to be supported by a timber structure.

None of the existing assets on site are fit for retention and reuse in a data center setting given their design specifics. The nature of data centers requires high loading capacities for the heavy server and service equipment associated with their operation, which neither of the two can accommodate. In addition, the architect aspires to house both the data halls and office spaces within the same building to improve communication among personnel and reduce response times. This means the three-storey house is not ideal to be reused for the office or staff spaces.

Considering the above, it has been decided to demolish both buildings and recover residual value where possible. All demolition works should be performed under a separate scope of work prior to works starting on construction of the proposed development. The existing buildings will be demolished, along with surrounding pavement. Clearing operations shall consist of stripping/removing of organic debris and other deleterious materials from the existing landscaped areas. All exposed surfaces shall be free of mounds and depressions that could prevent uniform compaction.

All concrete and asphalt pavements that do not contain rebar and are set to be demolished shall be delivered to a local recycler. Documentation identifying the quantity of concrete recycled shall be provided by the Contractor to the Developer, and the weight of concrete delivered for recycling shall be reported to the Developer. The weight of all concrete that is disposed of as solid waste shall also be reported to jurisdictional authorities as solid waste as required.

A set of informed steps will be made that will look to recover value from the existing site, where it is found feasible. The project leadership is therefore committed on working closely with the appointed Demolition Contractor to ensure the existing asset is disassembled with greater care to enable as much of it to be reused on or off-site, or recycled, as noted in EIAR Waste Chapter 14. The EIA Waste chapter notes that a Construction and Demolition Waste Management Plan (CDWMP) would be developed by the contractor to ensure sustainable and responsible management of all construction, demolition, and excavation (CDE) waste, while maximising opportunities for reuse and recycling. In addition, it also sets out the methods It should also be expected that the Demolition Contractor will take the ownership of the disassembled elements. The likely end-of-life routes should be specified in their CDWMP that should be carried out as soon as the contractor is appointed. The plan should follow the local guidance and industry practice. It is noted that the pre-demo audit associated with CDWMP should as minimum identify the key material groups, their quantities, quality and most appropriate end-of-life routes. Table 14-9 of the EIAR Chapter 14 estimates a total 84t of waste arising from the demolition of the existing elements found on site. Asphalt, concrete, bricks and tiles account for over 75% of this waste. It is expected that the concrete, brick, tiles and ceramics have a 95% reuse potential, enabling for 22t of reusable material. It is anticipated that about 56t of demolition waste would be recycled, with only less 5% being disposed of.

2.2 Conserving Resources

Conservation of resources and increasing the active life of a material is at the heart of a CE strategy and has been implemented throughout the design process for this phase of the development. The three core principles of the development can be seen below:

- Resource utilisation;
- Eliminating Waste; and
- Waste management.

Asphalt and pavers are used throughout the development to ensure a long-lasting landscape and reducing virgin material used through recycled content.

Superstructure and substructure design has considered material reduction and utilisation throughout. Structural frame efficiency and layout has been reviewed, which has allowed for the development of a more efficient column grid and steel transfer of the structure.

Space layout has been optimised to minimise the extent of the windows and glazing used in the development. The façade will be well-insulated via an insulated panel system, which allows for the reduction in operational energy spent on heating during the colder months.

Heating to the office areas will be provided by heat pumps that will recover heat from the data module cooling system. This will allow the heat pump system to operate at higher efficiencies compared to air cooled systems operating at standard ambient conditions.

The data storage modules will be cooled with air handling units. Cooling to the office and ancillary areas will be provided by roof mounted air-cooled free cooling chillers.

The fresh air ventilation system for the office area will be served using energy efficient Heat Recovery Units (HRU) which will recover waste heat from the office spaces and re-use to pre-heat the air with the HRU. This will reduce the overall energy consumption for this system.

LED lighting to be used both indoors and outdoors and will be controlled with presence detection controls or local switching where appropriate. Both energy meters and leak detection systems to be installed to ensure that the systems remain efficient throughout their use and any breaks or leaks of pipes can be identified as soon as possible. In addition, the design team will identify all unregulated water demands that may be reduced at a later stage. System(s) or processes to reduce the unregulated water demand will be identified and a meaningful reduction in the total water demand will be demonstrated through either good practice design or specification.

Material choices have been made with the embodied carbon in mind, where feasible, prioritisation of low impact materials have taken precedence over materials that have a larger impact, when possible. Embodied carbon of the material has been assessed through the carbon associated with the material through its whole life, including the material type (finite or renewable), manufacturing processes, and the energy used during the production. To ensure full clarity of the environmental impact and transparency of the sourcing process, materials with Environmental Product Declarations (EPD) have been prioritised over materials without.

Local, regional, and national sourcing will be considered, in that order, over importing materials. This will allow for minimised embodied carbon to be associated with the transportation of these materials. Secondary benefits, such as local economic growth and job creation, are also associated with this decision process. Validation of this process will require the confirmation of manufacturing and extraction location, which should be requested from the supplier.

Sustainable and responsible procurement will be considered to procure materials used in the hard landscaping, substructure and superstructure from suppliers who can provide certification for responsible sourcing (BES6001 Very Good or Excellent or equivalent). All timber products and timber-based products will be 'legally harvested and trader timber'.

Where possible, key building elements will be produced off-site, promoting an efficient construction process, and hence reducing material waste and operational energy. Due to the enhanced working environment, the process produces materials in a quicker time, while commonly producing a product that is of a higher quality.

2.3 Designing to Eliminate Waste

CE strategies and concepts can be embedded into a design to ensure waste is eliminated at the design phase, both during at the construction phase and the end-of-life. These concepts and strategies are as followed:

- Design for longevity, adaptability or flexibility and reusability or recoverability; and
- Design out construction, demolition, excavation, and municipal waste.

The proposed development has been designed to accommodate a range of uses. In the high-occupancy spaces such as break room, lobby, offices etc have been designed to accommodate changes during its life span as data centre. These have been designed with flexibility in mind, considered in terms of loading, layout, and services provisions.

'Building in Layers' has largely been used throughout the design process, with each layer being designed to fit its intended purpose and expected lifespan. This can be seen in the separated layers between the structure and the skin, which introduces a level of flexibility and adaptability, independent of one-another to accommodate changes in future climate or the tenant needs.

2.3.1 Designing Out Waste

Off-site construction processes have been considered to minimise waste arising from construction activities, through a much more efficient factory-based production line and assure that the waste is managed to industry standards, which is much harder to achieve in an in-situ setting. The modular layout and the use pre-cast elements also improves replicability when any parts of the building need replacement over its lifetime.

Steel structure and a panel façade system are the preferred design options due their long life and loose fit, among other advantages such disassembly and easy maintenance. The robustness of the system design will allow for easier replacements that will subsequently reduce the waste associated with building maintenance and the material handling that takes place during replacement cycles. Reversible joints and fixing via bolted connections will allow for key material groups to be removed, reclaimed, and reused before they are being demolished and downcycled in the future.

The façade of the proposed development is designed to incorporate robust design promoting repetition and replicability, eliminating waste during the manufacture and installation process. The design has kept core design principles at its heart, with high-quality metal cladding to ensure the building is designed with future architecture in mind, minimising the risk of replacement, resulting in an enhanced life span. The modularised panels create a system from standardised products, which can accommodate future changes, be reused, or recycled when the design life has been finished. The insulated cladding system permits the ease of replacement.

A set of dedicated outside air-handling units (DOAS) will provide outside air for ventilation and positive pressurization into each data module. Units will be directly ducted to each DM and critical space, which the ducting routes are optimised and their total length minimised where possible.

In the coming stages of the project, along with the Main Contractors appointment, the project team will enquire within the supply chain to promote the take-back schemes of any unused materials and material associated with transport i.e., pallets, packaging.

2.3.2 Flexibility and Adaptability

Designing a space that is truly flexible will extend the building lifespan and allow for changes in future tenancy without significant changes to the current design concept. Many areas in the development have been designed with this in mind, considering change in tenancy, plan layout or vertical extensions.

The nature of the steel structure and the insulated façade panels allow for bolted fixings that are easily reversible and as such can accommodate changes in façade, in part or full, based on the climate or tenancy needs. This consequently offers a high degree of shell adaptability.

Locating the DOAS on the roof, improves the spatial flexibility of the occupied floors. The future floor layouts, therefore, do not have to consider designing around a plant room and as such being restrained in the number of options that can be considered.

The proposed development has been designed with the potential to connect to a local heat network in the future, as part of an external off-site district heating scheme developed by others, should there be a local demand. This means that the site not only adds a level of flexibility for the development of the local area with a possibility of becoming an equivalent of a small heating plant, but also helps with minimising energy resources used in heat the building in proximity of the site in the future. To ensure that the heating system of the proposed development has the flexibility to connect into such a system whilst also maintaining a live data centre, valved, and capped off connections would be provided on return water risers, ready for future connection to a district heating network. Whilst the proposed development has been designed to incorporate a future district heating scheme it is not defined as a district heating scheme within reasonable proximity to the site is yet to be established.

2.3.3 Longevity and Ease of Maintenance

The façade panelling has been designed to ensure the maintenance of the panels can be completed efficiently, and under the scenario in which a panel is damaged, can easily be removed and replaced.

The roof, is designed to allow for easy access to improve inspection and maintenance, subsequently increasing its lifespan.

The critical HVAC systems will be designed to be concurrently maintainable, meaning that every piece of equipment can be taken out of service for routine maintenance without disrupting the critical load.

To extend the life of the chilled water critical cooling system, all air-cooled chillers are going to be placed on a rooftop platform for easy maintenance. The piping has been designed in a ring typology to enable concurrent maintenance.

A leak detection system will be used throughout the development to monitor fuel, condensate and humidifier leakage. This will ensure that any major water leak on the mains supply within the building, between buildings, and the utilities water meter will identify. This will ensure that water is not wasted but will add a layer of safety of detection to ensure materials and systems are not damaged as a result of the leak. Flashing is installed to ensure that rainwater cannot enter the elevation structure and in such a way that condensate and water leakage can leave the structure.

Maintenance solutions, measures and actions for the site will be developed and reviewed to improve the maintainability and increase the longevity of the new built assets as a result.

2.3.4 Disassembly and Recoverability

Recovery of materials has been considered throughout the design process, ensuring materials can be recovered by avoiding permanent fixings. To better understand the disassembly of materials and elements, the design team should request the product manufacturer to outline the future life of the product and how it could be repurposed or reused.

Products and systems that will be used in the development have been designed to ensure that these can be easily dismounted, reconfigured, and reused. This design consideration will improve the adaptability of the elements, as well as reducing the impact from future refurbishment.

Key considerations can be seen in the development of a uniform steel frame, where members have been designed to promote disassembly and reuse, while the pre-cast edge beams can be disassembled and reused for future projects.

Designing for future disassembly will ensure that the any appliances can be easily replaced when needed and will ensure the lifespan of a space can be enhanced. Where applicable, the services will be left exposed. This will ensure adaptable spaces and the ability for services to be rerouted and not confined in a single space. In future fitout works, short-lived components selection will be considered on potential leasing from the supplier.

The building is designed with the 'loose fit' approach in mind, which means that most of the key building layers are prepared for future disassembly and recovery via bolted joints and fixings. The building superstructure is built in steel, which enables direct reuse or upcycling, where the former is not feasible. The façade is designed in metal clad and brick slip panels that are in timeless minimalist style, which is fixed to the load bearing elements using bolted metal supports mounted directly on top of the steel columns. The pad and strip foundation and slab on grade, as well as the concrete pavers used in outdoor surfaces, although designed in concrete, allow for crushing the material down to its aggregate state for use in production of new concrete elements or use as a fill material in landscaping or support base for ground supported floors, where direct reuse is not possible.

The structural capacity of the building allows for change in use and tenancy and as such extend its potential lifespan. Much of the information related to material specifications can be stored for future use through BIM.

2.4 Managing Waste Sustainably

2.4.1 Construction and Demolition Waste Management Planning

A Construction and Demolition Waste Management Plan is the responsibility of the Demolition and Main Contractors. As such it should be embedded in their brief documents to ensure the right strategies are set out for responsible and efficient C&D waste management.

EIA Waste Chapter 14 highlights how any waste arising from enabling and construction works will be segregated to increase the opportunities for off-site reuse, recycling, and recovery. All waste collectors will be required to provide the appropriate credentials. The waste arising as well as their end-of-life routes will be closely monitored and documented the strategies set out in the CDWMP are being followed.

It is estimated in the EIA Waste Chapter that the largest quantities of construction and excavation waste will arise from topsoil removal and other excavated materials. They will make about 95% of all C&E waste. This means there is a great deal of potential for reusing these soil volumes in the landscaping design and shaping of the berms on the north and east borders of the site should they be chemically and geotechnically suitable. Where these soils have no beneficial use for the site, they will be exported for a full off-site reuse. It is estimated that only about 10% of all construction would be landfilled; all of concrete waste, which equates to about 5% of construction waste will be reused. The remaining volumes will be recycled.

2.4.2 Operational Waste Management Strategy

An OWMS should set out how waste generated by the operation of the proposed development will be managed. It can be based on the general arrangement plans of the proposed development. Storage provision for general waste, dry mixed recycling and wood waste has been calculated for weekly (7 day) waste collections for the proposed development. Hazardous waste, WEEE waste and metal waste will be collected on an ad hoc basis for the proposed development.

The OWMS should be prepared to satisfy the requirements for waste set out in the local policies for waste management in buildings, where appropriate. It is considered that the implementation of such strategy would confirm that the proposed development includes suitable space for the storage and management of waste necessary for a successful and efficient waste management regime.

The expected waste arisings from the operation of the proposed development should be categorised in at least seven streams listed below.

- Dry mixed recycling (e.g., glass, plastic, cardboard, paper)
- General waste (non-recyclable items)
- Wood (e.g., pallets)
- Metal (e.g., rack panels)
- Waste Electrical and Electronic Equipment
- Hazardous (e.g., batteries)
- Industrial (e.g., server equipment)

The future tenants of the proposed development will have to comply with VDC's waste management strategy based on a set waste hierarchy system. Tenants will be held responsible for returning waste from packing materials to the original suppliers to keep them in the loop and not dispose of.

In addition to the above, VDC aspires to reduce the waste arisings from the supply chain used by the tenant, specifically from packaging materials.

3. SUMMARY

3.1 Performance Summary

The table below outlines the overall strategic targets and aspirations for the proposed development.

Table 3: The site-specific CE approaches for each of the fundamental circularity principles

CE Commitment	Strategy Examples
Reduce embodied carbon	Low impact elements specified where appropriate. Materials with EPDs prioritised over those without. Local supply chain prioritised to reduce transportation distances.
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Operational waste management	Separated waste streams. Clearly indicated path to waste refuges.

Implementing CE at the early stages of a project can create the biggest 'return on investment', regarding environmental effect. To be truly successful, a Circular Economy Strategy will require a continuous input from all stakeholders, along with a requirement for new integrated collaboration models.

Table 4: Key actions for future work stages.

<table>
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