ARUP

Tiznow Property Company Limited (Comer Group Ireland)

City Park Development at the Former Tedcastles Site

Construction Environmental Management Plan – North Site

Reference: 267365-ARUP-XX-XX-RP-YE-0008

P02 | 28 March 2022

Job number 267365-00

Ove Arup & Partners Ireland Limited
One Albert Quay
Cork
T12 X8N6
Ireland
arup.com

ARUP

Document Verification

Project title	City Park Development at the Former Tedcastles Site
Document title	Construction Environmental Management Plan – North Site
Job number	267365-00
Document ref	267365-ARUP-XX-XX-RP-YE-0008
File reference	

Revision	**Date**	**Filename**	267365-ARUP-XX-XX-RP-YE-0008.docx		
P01	10/03/2022	**Description**	S2- Suitable for Information- Planning Issue		
			Prepared by	**Checked by**	**Approved by**
		Name	Ali Purcell	Stephen Ginn	John Hynes
		Signature			
P02	28/03/2022	**Filename**	267365-ARUP-XX-XX-RP-YE-0008.docx		
		Description	S2- Suitable for Information- Planning Issue		
			Prepared by	**Checked by**	**Approved by**
		Name	Ali Purcell	Stephen Ginn	John Hynes
		Signature	AP	SG	JH
		Filename			
		Description			
			Prepared by	**Checked by**	**Approved by**
		Name			
		Signature			

Issue Document Verification with Document ✓

Contents

Figures

Appendices

Introduction

1.1 Overview

This Construction Environmental Management Plan (CEMP) has been prepared by Arup to support Tiznow Property Company Limited (Comer Group Ireland)'s application for consent for the proposed strategic housing development (SHD) at the Former Former Tedcastles site on Centre Park Road, in Cork City.

Tiznow Property Company Limited (Comer Group Ireland), (hereafter referred to as *'the Developer'),* will have a construction management team which will supervise aspects of the construction phase of the proposed development.

The Developer's construction management team will ensure the contractor (and any subcontractors) will comply with all of the performance requirements set out in the tender documentation including the conditions attached to statutory consents which may be granted by An Bord Pleanála, Irish Water and other relevant statutory consent authorities.

The Developer's construction management team will ensure compliance with the mitigation measures set out in **Sections 6** and **7**.

This CEMP sets out the duties and responsibilities which will be imposed on the contractor in the construction contract. The Developer's construction management team will be responsible for ensuring that the contractor complies with all the requirements of this CEMP.

1.2 Purpose

The purpose of this CEMP is to provide a framework that outlines how The Developer will manage and where practicable minimise negative environmental effects during the construction of the proposed development. Construction is considered to include all site preparation, enabling works, demolition, materials delivery, materials and waste removal, construction activities and associated engineering works.

This CEMP identifies the minimum requirements with regard to the appropriate mitigation, monitoring, inspection and reporting mechanisms that need to be implemented throughout construction. Compliance with this CEMP does not absolve The Developer from compliance with all legislation and bylaws relating to their construction activities.

This CEMP has been produced as part of the application for consent to ensure compliance with legislative requirements.

1.3 Approach

This CEMP provides a framework to:

- Describe the programme for environmental management during construction;
- Implement those monitoring and mitigation measures outlined in **Section 6** and **Section 7**;
- Outline the principles and minimum standards required during the development of the CEMP (and associated Method Statements) and throughout construction;
- Identify the relevant roles and responsibilities for developing, implementing, maintaining, and monitoring environmental management; and
- Outline the procedures for communicating and reporting on environmental aspects of the proposed development throughout construction.

It is intended that this CEMP would be expanded and updated prior to the commencement of any construction activities on site. The CEMP is a dynamic document and will remain up to date for the duration of the construction period. The CEMP may need to be altered during the lifecycle of the construction period to take account of monitoring results, legislative changes, outcomes of third-party consultations etc.

Following appointment, the contractor will be required to develop more specific Method Statements that are cognisant of the proposed construction activities, equipment and plant usage and environmental monitoring plan for the proposed development. This CEMP should not be considered a detailed Construction Method Statement as it would be the responsibility of the contractor, appointed to undertake the individual works, in association with The Developer, to implement appropriate procedures and progress this documentation prior to commencement of construction.

This CEMP outlines the range of potential types of construction methods, plant and equipment which may be used by any contractor appointed to enable their effects to be assessed for the purposes of the planning authority's environmental impact assessment and appropriate assessment prior to determining whether to grant planning permission.

1.4 Structure

This CEMP is structured as follows:

- **Section 1** introduces the proposed development and outlines the purpose of the CEMP;
- **Section 2** describes in detail the proposed development;
- **Section 3** describes the construction strategy for the proposed development;
- **Section 4** sets out the framework and mechanisms through which environmental requirements would be managed;
- **Section 5** outlines the procedures to be employed during construction to manage environmental aspects;
- **Sections 6** and **7** describe in detail the measures to be implemented to minimise likely significant negative effects, as far as practicable, during the construction of the proposed development.

1.5 Updates to the Construction Environmental Management Plan

The detailed CEMP is considered a 'live document' that will be reviewed and revised regularly as construction progresses. The process for update, review and approval of the CEMP must be documented in the detailed CEMP to ensure that all revisions can be easily understood, applied and updated.

The contractor is required to update the CEMP to ensure that it:

- Is in accordance with the mitigation measures specified in the EIAR and associated ecological reports and this CEMP;
- Is in accordance with any conditions that may be prescribed as part of the consent(s) for the proposed development;
- Aligns with those design and construction details described in the EIAR and associated ecological reports and ensures there is no material change in terms of significant effects on the environment;
- Where practicable the contractor should seek to identify opportunities for further reducing significant negative environmental effects and to implement best practice in as far as reasonably practicable, i.e., take every reasonable effort to reduce and prevent negative effects, while enhancing benefits; and
- Will have regard to the guidance contained in the handbook published by Construction Industry Research and Information Association (CIRIA)[1].

Further, the following plans, and any others considered relevant, will be incorporated into the CEMP:

- Construction Compound Management Plan;
- Construction Traffic Management Plan;

[1] CIRIA (2015) Environmental Good Practice on Site Guide, 4th Edition

- Noise and Vibration Management Plan;
- Water Quality Management Plan;
- Dust Management Plan;
- Invasive Species Management Plan; and
- Emergency Incident Response Plan.

It is expected that amendments to the CEMP may be necessary to reflect inter alia changes in the project scope, contract scheduling, contractor appointments, environmental management policies, practices or regulations, and developments on the site. These reviews and updates are necessary to ensure that environmental performance is subject to continual improvement and that best practice is implemented throughout construction.

The Proposed Development

2.1 Overview

The Developer intends to apply to An Bord Pleanála (the Board) for consent for a Strategic Housing Development (SHD) with a total application area of c. 4.86ha on lands located on the Former Tedcastles site (hereafter referred to as '*the proposed development'*) at Centre Park Road, in Cork City. The area is considered to be a brownfield site with a number of pre-existing structures on the site which have been partially demolished. Refer to **Figure 1** for a site location map.

Figure 1: Indicative location of the proposed development site | Source: Google Earth © 2022 | not to scale

Figure 1: Indicative location of the proposed development site | Source: Google Earth © 2022 | not to scale indicates the approximate site boundary (red line) of the site. The subject site is bounded by Centre Park Road to the southeast, and ESB Charging Station to the west.

The existing topography of the site is slightly sloped with levels generally decreasing in elevation from approximately 5.3mOD at the northern boundary to 0.2mOD at the existing entrance to the site on the southern boundary.

2.2 Elements

The development will consist of:

- Demolition of the existing structures on site and the construction of a strategic housing development of 823 no. apartments, resident amenity and ancillary commercial areas including childcare facilities.
- The development will comprise 6 no. buildings ranging in height from part 1 no. to part 35 no. storeys over lower ground floor level.
- The proposed development also comprises hard and soft landscaping, pedestrian bridges, car parking, bicycle stores and shelters, bin stores, ESB substations, plant rooms and all ancillary site development works.
- Vehicular access to the proposed development will be provided via Centre Park Road.

Figure 2: Site Layout Plan with Blocks identified | not to scale

2.3 Key Interfaces

The site adjoins several existing public roads along its boundaries.

The site was formerly owned by Tedcastles, and consequently there are several service utilities located within the boundary of the site which previously served the site. In addition, two open drainage channels run just inside the North and South boundaries of the site, parallel to the River Lee and Centre Park Road respectively.

2.4 Existing Buildings

One structure currently remains on the North site.

The proposed development includes the demolition of this structure, which is approximately 269 m^2, as identified in Figure 3**.**

Figure 3: Existing Buildings and Structures | not to scale

2.5 Access Strategy

It is envisaged that access to the development site will be from Centre Park Road. The exact location is to be determined and agreed with CCC as construction phasing develops, but it is expected that the site access will be from Centre Park Road.

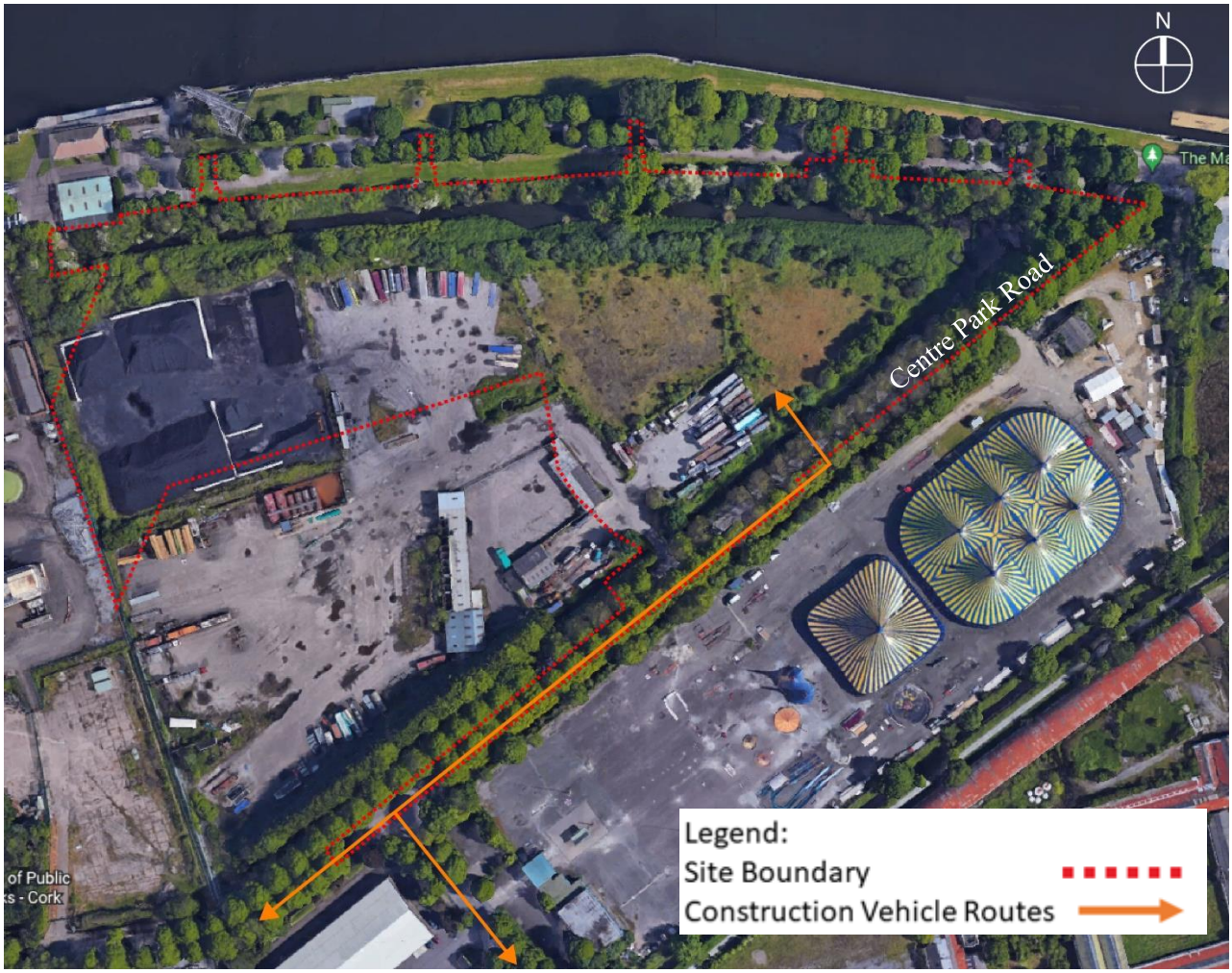


Figure 4: Construction Vehicle Access Strategy | Source: Google Earth © 2022 | not to scale

2.6 Project Participants

Table 1 List of Main Project Participants

Role	
Client	Tiznow Property Company Limited (Comer Group Ireland)
Architect	C+W O'Brien Architects
Civil and Structural Engineers	Arup
Contractor	To Be Confirmed
Mechanical and Electrical Engineers	Arup
Quantity Surveyor	Comer Group
PSDP	Arup
Fire Consultant	Arup
Landscape Architect	Parkhood Landscape Architects
Planning Consultant	Harry Walsh Planning

Construction Strategy

3.1 Construction Sequencing and Programming

This plan assumes that the building will be constructed as an in-situ reinforced concrete frame, however, pre-cast elements may also be used, depending on design development. The proposed development is anticipated to be constructed from East to West in 4 phases, with a number of sequential subphases in each, preceded by a Mobilisation and Enabling Works Phase.

The construction sequencing for each phase of the development is described in chronological order as follows:

- Phase 1: Lower Ground Floor to Podium Level (Blocks A, B, C, D, F)
  - Phase 1A: Enabling Works Phase
    - Phase 1A.1: Site Establishment (full site)
    - Phase 1A.2: Demolition and Site Clearance (full site)
    - Phase 1A.3: Utility Diversions (full site)
  - Phase 1B: Earthworks, Foundation and Podium Structure Works
- Phase 2: Blocks A, B & C (344 units)
  - Phase 2A: Superstructure Works
  - Phase 2B: Façade & Fit-Out Works & Drainage / Utilities Completions
  - Phase 2C: Landscaping Works.
- Phase 3: Blocks D & E (266 units)
  - Phase 3A: Earthworks, Foundation and Podium Structure Works (Block E)
  - Phase 3B: Superstructure Works
  - Phase 3C: Façade & Fit-Out Works & Drainage / Utilities Completions
  - Phase 3D: Landscaping Works.
- Phase 4: Block F (213 Units)
  - Phase 4A: Superstructure Works
  - Phase 4B: Façade & Fit-Out Works & Drainage / Utilities Completions
  - Phase 4C: Landscaping Works.

Figure 5: Phasing Plan | not to scale

3.2 Site Establishment

The site establishment works, to be carried out by the appointed Contractor, will include erecting perimeter hoardings around the site, construction of the site compound and storage areas, forming site access and egress points, enacting the traffic management plan, providing site security and erecting cranes. These items are discussed further below.

3.3 Demolition and Site Clearance

3.3.1 Pre-Demolition and Condition Surveys

A pre-demolition survey will be undertaken to provide sufficient information for the Main Contractor to prepare a detailed Demolition Management Plan (DMP), giving methodology and work sequences for the demolition phase.

This survey will inform the Design Team and Specialist Demolition Contractor of the structural framing, floor and wall construction of the remaining structures onsite so that measures can be put in place to ensure the safe deconstruction of these structures and to avoid uncontrolled collapse of a part of the structure.

This survey will also provide information on any non-structural elements that will form part of any initial soft strip out works. This information will also assist in the preparation of a detailed Waste Management Plan for these waste streams.

This survey will be accompanied by a detailed risk assessment to identify potential hazards, and necessary mitigation measures for safe demolition.

Dilapidation surveys will also be carried out in all adjoining properties, roads and footpaths and issued to the property owners and local authorities in advance of the demolition and excavation works.

3.3.2 Asbestos Audit

An asbestos audit will be undertaken on all structures to be demolished prior to demolition. Asbestos waste will be removed from site by specialist contractors and holders of the appropriate waste collection permit.

3.3.3 Soft Strip Building Demolition

Any loose internal fixtures and fittings such as furniture, kitchen fittings and other unattached items shall be removed by hand and segregated on site, where practical, into skips to allow for collection and transport by an approved waste carrier. The approved Waste Contractor will provide appropriate skips to facilitate on-site segregation of waste materials.

Any fixed soft stripped material such as plasterboard, wood panelling and other waste materials will be removed by hand, brought to segregation points and loaded into the skips and subsequently removed from site in skips or using haulage trucks. An exclusion zone shall be set up within the works area to provide a safe and operational area for skips and demolition waste and to prevent operatives from entering.

3.3.4 Structural Demolition

The strategy for structural demolition must ensure de-construction is undertaken in a carefully pre-planned sequence, using methodologies that ensure that buildings under demolition and any adjoining buildings are not affected in any way, weakened or de-stabilised during the works. All demolition works will be carried out with due consideration toward mitigating noise and vibration pollution to minimise disturbance to the surrounding area. Dust suppression systems, such as misters, will be used during the demolition operations, keeping air pollution to a minimum.

To comply fully with works specification, planning conditions, environmental and safety requirements and adhering to demolition best practice, the works should be undertaken by adopting a methodology that combines the following operations:

- Demolition by hand or using hand-held tools:

  This method will be adopted in all sensitive locations. These works can be undertaken from, crash decks or from mobile elevated work platforms.

- Saw cutting and lifting:

  This method will be adopted in sensitive locations. These works can be undertaken from crash decks or from mobile elevated work platforms.

- Mini excavators and breakers:

  The use of mini excavators and breakers may be adopted in constricted locations around the site where larger machinery may not be appropriate.

- Hydraulic concrete breaking equipment:

  The use of breaking equipment will be employed to break out ground floor slabs and any external areas of hard-standing, such as car parking areas. The breaker will typically be fitted to a 20T excavator but there may be some hand-held tools utilised in isolated or constricted locations.

3.3.5 Site Clearance – Asbestos Surveys

There may be unknown material on site that are presently not accessible due to overgrowth. Testing of material may be required prior to site clearance for the presence of asbestos or any other hazardous material.

3.4 Utility Diversions

Where the excavation strategy or temporary works require any diversions of local services or utilities within the site perimeter, this will be undertaken strictly with prior agreement of the relevant service providers and authorities. All diverted utility connections are to be put in place in advance of construction works

3.5 Podium Structure Works

3.5.1 General

The proposed development requires the construction of single a storey podium structure to serve each of the apartment buildings. Level 00 finished floor level is +5.40mOD. The podium structures underpin the entire footprint of the buildings, and support podium landscaped courtyards and open spaces between the buildings.

3.5.2 Earthworks

The existing topography of the site is slightly sloped with levels generally decreasing in elevation from approximately +5.3mOD at the northern boundary to +0.2mOD at the southern boundary.

An assessment of the presence of contaminated soils was carried out in accordance with the Environmental Protection Agency and international guidance. The investigation included a preliminary assessment of the site history and a site inspection to highlight potential sources of contamination. Subsequently a ground investigation was carried across the site at 50m spacing sufficient to identify any potential areas of contamination. Samples were collected every 1m from the made ground and a representative subset were sampled. The investigation considered risks to human health, groundwater, the surface water channels and the River Lee.

The ground investigation for the site has found in general that the site stratigraphy is as follows:

- Made ground (comprising of black sandy gravelly silt / silty sandy gravel with cobbles and boulders and typically 10% to 20% anthropogenic materials including brick, concrete blocks, pieces of glass and ceramics) from approximately 2.0 metres above Ordnance Datum, (mOD) up to -1.1mOD,
- Black becoming grey soft silt (reclaimed and natural) from approximately 0.4mOD up to a depth of -2.2mOD.
- Sand/Gravel from -0.2mOD and extending for several 10s of metres under the site.

During the construction of the foundations, site services and attenuation tanks the site level shall be lowered to approximately -1.30mOD. This will require the excavation of approximately 73,022m^3 of soil and hardstanding. Excavation will remove made ground and some of the silts and potentially some of the sand/gravels. This will require a dewatering strategy. Results indicate that the groundwater in the sand/gravel has an overall moderate quality, however there are elevated concentrations in some determinands which are likely linked to an off-site sources and background concentrations. The water quality in the drainage channels surrounding the site indicates brackish conditions with some elevated metals. A water sample collected from the drainage channel next to Centre Park Road detected per- and poly-fluoroalkylated substances (PFAS).

Once the foundations are constructed, fill materials will be required to build up the site to the required levels, in addition further fill will be required for under hard and soft landscaping areas.

Based on the results of the ground investigation, the soil between 0mbgl to 2mbgl is of poor quality in terms of risk to human health, with the presence of asbestos, polycyclic aromatic hydrocarbon (PAH), elevated metals, and benzene and toluene amongst others. Below 2mbgl, no significant risks were noted in relation to contaminants in the soil.

Water quality monitoring carried out at the site indicated that the water quality in the made ground could impact on the water quality in the drainage channels surrounding the site. However, there is no evidence that soil and water are impacting the water quality in the River Lee.

The soil to be excavated has been shown to contain asbestos fibres. The soil may have suitable engineering properties that could make it useful as a fill material. A detailed analysis shall be undertaken to consider the potential options for reuse of the soil. Should this highlight potential options and subject to any legal requirements such as environmental licensing, the contaminated soil will be treated and retained on site for re-use where possible. Suitable potential re-use options include between pilecaps, under hard and soft landscaping areas such as public open space. This is likely to comprise a sustainable solution but will likely require some offsite disposal for excess soils.

Any made ground soil disposed of offsite (with or without treatment) is likely to be classified as either non-hazardous waste with trace level of asbestos or hazardous waste and will be exported and disposed of outside of Ireland.

Samples from the ground investigation are to be compared to the limits defined in the EU Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 and Annex II to Directive 1999/31/EC, referred to as the Waste Acceptance Criteria (WAC). In addition, the results are to be compared to the contents of the EPA Hazardous Waste Classification Paper Tool (version WM3 V1) using the online tool HazWaste Online to determine if the materials are considered hazardous. Any natural soil and stone which has not been impacted by contamination will be considered for reuse on or offsite in preference to disposal.

The assessment criteria used to categorise the soils are based on Irish and European standard criteria. The operators of landfills may use their own discretion to set their own limits for materials.

Refer to the Construction and Demolition Waste Management Plan for details of the management of exported soils from site.

3.5.3 Foundations

It is proposed that the buildings are founded on Continuous Flight Auger (CFA) piles under pile caps. The piles shall be installed using a method that does not compromise the integrity of the low permeability silt layer between the made ground and the gravel. Where it is necessary for pile caps to penetrate the silt layer, the foundations will be detailed so that no new flow paths are created and that an equivalent aquitard function is maintained. This may be achieved by the use of a lean-mix fill or grout injection into the gravel to replace the low permeability layer around the foundations. The final pile length will be the subject to the detailed design but are likely to be advanced a significant distance into the gravel. A piling mat will be required at formation level to support the piling rig.

3.5.4 Ground Flood Slab and Substructure

The Ground Floor comprises of reinforced concrete suspended slab, spanning onto the pile caps, subject to design development. The exact depths of excavation required for the ground floor and foundation structures varies, depending on existing ground level, however it is generally in the region of 3-3.5m from existing ground level.

As part of the podium structure works the outer walls and first rise of internal core walls and columns will be constructed in in-situ concrete.

3.5.5 Podium Level Slab

Due to differing structural grids at superstructure and Ground Floor and substructure, a transfer structure is required at Level 01 (Podium Level) under each of the buildings. It is intended that this is to consist of a reinforced concrete flat slab, the thickness of which is dependent on the height of building supported.

Structure supporting all other areas at Podium Level, including hard and soft landscaping areas will consist of flat slab construction.

3.6 Superstructure Works

It is envisaged that the proposed buildings are all to be a combination of in-situ and / or precast concrete construction.

Stability will be achieved through central RC cores in each building around stair and lift cores, extending to ground floor level, and diaphragm action of the slabs.

The concrete framing for all buildings will be constructed on a sequential basis with concrete pumping envisaged. The floor slabs will be supported using temporary props as necessary, to ensure the stability of the structure at all times during the construction process. Concrete will be delivered to site using a ‘just-in-time’ approach. This will help mitigate against traffic congestion as well as reducing the amount of space required for material storage on site.

3.7 Façade and Fit Out Works

Once the building structure has been well advanced, the completion of the facades and the installation of mechanical and electrical services and building finishes will commence.

It is proposed that fit-out, handover and occupation of the buildings is carried out on a phased basis. The proposed phasing may be subject to change as the project progresses.

Final drainage and utility connections will be completed towards the end of the construction programme for each phase. Where it is necessary for drainage or utilities to penetrate the silt layer, the drainage and utilities will be detailed so that no new flow paths are created and that an equivalent aquitard function is maintained. This may be achieved by the or use of a lean-mix fill or grout injection into the gravel to replace the low permeability layer around the drainage and utilities.

3.8 Landscaping Works

Once the building fit-out, finishes and underground utility connections are substantially complete at the end of each construction phase, the completion of hard and soft landscaping of the Level 01 Podium areas and the Level 00 ground level areas will commence, including all ties-ins to existing and surrounding roadways and paths and cycle lanes.

3.9 Adjacent Proposed Public Infrastructure Development

The following confirmed and possible future adjacent public infrastructure projects may be constructed during one or more of the construction phases of the proposed development:

- Marina Park Development: Phase 2 (Design stage)
- Proposed BRT / LRT Corridor (Route selection stage)

Marina Park Development: Phase 2 (Design stage)

In accordance with the ratified Marina Park Masterplan, Phase 2 will extend from the Atlantic Pond to Church Avenue and will include the "Nature" zone of the park, accommodating picnic areas, boating facilities, adventure play areas, preserved marshland zone and several architectural heritage sites. The development is expected to commence in Q3 of 2022 with completion by the end of 2023.

Proposed BRT / LRT Corridor (Route Selection stage)

This proposed BRT / LRT Luas scheme will provide a high-capacity, high-frequency public transport link from the eastern to the western suburbs of Cork and will serve a large number of significant destinations including Cork South Docklands along Centre Park Road. A preferred route is expected to be chosen by Transport Infrastructure Ireland by June 2022.

At present, the above projects are in planning and preliminary design stages. Should there be an overlap in construction durations with the proposed development, the appointed Contractor will liaise with Cork City Council and any contractors appointed for the above works as required, to ensure coordination of construction works in the area.

3.10 Other Developments

3.10.1 Masterplan Development

As part of an overall masterplan, Tiznow Property Company Limited (Comer Group Ireland) intend to develop a Strategic Housing Development (SHD) at the former Former Cork Warehouse Company site, Centre Park Road, Cork City which will be located immediately south of the proposed development site.

While planning permission for this project has not yet been sought, the project will be subject to various environmental assessments including an Environmental Impact Assessment (EIA) Screening Report, which will include the potential for cumulative effects with the proposed development, as at that point, it is intended that details of the proposed development will be in the public domain as an application for consent with An Bord Pleanála.

These environment assessments, along with the minimal environmental effects associated with the proposed development and the implementation of this Construction Environmental Management Plan will ensure that no significant cumulative effects on the environment will occur associated with the proposed development. Should the EIA Screening Report for the project on the Former Cork Warehouse Company site identify significant cumulative effects on the environment, An Bord Pleanála will have due regard to those significant cumulative effects in their decision to consent or refuse to give consent for that project.

3.10.2 The Former Ford Distribution Site

Marina Quarter Ltd propose to develop a Strategic Housing Development (SHD) of 1,002 no. apartments at the Former Ford Distribution Site, fronting on to Centre Park Road, Marquee Road and Monahan's Road, Cork. The development will require the demolition of existing structures, 10-year permission for the construction of the apartments, childcare facilities and associated site works.

Permission was granted on the 20th April 2021.

Due to the minimal environmental effects associated with the proposed development along with the absence of significant environmental effects associated with this permitted development, significant cumulative effects are not envisaged.

3.10.3 Lands at South Docklands, Cork

Leeside Quays Limited has submitted two planning applications for the redevelopment of the lands at the South Docklands, Cork City, which together constitute the project for the purposes of the EIAR.

The first planning application seeks planning permission over a period of ten years for a proposed mixed-use development comprising five new buildings and the change of use and extension of the former Odlum's Mill Building (Record of Protected Structures (RPS) ref. PS856) on sites bounded by Kennedy Quay to the north, Marina Walk to the south, Victoria Road to the west and Mill Road to the east, all in the South Docklands of Cork City.

The concurrent planning application seeks planning permission over a period of ten years for a proposed rehabilitation hospital located in the westernmost corner of the western Victoria Road city block, bounded by Kennedy Quay to the north and Victoria Road to the west.

A decision for this application is due on the 4th February 2022. Should the project receive planning consents, no significant cumulative environmental effects are predicted. Potential construction-phase impacts will be managed through the active implementation of the CEMP for the proposed development.

Environmental Management Framework

4.1 Overview

The contract(s) awarded for the proposed development will include a requirement for the contractor to comply with relevant documentation including the planning (and other statutory consent) conditions received and this CEMP.

As part of the environmental management framework contractors will be required to comply with all relevant environmental legislation and take account of published standards, accepted industry practice, national guidelines and codes of practice appropriate to the proposed development. Due regard should be given to the

guidance and advice given by ISO14001 standard[2] and Construction Industry Research and Information Association (CIRIA) guidance[3,4,5].

The contractor will be required to develop and implement an Environmental Management System (EMS) that follows the principles of ISO14001. Further, the contractor's EMS should include an environmental policy, operational, monitoring and auditing procedures to ensure compliance with all environmental requirements and to monitor compliance with environmental legislation and the environmental management provisions outlined in the relevant documentation.

4.2 Responsibilities

4.2.1 Employer

The Developer will be the employer responsible for ensuring that competent parties are appointed to undertake construction and that sufficient resources are made available to facilitate the appropriate management of risks to the environment.

4.2.2 Employer's Representative

The Developer and/or the Employers Representative (ER) appointed by The Developer will be responsible for monitoring compliance with the CEMP. The ER may be required to appoint temporary or permanent specialists with appropriate skills and experience as required to implement on site procedures and monitor construction on behalf of the employer, i.e. competent experts in biodiversity, noise, vibration, dust, waste, land, soils, contamination and/or water.

4.2.3 The Contractor

The contractor(s) appointed will be responsible for the organisation, direction and execution of environmental related activities during the detailed design and construction of the proposed development. The contractor is required to undertake all activities in accordance with the relevant environmental requirements including the consent documentation and other regulatory and contractual requirements.

4.2.4 Site Manager

A Site Manager will be appointed by the contractor to oversee the day-to-day management of working areas within the site and ensure that effective, safe, planned construction activities are delivered on an ongoing basis to the highest standards. The Site Manager will be a suitably qualified, competent and experienced professional that will oversee site logistics, communicate regularly with construction staff, accommodate project-specific inductions for staff on site and ensure that all work is compliant with the relevant design standards and health and safety legislation.

4.2.5 Environmental Manager

An Environmental Manager will be appointed by the contractor to ensure that the CEMP is effectively implemented. The Environmental Manager will be a suitably qualified, competent and experienced professional that would perform the necessary tasks, review environmental procedures and consult with the members of the construction team and stakeholders as requited. The Environmental Manager will be responsible for:

- Preparing, maintaining and implementing the CEMP;
- Establishing, implementing, and maintaining the EMS in line with ISO 14001;

[2] ISO (2015) ISO 14001:2015 Environmental management systems -- Requirements with guidance for use

[3] CIRIA (2015) Environmental Good Practice on Site C692 (fourth edition) (C762)

[4] CIRIA (2015) Coastal and marine environmental site guide (second edition) (C744)

[5] CIRIA (2002) Brownfield development sites: ground-related risks for buildings (X263)

- Conducting regular environmental inspections and audits as specified in the contract and checking adherence to the CEMP;
- Ensuring that construction occurs in accordance with the relevant environmental requirements and that such compliance is adequately recorded and documented;
- Completing a site inspection and compiling an environmental compliance as agreed and specified in the CEMP;
- Attending site and stakeholder meetings as required;
- Keeping up-to-date with relevant environmental best practice and legislative changes;
- Liaising with the relevant staff to prepare Method Statements and relevant plans for all activities where there is a risk of environmental damage;
- Having a detailed level of knowledge on all aspects of environmental information associated with the proposed development;
- Ensuring all personnel have undertaken adequate environmental inductions, awareness briefings and training (including subcontractors);
- Dealing with environmental complaints; and
- Managing and responding to environmental incidents and ensuring that all incidents are recorded and reported in an appropriate manner.

4.2.6 Public Relations and Liaison Manager

The site is located near to number of residences and local businesses. The Main Contractor will be required to ensure that all Agents, Sub-contractors and Suppliers act in a manner to minimise disruption to the surrounding locality.

Keeping people informed of site operations will help create and maintain good relationships, fostering a co-operative atmosphere. A Liaison Manager will be appointed by the Main Contractor, whose responsibility would include:

- Regular briefings with local neighbour and business representatives on progress and issues.
- Liaison with Cork City Council and emergency services as appropriate.
- Liaison with An Garda Síochána, particularly in relation to traffic movements and permits.
- Preparation of reports for the site meetings on neighbourhood issues.

4.2.7 Environmental Specialists engaged by the Contractor

To fulfil its obligations under the CEMP and to support its Environmental Manager, the contractor will be responsible for engaging suitably qualified and experienced professionals including where necessary the following (i.e. depending on the scope of the contract) competent experts:

- Project archaeologist;
- Project ecologist;
- Noise and vibration specialist;
- Air quality and dust specialist;
- Land, soils and contamination specialist(s); and
- Water specialist.

4.3 Communication Procedures

4.3.1 Community and Stakeholder Engagement

The contractor will take all reasonable steps to engage with stakeholders in the local community, focusing on those who may be affected by the construction works including residents, businesses, community resources and specific vulnerable groups.

Communication with the local community, Cork City Council and other relevant stakeholders shall be undertaken at an appropriate level and frequency throughout construction. Where communications are related to environmental issues the Environmental Manager will be informed and engaged with, as appropriate.

4.3.1.1 Community Liaison

The Developer recognises the importance of effective community liaison in order to reduce nuisance to residents, to ensure public safety and welfare and to help ensure the smooth running of construction activities. Important issues in ensuring good relations are:

- Providing information for the public during the construction phase, (particularly nearby sensitive receptors);
- Providing the correct points of contact and being responsive; and
- Ensuring good housekeeping in all aspects of the operations.

A 'good neighbour' policy will be implemented, as far as possible. Key aspects of this policy include:

- Early implementation of the policy i.e. from the commencement of construction;
- Reduction of nuisance factors;
- Maintaining access to neighbouring premises and businesses;
- Clear and concise information; and
- Undertaking timely liaison with stakeholders.

4.3.2 Advance Notice of Works

The contractor will ensure that local residents, businesses, occupiers, general users of the area and stakeholders are informed in advance of construction activities that may affect them. Relevant obligations and procedures in relation to advance notice of works will be identified in the updated CEMP.

All notifications will detail the nature, estimated duration and working hours. All notifications will include a project-specific contact number to which any enquires can be directed. The contractor will be responsible for preparing and issuing the notifications subject to the relevant approval and consents.

The Developer and the contractor in consultation with Cork City Council and statutory stakeholders will decide whether to arrange any further targeted consultation with the public or relevant stakeholders in advance of specific construction activities on a local basis.

4.3.3 Emergency Contacts

An emergency contact list will be established and made available to all construction staff employed. The contact list shall be displayed prominently on site as well as at suitable locations where construction activity is being carried out around working areas. The contact list will include key environmental representatives that may need to be contacted in the event of an incident.

4.3.4 Enquiries and Complaints

The contractor will establish a process for handling all enquiries including complaints. All enquiries will be recorded and a log will be maintained to include details of the response and action taken. This will be

available upon request for inspection to Cork City Council. All enquiries, whether a query or a complaint, will be dealt with in a timely manner.

The Environmental Manager will be immediately informed of any environmental-related issues that have been raised. Where appropriate, the Environmental Manager would be responsible for informing Cork City Council, relevant stakeholders and statutory bodies.

Environmental Management Procedures

5.1 Training, Awareness and Competence

The contractor (and their subcontractors) will be selected with due consideration of relevant qualifications and experience. The contractor will be required to employ construction staff with appropriate skills, qualifications and experience appropriate to the needs of the works to be carried out during construction.

A site induction will be provided to all construction staff before they commence work on site. Where appropriate, the contractor will identify specific training needs for the construction workforce and will ensure that appropriate training requirements are fulfilled.

The contractor will establish an Environmental Training and Awareness Programme and ensure that all personnel receive adequate training prior to the commencement of construction activities. A baseline level of environmental awareness will be established through the site induction programme. Key environmental considerations and objectives will be incorporated into this induction. Specifically, site inductions will cover the following as a minimum:

- Introduction to the Environmental Manager;
- Description of the CEMP and consequences of non-compliance;
- The requirements of due diligence and duty of care;
- Overview of conditions of consents, permits and licences;
- Requirements associated with community engagement and stakeholder consultation;
- Identification of environmental constraints and notable features within the site; and
- Procedures associated with incident notification and reporting including procedures for dealing with damage to the environment.

Nobody will work on site without first receiving environmental induction. Signed records of environmental training will be established, maintained and made available to the Employers Representative.

Site briefings and talks would be carried out on a regular basis to ensure that construction staff have an adequate level of knowledge on environmental topics and community relations and can effectively follow environmental control procedures throughout construction.

5.2 Meetings

The Developer and/or the Employer's Representative will arrange regular meetings to discuss environmental matters and ensure effective coordination to be attended by:

- Tiznow Property Company Limited (Comer Group Ireland)
- The Employer's Representative;
- Contractor (including Site Manager);
- Environmental Manager; and

- Environmental Specialists – engaged by either Tiznow Property Company Limited (Comer Group Ireland) and/or the contractor.

The Environmental Manager will be responsible for arranging and holding monthly meetings and site walk overs with the Employer's Representative. The Environmental Manager would develop and distribute minutes of the monthly meetings and distribute them accordingly.

5.3 Monitoring, Inspections and Audits

For the duration of the contract(s), the environmental performance of the contractor will be monitored through site inspections and audits. The programme for monitoring, inspections and audits shall be specified in the contract and it is likely to be a combination of internal inspections and independent external audits that may be either random or routine.

Records of all inspections carried out will be recorded on standard forms and all actions should be closed out in a reasonable time. The updated CEMP will include further details of inspection procedures.

5.3.1 Monitoring

Mitigation and monitoring will be carried out in accordance with the relevant environmental requirements so that construction activities are undertaken in a manner that does not give rise to significant negative effects. Suitable monitoring programmes will need to be developed, implemented, documented, and assessed.

The results of all environmental monitoring activities would be reviewed by the Environmental Manager on an ongoing basis to enable trends or exceedance of criteria to be identified and corrective actions to be implemented as necessary. The contractor will be required to inform the Employer's Representative of any continuous exceedances of criteria.

5.3.2 Inspections

Routine inspections of construction activities will be carried out by the Environmental Manager daily to ensure all necessary environmental measures relevant to the construction activities are being effectively implemented by construction staff, ensuring legal and contractual conformity.

More detailed inspections would be undertaken by the Environmental Manager on a weekly basis.

The weekly inspections would be appropriately documented by the Environmental Manager and copies of these records and any action required to be undertaken should be made available to the Employers Representative.

Each month one of the weekly inspections will include a review of environmental documentation and records. The monthly inspection will be recorded on a standard form and reported to the Employers Representative within five days of the inspection taking place. This standard form will address the following as a minimum:

- Summary of compliance/non-compliance with the CEMP;
- Results and interpretation of the monitoring programme;
- Key issues noted in inspections and/or audits;
- Summary record of non-conformities, incidents and corrective actions;
- Summary of environmental complaints and queries received in relation to environmental matters; and
- Summary record of environmental training undertaken by staff.

5.3.3 Audits

The Developer will arrange for independent environmental audits to be carried out by a third-party during construction. External audits provide the opportunity for an independent auditor to advise on compliance with applicable environmental regulatory requirements, the efficacy of the environmental management

approaches used, and recommendations for reducing identified environmental risks (if considered appropriate).

Further, regulatory and statutory bodies may undertake site visits to monitor compliance with legislative and regulatory requirements. These site visits may occur randomly throughout the construction period. The contractor will facilitate these visits and the Environmental Manager will be available to provide information as required and deal with any issues that may arise during, or as a result of, these visits.

Planned and documented audits aimed at evaluating the conformance of the EMS would also be carried out by the Environmental Manager. The Environmental Manager will establish a schedule for internal audits and this inspection calendar will be made available to the Employer's Representative. These environmental audits will be scheduled at least once every three months.

Standard forms for reporting and audit items will be prepared and will include but not be limited to the following activities:

- Review of environmental documentation to establish if relevant requirements are being achieved and if continual improvement is occurring;
- Site inspection and interviews with onsite personnel; and
- Reporting with recommendations.

For any environmental nonconformities found, the auditor will prepare a Corrective Actions Report to describe and record the findings of the non-conformance. The verification of previous Corrective Actions Reports should be also recorded.

Upon completion of an audit, the auditor will review all Corrective Actions Reports and prepares an Audit Report to summarise:

- Corrective action requests raised;
- Previous corrective action requests closed; and
- Observations made during the audit.

The Environmental Manager will be entitled to participate in all audits. Notwithstanding this, the Employers Representative shall produce and provide the contractor with a copy of each audit report within five working days of the audit. Each audit report will detail the findings from the auditor, specify non-conformances identified and outline the proposed corrective action.

5.4 Incident Response

5.4.1 Corrective Actions

5.4.1.1 Overview

Corrective actions are measures to be implemented to rectify any non-conformances (i.e. exceedance of criteria or targets) identified during monitoring, inspections and/or audits.

In the first instance, an investigation should be undertaken by the Environmental Manager to identify the cause of any non-conformances. Appropriate remedial measures shall be identified and implemented as soon as practicable to prevent further exceedances. If necessary, the appropriate statutory authority and stakeholders will be notified.

Where new or amended measures are proposed, the relevant CEMP will be updated accordingly by the Environmental Manager and the Employer's Representative should be informed at the earliest opportunity.

5.4.1.2 Corrective Action Reports

As previously mentioned, a Corrective Actions Report is prepared on foot of any non-conformances identified during environmental monitoring, inspections and/or audits on site. The Corrective Actions Report

will describe in detail the cause and effect of a non-conformance on site and describe the recommended corrective action that is required to remedy it.

An appropriate timeline for closing out the corrective actions will be identified by the contractor as well as arrangements for the Environmental Manager verifying the Corrective Actions Report and informing appropriate authorities and stakeholders in a timely manner.

5.4.2 Emergency Incidents

5.4.2.1 Overview

Emergency incidents are those occurrences that give rise to significant negative environmental effects including but not limited to the following:

- Any malfunction of any mitigation measure and/or environmental protection system;
- Any emission that does not comply with the requirements of the contract and relevant licences;
- Any circumstance with the potential for environmental pollution; or
- Any emergency that may give rise to environmental effects (e.g. significant spillages or fire outbreak).

As discussed in **Section 4.3.3** an emergency contact list will be established and made available to all construction staff employed. The contact list shall be displayed prominently on site as well as at suitable locations where construction activity is being carried out around working areas. The contact list will include key environmental representatives that may need to be contacted in the event of an incident.

5.4.2.2 Spill Control Measures

Every effort will be made to prevent pollution incidents associated with spills during the construction of the proposed development. The risk of oil/fuel spillages will exist on the site and any such incidents will require an emergency response procedure. Given the scale and extent of the proposed development, contractors will carry spill kit materials in their cabins.

The following steps provide the procedure to be followed in the event of an oil/fuel spill occurring on site:

- Identify and stop the source of the spill and alert people working in the vicinity;
- Notify the Environmental Manager immediately giving information on the location, type and extent of the spill so that they can take appropriate action;
- If applicable, eliminate any sources of ignition in the immediate vicinity of the incident;
- Contain the spill using the spill control materials, track mats or other material as required. Do not spread or flush away the spill;
- If possible, cover or bund off any vulnerable areas where appropriate such as drains, watercourses and/or sensitive habitats;
- If possible, clean up as much as possible using the spill control materials;
- Contain any used spill control material and dispose of used materials appropriately using a fully licensed waste contractor with the appropriate permits so that further contamination is limited;
- The Environmental Manager shall inspect the site as soon as practicable and ensure the necessary measures are in place to contain and clean up the spill and prevent further spillage from occurring; and
- The Environmental Manager will notify the appropriate stakeholders such as Cork City Council, National Parks and Wildlife Service, Department of Environment Climate and Communications, and Department of Housing, Local Government and Heritage and/or the EPA.

Environmental incidents are not limited to just fuel spillages. Therefore, any environmental incident must be reported, recorded and investigated in accordance with the procedures described in **Section 4.4**.

5.4.2.3 Emergency Incident Response Plan

A set of standardised emergency response procedures will govern the management of emergency incidents. The contractor will be required to detail emergency incident response procedures and to develop an Emergency Incident Response Plan.

The Emergency Incident Response Plan will contain emergency phone numbers and the method of notifying local authorities, statutory authorities and stakeholders. Contact numbers for key personnel will also be included therein. Contractors will be required to adhere to and implement these procedures and ensure that all staff and personnel on site are familiar with the emergency arrangements.

In the case of work required in an emergency, or which if not completed would be unsafe or harmful to workers, the public or local environment, Cork City Council will be informed as soon as reasonably practicable of the reasons and likely duration. Examples may include where the ground needs stabilising if unexpected ground conditions are encountered, concrete pouring taking longer than anticipated due to delayed deliveries or equipment failure.

In the event of an emergency incident occurring, the contractor will be required to investigate and provide a report including the following, as a minimum:

- A description of the incident, including location, the type and quantity of contaminant and the likely receptor(s);
- Contributory causes;
- Negative effects;
- Measures implemented to mitigate adverse effects; and
- Any recommendations to reduce the risk of similar incidents occurring.

The contractor will consult with the relevant statutory authorities, stakeholders and relevant parties such as the Health and Safety Authority, the Fire Authority, the Ambulance Service, the EPA, utilities companies and Cork City Council when preparing and developing response measures. Further, if any sensitive receptor is impacted, the appropriate environmental specialists will be informed and consulted with accordingly.

Any response measures will be incorporated into an updated Emergency Incident Response Plan that should be disseminated accordingly to construction staff, The Developer and the Employer's Representative.

5.4.2.4 Emergency Access

The contractor will be required to maintain emergency access routes throughout construction and identify site access points for each working area.

This should be developed in partnership with the emergency services and documented as part of the Emergency Incident Response Plan.

5.4.2.5 Extreme Weather Events

The contractor will consider the effects of extreme weather events and related conditions during construction. The contractor will use a short to medium range weather forecasting service from Met Eireann or other approved meteorological data and weather forecast provider to inform short to medium term programme management, environmental control and mitigation measures.

All measures deemed necessary and appropriate to manage extreme weather events will be considered and will specifically cover training of personnel and prevention and monitoring arrangements for staff. As appropriate, method statements will also consider extreme weather events where risks have been identified, e.g., construction works adjacent to public roads and business premises.

5.4.3 Unexpected Discoveries

Appropriate procedures will be put in place in the event of encountering unexpected archaeological or cultural heritage assets or subsurface contamination during intrusive ground works.

Appropriate procedures will be developed as part of the CEMP and the Environmental Manager will ensure that specialists (e.g., archaeologist) are facilitated to ensure management in accordance with industry best practice and effective compliance with the relevant legislation. All unexpected discoveries will be reported to the appropriate authorities and documented in an appropriate manner.

5.5 Reporting

5.5.1 Environmental Compliance Report

The contractor will be required to submit a monthly report to the Employer's Representative for review and approval. The report shall address the following as a minimum:

- Summary of compliance with the CEMP including identification of any non-conformances;
- Interpretation of the results of ongoing monitoring;
- Detailed description of any issues and/or non-conformances identified during inspections and/or audits;
- Record of incidents and corrective actions (including Corrective Actions Reports as appropriate);
- Synopsis of environmental complaints received / queries raised by stakeholders; and
- Records of environmental training undertaken (as appropriate).

5.5.2 Incident Investigation Reports

The contractor will inform the Employer's Representative of all emergency incidents immediately and prepare an initial report within 24 hours setting out the details of the incident and cause(s) if known. The contractor will be required to complete the Environmental Incident Report and any further documentation requested by the Employer's Representative in relation to the incident within 7 days of the incident occurring. The Contractor will respond to all comments made by the ER on any incident.

The Environmental Incident Report will contain details of the incident including the location, known and suspected causes and weather conditions. It will define the scale and effects (short, medium, long term, temporary/permanent) as well as required corrective actions and mitigation/ remediation/compensation measures (as appropriate).

5.5.3 Environmental Records

Records of all environmental documentation will be maintained including monitoring, test results, method statements and plans. All records will be kept up to date and be made available for audits, inspections and periodical reporting. The Contractor will maintain the following environmental records (as a minimum) that will be made available for inspection to the Employer's Representative and the relevant authorities, if required:

- Management Plans;
- Records of environmental incidents;
- Monthly environmental reports;
- Records of environmental training;
- Register of environmental complaints;
- Corrective Action Reports;
- Environmental inspection and audit reports;
- All monitoring data;
- Waste and chemical inventories; and
- Health and Safety records.

Site Management and General Requirements

6.1 Good Housekeeping

A “good housekeeping” policy will be employed at all times. This will include, but not necessarily be limited to, the following requirements:

- General maintenance of working areas and cleanliness of welfare facilities and storage areas;
- Provision of site layout map showing key areas such as first aid posts, material storage, spill kits, material and waste storage, welfare facilities etc;
- Maintain all plant, material and equipment required to complete the construction work in good order, clean, and tidy;
- Keep construction compound, access routes and designated parking areas free and clear of excess dirt, rubbish piles, scrap wood, etc. at all times;
- Details of site managers, contact numbers (including out of hours) and public information signs (including warning signs) will be provided at the boundaries of the working areas;
- Provision of adequate welfare facilities for site personnel;
- Installation of appropriate security, lighting, fencing and hoarding at each working area;
- Effective prevention of oil, grease or other objectionable matter being discharged from any working area;
- Provision of appropriate waste management at each working area and regular collections to be arranged;
- Excavated material generated during construction will be reused on site as far as practicable and surplus materials/soil, should it be deemed a by-product, shall be recovered or if considered to be waste material, disposed of to a suitably authorised waste facility site;
- Effective prevention of infestation from pests or vermin including arrangements for regular disposal of food and material attractive to pests will be implemented. If infestation occurs the contractor will take appropriate action to eliminate and prevent further occurrence;
- Maintenance of self-contained wheel washing facilities at the construction compound and other contaminant measures as required;
- No discharge of site runoff or water without agreement of the relevant authorities and an appropriate discharge licence, if relevant;
- Open fires will be prohibited at all times;
- The use of less intrusive noise alarms which meet the safety requirements, such as broadband reversing warnings, or proximity sensors to reduce the requirement for traditional reversing alarms;
- Maintenance of public rights of way, diversions and entry/exit areas around working areas for car users, pedestrians and cyclists where practicable and to achieve inclusive access; and
- Material handling and/or stockpiling of materials, where permitted, will be appropriately located to minimise exposure to wind. Water misting or sprays shall be used as required if particularly dusty activities are necessary during dry or windy periods.

6.2 Health and Safety

The primary aim of planning for safety on this site is ensuring the safety of people involved in and affected by the development. This includes pedestrians, road users, neighbours, site staff and visitors to site.

The following are examples of some site specific issues that will have to be addressed during the construction of the proposed development:

- Managing demolition works and disposal of demolished materials
- Identifying, storing and handling of hazardous and contaminated materials
- Protecting existing roadways against damage, in particular in areas where excavations and retaining structures are proposed adjacent to roadways.
- Identifying, diverting, maintaining and connecting to existing live services.
- Managing vehicular and pedestrian traffic on the surrounding roadways for the duration of the construction works.
- Managing crane movements to limit lifting over live buildings and roadways.

All Contractors must progress their works with reasonable skill, care and diligence and, at all times, proactively manage the works in a manner most likely to ensure the safety, health and welfare of those carrying out construction works, pedestrians, road users and other interacting stakeholders.

Contractors are further required to ensure that, as a minimum, all aspects of their works and project facilities comply with legislation, good industry practice and all necessary consents.

Health and Safety requirements will be further expanded and developed within the Main Contractor's Construction Management Plan and Construction Stage Health and Safety Plan required to be prepared by the Project Supervisor at Construction Stage, prior to the commencement of works on site.

6.3 Working Hours

Hours of construction are to be between the hours of 07:00 and 19:00, Monday to Friday, and 07:00 to 16:30 on Saturdays or as stipulated on the Planning Permission in due course.

Due to the specific nature of some construction activities, or to mitigate disruption to the local environment, there may be a requirement for working outside these hours. Should this be required, it will be by agreement with Cork City Council (CCC).

6.4 Security

Adequate security will be provided to prevent unauthorised entry to or exit from any working areas. The following measures may be used to prevent unauthorised access:

- Install CCTV and alarm systems where required;
- CCTV and security systems will be sited and directed so that they do not intrude into occupied residential properties;
- Provide adequate security guards and patrols where required;
- When there is no site activity, close and lock site gates and set appropriate site security provisions in motion;
- Consult with neighbouring properties, local businesses and local crime prevention officers including Cork City Council and An Garda Síochána on site security matters as required; and
- Prevent access to restricted areas and neighbouring properties by securing equipment on site such as scaffolding and ladders.

6.5 Hoarding and Fencing

Following possession of the site, the Main Contractor will erect a suitably robust hoarding around the perimeter of the site. This will provide separation of the construction works from the adjacent roadways and buildings. The plan alignment of the hoarding may not remain constant for the entire works and is likely to change to meet the particular requirements and constraints of construction sequence.

Where existing secure site boundary has been removed, the hoarding will typically take the form of standard plywood hoarding to a height of 2.4m, as illustrated in Figure 6. IBEX and/or Harris fencing, or alternate fencing/hoarding and the existing boundary may also be used in places, given the large site and phased nature of the construction works. Controlled access points to the site, in the form of gates or doors, will be kept locked for any time that these areas are not monitored (e.g. outside working hours). The hoarding will be painted, well maintained and may contain graphics portraying project information.

Figure 6: Example of Suitable Hoarding

6.6 Site Access

Primary Construction access will be from the existing access from Centre Park Road with exact locations to be determined and agreed with Cork City Council as construction phasing develops as outlined in **Section 2.5.**

6.7 Site Security

The Main Contractor will be responsible for the security of the site for the duration of the works. All reasonable precautions will be taken to prevent unauthorised access to the site, the works and adjoining property. Adequate safeguards will be put in place to protect the site, the works, products / materials, plant and any existing buildings affected by the construction works from damage, theft and trespass. For site access refer to **Section 2.5.**

As part of their site security responsibilities, the Main Contractor will be required to:

- Install and maintain adequate site hoarding to the site boundary with adequate controlled access and egress points.
- Maintain site security at all times.

- Install access security in the form of turnstiles and gates for staff.
- Ensure restricted access is maintained to the works.
- Monitor and record all deliveries to site and materials / waste taken off site.

All staff will be made fully aware of their individual responsibilities with regard to safety and security and will undertake their work in accordance with such guidelines. All staff and operatives will be fully inducted into the security, health and safety and logistic requirements on site.

6.8 Site Compound and Material Storage

The extent of compound and storage space required by the Main Contractor will vary for the duration of the works.

For the enabling works and earthworks phases, the Main Contractor will likely require a large-scale compound for storage and segregation of hazardous and non-hazardous excavated material. For the main construction works, the Main Contractor will again require a large compound and material storage area.

Given the size and open nature of the proposed development site, it is envisaged that there is adequate space for the site compound, and adequate space to store such materials on a temporary basis, with no provisions for off-site storage proposed currently.

The Main Contractor is responsible for obtaining all necessary permissions from relevant statutory bodies, including local authorities, for the disposal of water off site. Standing water should be cleared as soon as is practicable or treated with an approved product at least once a week.

The Main Contractor is to ensure that there is no hazardous build-up of water and is to provide for temporary disposal of rainwater from the site during the course of the works. Any water that is potentially contaminated is to be treated on site by way of sediment/filtration tanks and comply with a waste disposal licence obtained by the Contractor from the Local Authority.

6.9 Craneage

The construction works will require the use of a tower cranes on site. It is envisaged that 3-4 no. 50m jib length tower cranes may be required to provide the necessary site coverage for each of the four construction phases. The cranes will be required for the moving of building materials on site such as formwork for concrete, reinforcement, precast concrete, steelwork, façade elements, plant and general building materials. Mobile cranes may also be utilised to assist in some elements of the construction works such as façade installation. The Main Contractor will develop a crane management plan to limit lifting operations over live buildings and roadways. The layout of cranes to achieve maximum coverage of the site will be determined by the Main Contractor. Given the proposed height of the buildings, crane(s) servicing the tallest buildings should be notified 30 days in advance to aviation authorities, IAA and Cork Airport, in accordance with statutory requirements.

6.10 Dust

A dust minimisation plan will be formulated for the demolition and construction phase of the project. The Main Contractor shall put in place a regime for monitoring dust levels in the vicinity of the site during works using the Bergerhoff Method (German Standard VDI 2119, 1972). The minimum criteria to be maintained shall be the limit specified by the Environmental Protection Agency (EPA) for licenced facilities in Ireland which is 350mg/m²/day as a 30-day average. The Main Contractor shall monitor dust during construction to ensure the limits are not breached throughout the project.

The level of monitoring and adoptions of mitigation measures will vary throughout the construction works depending on the type of activities being undertaken and the prevailing weather conditions at the time. For instance, additional monitoring and mitigation such as damping down of earth mounds on site would be undertaken if the prevailing weather conditions are dry and windy.

The key aspects of controlling dust are listed below. In summary the measures which will be implemented will include:

- Prior to demolition buildings will be soft striped internally initially (walls and windows in the rest of the building to remain where possible, to provide a screen against dust).
- During the demolition process, water suppression will be used, preferably with a hand-held spray. Only the use of cutting, grinding or sawing equipment fitted or used in conjunction with a suitable dust suppression technique such as water sprays/local extraction will be used.
- Drop heights from conveyors, loading shovels, hoppers and other loading equipment will be minimised, if necessary fine water sprays will be employed.
- Hard surface roads will be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential site traffic.
- Any road that has the potential to give rise to fugitive dust will be regularly watered, as appropriate, during dry and/or windy conditions.
- Vehicles exiting the site shall make use of a wheel wash facility where appropriate, prior to entering onto public roads.
- Vehicles using site roads will have their speed restricted, and this speed restriction will be enforced rigidly. On any un-surfaced site road, this will be 20 kph, and on hard surfaced roads as site management dictates.
- Public roads outside the site will be regularly inspected for cleanliness and cleaned as necessary.
- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods.
- During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions.

At all times, these procedures will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust would be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.

6.11 Dirt

Given the volumes of traffic generated by aspects of the construction works, particularly during the earthworks, the Main Contractor shall ensure, where appropriate:

- A sufficient number of wheel wash facilities are provided at each egress point from the site.
- The wheel wash must be kept in place and used throughout the critical dirt generating activities of the construction works.
- Water supplies servicing the wheel wash will be from recycled sources, where possible. All waters shall be drained through appropriate filter material prior to discharge.
- The Main Contractor will endeavour to mitigate the risk of blockage of local gullies and drains due to construction materials and will carry out drain clearing as required.

6.12 Road and Footpath Maintenance

In addition to the dirt control measures listed above, the following measures will be taken to ensure that the site and surroundings are kept clear, tidy and well maintained:

- A regular programme of site tidying will be established to ensure a safe and orderly site.
- Food waste will be strictly controlled on all parts of the site.

- Scaffolding will have debris netting attached to prevent materials and equipment being scattered by the wind.
- In the event of any fugitive solid waste escaping the site, it will be collected immediately and removed to storage on site, and subsequently disposed of in the appropriate manner.
- If the existing roads or footpaths around the site are damaged as a consequence of the construction, the Contractor will carry out repairs to same.

6.13 Services and Lighting

6.13.1 Services and utilities

Site services will be installed as part of the enabling works in parallel with the rearrangement and diversion of existing utilities. Working areas will be powered by mains supplies or diesel generators where an electrical supply is not available.

6.13.2 Lighting

Site lighting will typically be provided by tower mounted 1000W metal halide floodlights. The floodlights will be cowled and angled downwards to minimise spillage to surrounding properties. The following measures will be applied in relation to site lighting:

- Lighting will be provided with the minimum luminosity sufficient for safety and security purposes. Where practicable, precautions will be taken to avoid shadows cast by the site hoarding on surrounding footpaths, roads and amenity areas;
- Motion sensor lighting and low energy consumption fittings will be installed to reduce usage and energy consumption; and
- Lighting will be positioned and directed as not to unnecessarily intrude on adjacent buildings and businesses, ecological receptors and structures used by protected species, nor to cause distraction or confusion to passing motorists.

6.14 Welfare Facilities

Welfare facilities will be provided, as appropriate, for construction staff and site personnel such as locker rooms, toilets, showers, kitchen etc. The construction compound will be used as the location for worker welfare facilities.

Potable water will be made available by installing a temporary construction water connection.

6.15 Reinstatement of Working Areas on Completion

All working areas and access routes will be reinstated as work proceeds during construction. All plant, equipment, materials, temporary infrastructure and vehicles will be removed at the earliest opportunity.

Environmental Management

This section describes the specific environmental requirements identified as part of the specimen design and associated ecological reports that will need to be adhered to.

It should be noted that the measures in this CEMP provide a summary of minimum requirements that will be developed as the project progresses. It is intended that the measures set out herein will be discussed in more detail with relevant stakeholders as required to support the identification of any additional measures to be taken account of during construction.

7.1 Construction Traffic Management

7.1.1 Site Access

Refer to **Section 2.6**

7.1.2 Construction Traffic Mitigation

7.1.2.1 General Construction Strategy

Construction traffic will be limited to certain routes and times of day, with the aim of keeping disruption to existing traffic and residents to a minimum. To minimise disruption to the local areas, construction traffic volumes will be managed through the following measures:

- During peak hours, ancillary, maintenance and other site vehicular movements will be discouraged.
- Daily construction programmes will be planned to minimise the number of disruptions to surrounding streets by staggering HGV movements to avoid site queues.
- HGV routes to and from the site will be developed in agreement with Cork City Council and with the objective of minimising the impact in the local area for residents and businesses. HGV trips to and from the site for construction will only be via Centre Park Road from the Victoria Road Roundabout.
- Parking restrictions and management measures on adjacent streets/residential areas will be reviewed and implemented as necessary in agreement with the local residents and CCC to avoid any site parking overspill issues.
- It is likely that the unused portions of the site will be available as a compound/parking area, but the amount of construction personnel parking available here will be limited. The contractor will be required to promote travel by sustainable modes of transport, see Section 7.1.2.4.

7.1.2.2 Hours of Working

Construction operations on site are proposed to be between the hours of 07:00 and 19:00, Monday to Friday, and 07:00 to 16:30 on Saturdays. Similarly, deliveries of materials to site will generally be between the hours of 07:00 and 19:00, Monday to Friday, and 08:00 to 16:00 on Saturdays.

The construction shift times will ensure construction traffic will have limited impact on the peak periods of 07:30-08:30 in the morning and 17:15-18:15 in the evening as it is envisaged most construction staff will arrive to work before 07:00 in the morning and leave after 19:00 in the evening.

Due to the specific nature of some construction activities, or to mitigate disruption to the local environment, there may be a requirement for working outside these hours. Should this be required, it will be by agreement with Cork City Council (CCC).

7.1.2.3 Construction Traffic Management Plan

A Construction Traffic Management Plan (CTMP) will be developed by the Contractor and presented to CCC for approval prior to commencement of the construction works. The CTMP will contain detailed

temporary traffic management drawings for each construction stage and will include the mitigation measures described in this section.

7.1.2.4 Mobility Management

The contractor will be required as part of the contract to introduce a Construction Stage Mobility Management Plan for its workforce to encourage access to the site by means other than by private car. The following section identifies some of the measures the contractor will provide as part of the Mobility Management Plan.

The Construction Stage Mobility Management Plan will form part of the overall Construction Traffic Management Plan and will be agreed with Cork City Council prior to works beginning on site.

Walking: The pedestrian environment surrounding the site is considered to be good with footpaths provided along all roads. Good pedestrian routes exist between the site and nearby bus stops on the Monahan Road and on the Blackrock Road.

Cycling: Cycle parking spaces and associated showers and lockers will be provided on the site for construction staff.

Car Sharing: Car sharing among construction staff should be encouraged, especially from areas where construction staff may be clustered. The Contractor shall aim to organise shifts in accordance to staff origins, hence enabling higher levels of car sharing. Such a measure offers a significant opportunity to reduce the proportion of construction staff driving to the site car parking facility and will minimise the potential traffic impact on the road network surrounding this facility.

Public Transport: The Contractor will issue an information leaflet to all staff as part of their induction on site highlighting the location of the various public transport services in the vicinity of the construction site, including bus routes that operate in the vicinity of the site. The Contractor will also offer the "Travel to Work Scheme" to employees.

7.2 Air Quality and Climate

Emissions to air during construction will occur, although the prevailing weather, the extent of the works and the distance from sensitive receptors will determine the extent of the effects. The focus of the control procedures will therefore be to reduce the generation of airborne material.

'Standard mitigation' measures will be implemented, as per guidance presented in the TII document *Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes* (TII, 2011). These will include the following:

- Spraying of exposed earthwork activities, temporary stockpiles and site haul roads during dry weather;
- Provision of wheel washes facilities at the site entrance;
- Covering of temporary stockpiles;
- Control of vehicle speeds, speed restrictions and vehicle access; and
- Sweeping of hard surface roads.

In addition, the following measures will be implemented. These measures are based on best practice as outlined in the British Research Establishment (BRE) document *Controlling particles, vapour and noise pollution from construction sites* (BRE, 2003) and the Institute of Air Quality Management (IAQM) document *Guidance on the assessment of dust from demolition and construction* (IAQM, 2016).

- Exhaust emissions from vehicles operating within the working areas, including trucks, excavators, diesel generators or other plant equipment, will be controlled by the contractor through regular servicing of machinery;
- During dry periods when dust generation is likely or during windy periods, working areas and vehicles delivering material with dust forming potential will also be sprayed with water, as appropriate;

- Areas where materials will be handled and stockpiled will be designed to minimise their exposure to wind – all temporary stockpiles shall be kept to the minimum practicable height with gentle slopes;
- There shall be no long-term stockpiling within the working areas and storage time will be minimised;
- Material drop heights from plant to plant or from plant to stockpile will be minimised;
- Dust screens will be implemented at locations where there is the potential for air quality effects during the construction phase e.g. mesh netting to be erected around the scaffolding to minimise dust emissions from the site; and
- Truck loads will be covered when carrying material likely to generate dust.

Employee awareness is also an important way that dust may be controlled on any site. Staff training and the management of operations will ensure that all dust suppression methods are implemented and continuously inspected. Further details on employee training is provided in **Section 5.1** above.

The following mitigation measures will be implemented during the construction phase of the development to minimise CO_2 emissions:

- A Construction Traffic Management Plan to be prepared by the contractor in advance of the commencement of the construction will be implemented in full. This will minimise congestion and encourage car sharing and the use of public transport, where practicable;
- Materials will be handled efficiently on site to minimise the waiting time for loading and unloading, thereby reducing potential emissions;
- Engines will be turned off when machinery is not in use; and
- The regular maintenance of plant and equipment will be carried out.

7.3 Noise and Vibration

7.3.1 Noise

A Noise and Vibration Management Plan (NVMP) will be formulated for the demolition and construction phase of the project. The main contractor is required to follow and implement where required, the procedures set out in the NVMP. The main contractor will have responsibility for managing construction noise and vibration in accordance with the procedures outlined in the NVMP. Where required, appropriate mitigation measures shall be implemented to minimise significant impacts at receptor locations.

A noise monitoring programme will be implemented on site for the duration of the construction works. Noise monitors shall be maintained and operated as per the methods set out in the NVMP.

Construction noise should not exceed the threshold values outlined in **Table 2** at residential dwellings, or further limits if imposed by the planning authority or specified in the NVMP.

Table 2 Construction noise threshold for significant effect at dwellings

Period over which criterion applies		Noise impact criterion (LAeq, 1hr)
Monday to Friday	Day: 7.00am to 7.00pm	70 dB
	Evening: 7.00pm to 10.00pm	60 dB*
Saturday: Day: 7.00am to 4.30pm (work outside these hours will generally not be permitted)		65 dB

***Note:** *Construction activity at these times, other than that required for emergency works, will require the permission of the relevant Local Authority.*

7.3.2 Vibration

Table 3 sets out the vibration threshold levels applicable at nearby soundly constructed buildings to avoid any cosmetic damage to the building.

Table 3 Construction vibration maximum allowable levels

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive building to the source of vibration, at a frequency of		
Less than 10Hz	**10 to 50Hz**	**50Hz and above**
8 mm/s	12.5 mm/s	20 mm/s

The main Contractor shall be required to assess and monitor vibration levels during critical work activities to identify any risks of vibration impacts at nearby receptors in accordance with the procedures outlined in the NVMP.

7.3.3 General

Specific noise abatement measures will be taken to comply with the recommendations of BS 5228-1 and 2:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites: Noise and vibration* (BSI, 2014) and the *European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001* (EC, 2001).

The following specific measures will be implemented during the construction phase to ensure noise and vibration effects are minimised:

- Site representatives shall be appointed to be responsible for matters relating to noise and vibration;
- Equipment will be switched off when not required;
- Internal haul routes will be well maintained;
- Rubber linings shall be used in chutes and dumpers etc. to reduce impact noise;
- Plant and vehicles will be started sequentially rather than all together;
- Construction plant and activities to be employed on site will be reviewed to ensure that they are the quietest available for the required purpose;
- Generators will be located away from sensitive receivers and will be enclosed;
- Where required, improved sound reduction methods e.g. enclosures shall be used;
- For all construction works likely to generate off-site vibration, the contractor will be required to meet the vibration limits set out in BS 5228.
- Acoustic barriers will be provided around construction works to minimise the effects of noise and vibration generating activities in the vicinity of sensitive locations;
- Typically, site activities will be limited to 7:00am – 7pm, Monday to Friday; and 7am – 4:30pm on Saturdays. It may also be necessary in exceptional circumstances to undertake some other types of activities outside of normal construction core working hours. Any such working hours outside the normal construction core working hours will be agreed with Cork City Council. The planning of such works will have regard to nearby sensitive receptors;
- A Community Liaison Plan shall be prepared to provide for effective community liaison to help ensure the smooth running of construction activities and to address any issues that may arise.
- Avoid unnecessary revving of engines and switch off equipment when not required;
- Keep internal haul routes well maintained and avoid steep gradients;

- Use rubber linings in, for example, chutes and dumpers to reduce impact noise;
- Minimise drop height of materials; and

The following more specific measures will also be implemented where practicable:

- In accordance with Best Practicable Means, plant and activities to be employed on site will be reviewed to ensure that they are the quietest available for the required purpose;
- Where required, improved sound reduction methods, e.g. enclosures should be used;
- Site equipment should be located away from noise sensitive areas, as much as is feasible;
- Regular and effective maintenance by trained personnel should be carried out to reduce noise and/or vibration from plant and machinery;
- A 2.4 metre high hoarding will be provided around the construction site;
- Limiting the hours during which site activities likely to create high levels of noise or vibration are carried out;
- Establish channels of communication between the contractor/developer, Local Authority and residents;
- Appointing of a site representative responsible for matters relating to noise and vibration.

7.4 Biodiversity

7.4.1 General

The mitigation measures have been drawn up in line with current best practice and include an avoidance of sensitive habitats at the design stage and mitigation measures will function effectively in preventing significant ecological impacts. The following mitigation measures will be implemented:

Mitigation measures (of relevance in respect of any potential ecological effects) will be implemented throughout the project, including the preparation and implementation of detailed method statements. The works will incorporate the relevant elements of the guidelines outlined below:

- The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads. National Roads Authority, Dublin (2010).
- Control of water pollution from construction sites. Guidance for consultants and contractors (C532). CIRIA. H. Masters-Williams et al (2001)
- Control of water pollution from linear construction projects. Technical guidance (C648). CIRIA. E. Murnane, A. Heap and A. Swain. (2006)

All personnel involved with the proposed development will receive an on-site induction relating to construction and operations, and the environmentally sensitive nature of the River Lee and to re-emphasise the precautions that are required as well as the control measures to be implemented. Site managers, foremen and workforce, including all subcontractors, will be suitably trained in risks and preventative measures.

All staff and subcontractors have the responsibility to:

- Work to agreed plans, methods and procedures to eliminate and minimise environmental impacts,
- Understand the importance of avoiding on-site impacts, including noise and dust, and how to respond in the event of an incident to avoid or limit environmental impact;
- Respond in the event of an incident to avoid or limit environmental impact;
- Report all incidents immediately to the site manager;
- Monitor the workplace for potential environmental risks and alert the site manager if any are observed; and

- Co-operate as required, with site inspections.

7.4.2 Water Quality

The employment of good construction management practices will minimise the risk of impacts to soil, stormwater run-off, seawater or groundwater. A summary of the measures relevant to hydrology are provided as follows and are in accordance with Construction Industry Research and Information Association (CIRIA) guidance – *Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors* (Masters-Williams et al, 2001).

Mitigation measures in relation to water quality are outlined in **Section 7.8** *Water*.

7.4.3 Noise

Specific noise abatement measures will be taken to comply with the recommendations of BS 5228-1 and 2:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites: Noise and vibration* (BSI, 2014) and the *European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001* (EC, 2001).

Mitigation measures in relation to noise and vibration are outlined in **Section 7.3** *Noise and Vibration*.

7.4.4 Lighting

Site lighting during construction will be directed away from adjoining areas, to minimise light spill outside the proposed development site boundary.

During operation, lighting design will ensure that light spillage outside the site is minimal and there will be no light spillage onto sensitive habitats outside the site boundary i.e., River Lee.

7.4.5 Invasive Species

Management programmes will need to be deployed as soon as practically possible in light of the potential for further dispersal of Japanese knotweed vector material, within overall masterplan boundary, which could impact on the success of the selected management programme.

It is recommended that any growth of other invasive species are treated, where required, with chemical herbicide during the optimum treatment period to avoid any future encroachment by these species and to minimise long-term landscape maintenance requirements.

Sie specific measures have been outlined in the Invasive Species Management Plan which is included as **Appendix A**.

7.4.6 Protection of Habitats

The Wildlife Act 1976, as amended, provides that it is an offence to cut, grub, burn or destroy any vegetation on uncultivated land or such growing in any hedge or ditch from the 1 March to the 31 August. Exemptions include the clearance of vegetation in the course of road or other construction works or in the development or preparation of sites on which any building or other structure is intended to be provided. If works are carried out during the breeding season, a pre-construction survey will be carried out by the project ecologist and if birds are detected appropriate mitigation measures will be implemented.

The Landscape Design Plan for the proposed development site includes the following:

- Tree planting
- Small multi-stem trees
- Tree planting in wetland area
- Native woodland planting

- Shrub planting
- Swale planting
- Wildlife buffer planting
- Meadow and bulb planting
- Riparian woodland planting
- Ecological Park also includes the following:
    - Five log piles using native logs for hedgehogs
    - Five insect hotels
    - Six bat boxes.

7.4.7 Bats

During the site works, general mitigation measures for bats will follow the National Road Authority's 'Guidelines for the Treatment of Bats during the Construction of National Road Schemes' NRA (2005c) and 'Bat Mitigation Guidelines for Ireland: Irish Wildlife Manuals, No. 25' (Kelleher, C. & Marnell, F. (2006)). These documents outline the requirements that will be met in the pre-construction (site clearance) stage to minimise negative effects on roosting bats or prevent avoidable effects resulting from significant alterations to the immediate landscape.

Buildings within the site will be demolished. No signs of bats were recorded within the existing structures, and they have a low potential as roosting habitat. However, as a precautionary measure, the following measures will be implemented prior to and/or during demolition.

Mitigation measures will be agreed with the NPWS prior to any demolition works.

- Ideally work on buildings will take place outside the summer season between and October March inclusive when bats will be hibernating as the buildings to be removed have negligible potential as winter hibernation sites.
- In all cases immediately in advance of demolition a bat specialist will undertake an examination of the building. Emergence surveys will be carried out if buildings are affected during the April to September period. If bats are present at the time of examination it is essential to determine the nature of the roost (i.e. number, species, whether it is a breeding population) as well as its exact location.
- If bats are recorded in buildings earmarked for demolition, special mitigation measures to protect bats will be put in place and a license to derogate from the conservation legislation will be sought from the NPWS.
- The contractor will take all required measures to ensure works do not harm individuals by altering working methods or timing to avoid bats, if necessary.
- If roosting habitat for bats is removed, replacement habitat will be provided.

No significant mature trees will be removed during site clearance. Although mature trees with the potential of be of significant value as bat roosts are absent from the site, the following precautionary measures will be implemented.

- Tree-felling will ideally be undertaken in the period September to late October/early November. During this period bats are capable of flight and may avoid the risks of tree-felling if proper measures are undertaken.
- Felled trees will not be mulched immediately. Such trees will be left lying several hours and preferably overnight before any further sawing or mulching. This will allow any bats within the tree to emerge and avoid accidental death. The bat specialist will be on-hand during felling operations to inspect felled trees for bats. If bats are seen or heard in a tree that has been felled, work will cease and the local NPWS Conservation Ranger will be contacted.

- No ‘tidying up’ of dead wood and spilt limbs on tree specimens will be undertaken unless necessary for health and safety.
- Treelines outside the proposed development area but adjacent to it and thus at risk, will be clearly marked by a bat specialist to avoid any inadvertent damage.
- During construction directional lighting will be employed to minimise light spill onto adjacent areas. Where practicable during night-time works, there will be no directional lighting focused towards the River Lee or boundary habitats and focusing lights downwards will be utilised to minimise light spillage.
- It is proposed that six bat boxes will be located within the proposed development site (https://www.wildcare.co.uk/vincent-pro-bat-box-10651.html for box proposed or similar). The boxes will be erected a suitably qualified ecologist taking into account landscape plans, vehicle movements and lighting.

As noted above, lighting mitigation measures will follow Bats & Lighting Guidance Notes for: Planners, engineers, architects and developers (Bat Conservation Ireland, 2010).

All mitigation measures including detailed method statements will be agreed with the NPWS prior to commencement of works, which could affect any bat populations on site.

7.4.8 Birds

As noted above where possible, vegetation will be removed outside of the breeding season and in particular, removal during the peak-breeding season (April-June inclusive) will be avoided. This will also minimise the potential disturbance of breeding birds outside of the study area boundary.

It is noted that provision of woodland planting and the use of more diverse grassland planting will provide additional nesting and feeding sites for birds, particularly as these habitats mature.

7.5 Archaeology, Architecture and Cultural Heritage

Archaeological monitoring of ground excavation works during the construction phase will be carried out by a suitably qualified archaeologist licensed by the National Monument Service. This is in accordance with Section 4.7.2.3 (Archaeological Monitoring) of the *South Docks Local Area Plan* (2008). In the event that any archaeological remains are identified during the course of monitoring, they will be recorded and left to remain securely *in situ* while the National Monuments Service and Cork City Council are consulted to determine further appropriate mitigation measures, which may entail preservation *in situ* by avoidance or preservation in record by archaeological excavation. A report comprising a written and photographic record of the results of the archaeological monitoring will be compiled and submitted to the National Monuments Service and Cork City Council.

7.6 Townscape and Visual

The proposed measures relate to implementation of appropriate site management procedures – such as the control of site lighting, storage of materials, placement of compounds, delivery of materials, car parking, etc.

- Visual impact during the construction phase will be mitigated somewhat through appropriate site management measures and work practices to ensure the site is kept tidy, dust is kept to a minimum, and that public areas are kept free from building material and site rubbish.
- Site hoarding will be appropriately scaled, finished and maintained for the period of construction of each section of the works as appropriate.
- To reduce the potential negative impacts during the construction phase, good site management and housekeeping practices will be adhered to. The visual impact of the site compound and scaffolding visible during the construction phase are of a temporary nature only and therefore require no remedial action other than as stated above.

7.7 Land and Soils

The following measures will be implemented in relation to land and soils during construction:

- Potential pollutants shall be adequately secured against vandalism and will be provided with proper containment according to the relevant codes of practice. Any spillages will be immediately contained, and contaminated soil shall be removed from the proposed development and properly disposed of in an appropriately licensed facility.
- Dust generation shall be kept to a minimum through the wetting down of haul roads as required and other dust suppression measures.
- Any stockpiles of earthworks and site clearance material shall be stored on impermeable surfaces and covered with appropriate materials where necessary.
- Silt traps shall be placed in gullies to capture any excess silt in the run-off from working areas.
- Soil and water pollution will be minimised by the implementation of good housekeeping (daily site clean-ups, use of disposal bins, etc.) and the proper use, storage and disposal of these substances and their containers as well as good construction practices as described the CIRIA guidance.
- A contingency plan for pollution emergencies will also be developed by the appointed contractor prior to the commencement of works and regularly updated. The contingency plan will identify the actions to be taken in the event of a pollution incident in accordance with the CIRIA guidance which requires the following to be addressed:
  - Containment measures;
  - Emergency discharge routes;
  - List of appropriate equipment and clean-up materials;
  - Maintenance schedule for equipment;
  - Details of trained staff, location and provision for 24-hour cover;
  - Details of staff responsibilities;
  - Notification procedures to inform the relevant environmental protection authority or Cork City Council
  - Audit and review schedule;
  - Telephone numbers of statutory water undertakers and local water company; and
  - List of specialist pollution clean-up companies and their telephone numbers.

Loss of crushed rock aggregate and granular aggregate potential area

Excavated material will be removed during the construction phase. Where possible, excavated material will be reused as construction fill. The appointed contractor will ensure acceptability of the material for reuse for the proposed development with appropriate handling, processing and segregation of the material. This material would have to be shown to be suitable for such use and subject to appropriate control and testing according to the Earthworks Specification(s). These excavated soil materials will be stockpiled located within the working area where possible, using an appropriate method to minimise the impacts of weathering. Care will be taken in reworking this material to minimise dust generation, groundwater infiltration and generation of runoff. Any surplus suitable material excavated that is not required elsewhere for the proposed development shall be used for other projects where possible, subject to appropriate approvals/notifications.

Ground movements

Ground movement, horizontal movement and vibration monitoring will be implemented during construction activities to ensure that the construction does not exceed the design limitations.

Ground movements will be controlled through the selection of a foundation type and method of construction which are suitable for the particular ground conditions.

Pollution from construction activities

The employment of good construction management practices will minimise the risk of pollution of soil, storm water run-off, adjacent watercourses and groundwater. The construction management of the site will take account of the recommendations of the CIRIA guidance Control of Water Pollution from Construction Sites – Guidance for consultants and contractors (Masters-Williams et al., 2001) to minimise as far as possible the risk of soil, groundwater and surface water contamination.

Measures, as recommended in the guidance above, that will be implemented to minimise the risk of spills and contamination of soils and waters, include:

- Training of site managers, foremen and workforce, including all subcontractors, in pollution risks and preventative measures;
- Careful consideration will be given to the location of any fuel storage facilities. These will be designed in accordance with guidelines produced by CIRIA, and will be fully bunded;
- All vehicles and plant will be regularly inspected for fuel, oil and hydraulic fluid leaks. Suitable equipment to deal with spills will be maintained on site;
- Ensure that all areas where liquids are stored or cleaning is carried out are in designated impermeable areas that are isolated from the surrounding area e.g. by a roll-over bund, raised kerb, ramps or stepped access;
- Minimise the use of cleaning chemicals; and
- Use trigger-operated spray guns, with automatic water-supply cut-off.

Earthworks haulage

Earthworks haulage will be along agreed predetermined routes along existing national, regional and local routes. Where compaction occurs due to truck movements and other construction activities on unfinished surfaces, remediation works will be undertaken to reinstate the ground to its original condition. Where practicable, compaction of any soil or subsoil which is to remain in situ along the sites will be avoided.

Earthworks operations shall be carried out such that surfaces shall be designed with adequate falls, profiling and drainage to promote safe runoff and prevent ponding and flooding. Runoff will be controlled through erosion and sediment control structures appropriate to minimise the water impacts in outfall areas. Care will be taken to ensure that the bank surfaces are stable to minimise erosion.

7.7.1 Contaminated Soil Exposure Mitigation

Several likely adverse effects which without mitigation could have potentially significant impacts. These include:

- contamination, such as asbestos, becoming airborne and affecting the human health of people in the vicinity of the excavation;
- site workers being exposed to contamination in soil; and
- site workers being exposed to ground gas.

Proposed mitigation measures include the following:

- During construction, the potential risk to site users and member of the public from contaminated dust will be managed using standard health and safety measures as outlined in the Health and Safety Authority guidance document on working with asbestos (HSA 2013). This states that:

  "*Removal of asbestos from contaminated soil will require a specialist asbestos contractor for any friable asbestos to be removed.*"

And

"*A risk assessment by an independent competent person should determine the most appropriate control measures and remediation strategies*."

- Control measures for the construction stage will be devised based on a risk assessment carried out by the contractor prior to the development and will be specific to the construction methods.

7.8 Water

The following best practice water management measures will be implemented during the construction phase:

- Specific measures to prevent the release of sediment over baseline conditions to Atlantic Pond and Lee Estuary Lower during the construction work, which will be implemented as the need arises. These measures include, but are not limited to, the use of silt fences, silt curtains, settlement lagoons and filter materials. This is particularly important when undertaking any works/upgrading to the surface and foul water drainage networks at the proposed development site.
- Provision of exclusion zones and barriers (e.g. silt fences) between earthworks, stockpiles and temporary surfaces to prevent sediment washing into the existing drainage systems and hence the downstream receiving water environment.
- Provision of temporary construction surface drainage and sediment control measures to be in place before earthworks commence.
- Weather conditions will be taken into account when planning construction activities to minimise risk of run-off from the site. Topsoil and subsoil will not be mixed together.
- Any fuels or chemicals (including hydrocarbons or any polluting chemicals) will be stored in a bunded area to prevent any seepage of into the local surface water network or groundwater. These will be designed in accordance with guidelines produced by CIRIA.
- All mobile fuel bowsers shall carry a spill kit and operatives will have spill response training. All fuel containing equipment such as portable generators shall be placed on drip trays. All fuels and chemicals required to be stored on-site will be clearly marked.
- Implementation of response measures to potential pollution incidents.
- Emergency procedures and spillage kits will be available and construction staff will be familiar with emergency procedures in the event of accidental fuel spillages.
- All trucks will have a built-on tarpaulin that will cover excavated material as it is being hauled off-site and wheel wash facilities will be provided at all site egress points.
- Any seepage/infiltration and surface ponding from rainfall events will be gathered locally to facilitate pumping with subsequent discharge, under licence, to the local sewerage drainage network. For example, prior to any discharge, the water will be passed through silt traps and hydrocarbon/oil interceptors within the construction site confines. This will result in the separation of sediment from the water prior to its discharge and will ensure that the water is of adequate quality before it enters the local authority drainage system. The use of silt traps and interceptors will be supplemented by proper housekeeping and control measures such as regular testing and monitoring of water quality to ensure compliance.
- Temporary oil interceptor facilities shall be installed and maintained where site works involve the discharge of drainage water to the receiving Atlantic Pond and Lee Estuary Lower and implementation of good housekeeping (site clean-ups, use of disposal bins, etc.) at working areas.
- When cast-in-place concrete is required, all work must be done in the dry and effectively isolated from flowing water or water that may enter the watercourses bounding the site for a period sufficient to ensure no leachate from the concrete.
- All hazardous materials will be stored within secondary containment designed to retain at least 110% of the storage contents.

- Mobile plant will be refueled in a designated area, on an impermeable base away from drains or watercourses.
- Safe materials handling of all potentially hazardous materials will be implemented by all construction personnel employed.
- The pumping of groundwater may be required during excavation for foundation and attenuation tank construction, with the proposed locations of pump wells selected so as to minimise the volume of pumping.
- Water supplies shall be recycled for use in the wheel wash. All waters shall be drained through appropriate filter material prior to discharge from the construction sites.
- A discovery procedure for contaminated material will be prepared and adopted by the appointed contractor prior to excavation works commencing on site. These documents will detail how potentially contaminated material will be dealt with during the excavation phase to ensure no contaminated material enters the watercourse.
- Implementation of measures to minimise waste and ensure correct handling, storage and disposal of waste (most notably wet concrete, pile arisings and asphalt).
- Groundwater level and quality monitoring during construction

7.8.1 Flood Risk Mitigation

The following site-specific flooding mitigation measures will be implemented:

- The main contractor will manage surface water during the replacement the open drainage. Where pipe culvert construction is proposed a temporary by-pass channels or other appropriate measures (i.e. pumping to downstream drainage) will be put in place to avoid obstruction of flow.
- Any surface ponding from rainfall events will be gathered locally to facilitate pumping with subsequent discharge, under licence, to the local sewerage drainage network. The CEMP will cover all potentially polluting activities from this process and include an emergency response procedure.
- Earthworks operations shall be carried out such that surfaces shall be designed with adequate falls, profiling and drainage to promote safe run-off and prevent ponding and flooding.

7.9 Resource and Waste Management

Construction – General

In addition to the inherent design measures which will be implemented during the construction phase, the following mitigation measures will be implemented:

- Waste disposal will be minimised so far as is reasonably practicable;
- Possibilities for re-use of clean non-hazardous excavation material as fill on the site or in landscaping works will be considered following appropriate testing to ensure material is suitable for its proposed end use. Where excavated material may not be re-used within the proposed works the Contractor will endeavour to send material for recovery or recycling so far as is reasonably practicable;
- Waste from the proposed development will be transported by authorised waste collectors in accordance with the relevant Irish waste legislation (Waste Management (Collection Permit) Regulations, 2007 as amended;
- Waste from the proposed development will be delivered to authorised waste facilities in accordance with the relevant Irish waste legislation (Waste Management Acts 1996-2016) as amended;
- Source segregation: Where possible, metal, timber, glass and other recyclable material will be segregated on site in a designated area within the construction compound during construction works and will be removed off site to a permitted/licensed facility for recycling. Where required waste stream colour coding,

and photographs of wastes will be used to facilitate segregation. Where waste generation cannot be avoided this will maximise the quantity and quality of waste delivered for recycling and facilitate its movement up the waste hierarchy away from landfill disposal and reduce its environmental effect;

- Material management: 'Just-in-time' delivery will be used so far as is reasonably practicable to minimise material wastage;
- Supply chain partners: The contractor will engage with the supply chain to supply products and materials that use minimal packaging, and segregate packaging for reuse;
- Waste Auditing: The contractor will record the quantity in tonnes and types of waste and materials leaving site during the construction phase;
- Waste fuels/oils may be generated from equipment used on-site during construction and may be classified as hazardous waste. Such wastes will be stored in a secure, bunded area on-site prior to collection by a Contractor who holds the appropriate waste collection permit;
- Possibilities for re-use of excess uncontaminated soil and stone only as fill or in landscaping works within the site will be considered following appropriate testing to ensure material is suitable for its proposed end use. Where excess excavation material may not be re-used within the proposed works the Contractor will endeavour to send material for recovery or recycling so far as is reasonably practicable;
- The name, address and authorisation details of all facilities and locations to which waste and materials are delivered will be recorded along with the quantity of waste in tonnes delivered to each facility. Records will show material, which is recovered, and which is disposed of; and
- The contractor will ensure that any off-site interim storage or waste management facilities for excavated material have the appropriate waste licences or waste facility permits in place.
- A risk assessment will be carried out to determine the suitability for re-use of asbestos/contaminated material encountered during construction. If re-use within the site is not possible, contaminated material will be removed offsite to an appropriately licenced facility.

7.10 Population and Human Health

Measures which will be implemented to minimise effects on the general amenity of residents will include:

- The erection of directional and information signage for members of the public to indicate alternative routes and paths to be taken and convey "Business As Usual" for adjoining businesses;
- The provision of information to local residents and businesses during the construction phase;
- The provision of community liaison and nomination of personnel to manage community relations; and
- The preparation of an emergency response plan to cover foreseeable risks.

Industry-standard traffic management measures will be put in place to alleviate construction-related traffic disruptions. Refer to **Section 7.1** for further details.

Dust emissions will be controlled throughout the construction phase. Refer to **Section 7.2** for details of dust mitigation measures.

Noise and vibration disturbance will also be minimised. Best practice measures for noise control on construction sites will be adhered to during construction. Refer to **Section 7.3** for further details of noise and vibration mitigation measures.

As required by regulation and legislation, a Health and Safety Plan will be prepared to address health and safety issues during the construction phase. This plan will be reviewed and updated as required, as the development progresses. The Project Supervisor Construction Stage will assemble the Safety File as the project progresses.

7.11 Material Assets

The following measures in relation to material assets during construction will be implemented:

- The contractor will undertake their own surveys to establish full extent of underground services prior to the commencement of construction to support any surveys already undertaken as part of early design work and statutory consent applications
- Put measures in place to ensure that there are no interruptions to existing utilities and services unless this has been agreed in advance with the relevant service provider
- All utilities and services diversions will be agreed and undertaken as part of the enabling works and in advance of the commencement of construction activities
- All works near utilities apparatus will be carried out in ongoing consultation with the relevant utility company and/or local authority and will be in compliance with any requirements or guidelines they may have.
- Where new services are required, the Contractor will apply to the relevant utility company for a connection permit where appropriate and will adhere to their requirements;
- All construction activities in the vicinity of existing services and utilities will be carried out with ongoing consultation with the relevant service provider and undertaken in compliance with any requirements or guidelines they may have.
- If asbestos is uncovered on site, the Asbestos Containing Material will be double-bagged, stored, collected and removed from site by a competent contractor and disposed of in accordance with the relevant procedures and legislation.

7.12 Major Accidents and Disasters including COMAH

The proposed development will be designed and built in line with best international current practice and, as such, mitigation against the risk of major accidents and/or disasters will be embedded throughout the design.

The contractor will be required to ensure that all fire safety requirements are provided for in co-ordination with Cork City Council. Appropriate site personnel will be trained as first aiders and fire marshals. The contractor will also be required to maintain an emergency response plan which will cover all foreseeable risks i.e. fire. In preparing this plan the contractor will be required to liaise with the emergency response services.

The mitigation measures, which will limit the likelihood and consequence of a vehicle collision, include a Construction Traffic Management Plan (CTMP). This will be a live document which will be updated/added to as construction progresses and will be implemented for the duration of the proposed works.

See **Section 7.8** for details on pollutant control.

A review was undertaken to identify the closest Seveso site in relation to the proposed development site. Goulding Chemicals Limited is located circa. 550m west of the site along Centre Park Road and is classed as a Lower-Tier site, under The Chemical Act (Control of major Accident Hazards Involving Dangerous Substances Regulations, 2015 (which transpose the Seveso III Directive (2012/18/EU) into Iris law). The proposed development is not located in the consultation zone of this Seveso site and therefore, no consultation with the Health and Safety Authority was necessary with regard to the proposed development.

The nearest Seveso site in proximity to the proposed development is Goulding Chemicals Ltd. In accordance with the Regulations operators of a ‘Lower Tier Establishment’ are required to develop a site-specific Major-Accident Prevention Policy (MAPP) which is implemented by site specific procedures and systems. Due to the nature of the proposed development, and the distance between the Goulding facility and the proposed development, it is not predicted that the risk of major accidents relating to the facility will constrain the proposed development, and the provisions of the Directive have been appropriately considered with regard to the proposed development.

References

BRE (2003). *Controlling particles, vapour and noise pollution from construction sites*

BSI (2014). *BS 5228-1 and 2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites: Noise and vibration*

CIRIA (2002). *Brownfield development sites: ground-related risks for buildings (X263)*

CIRIA (2015). *Coastal and marine environmental site guide (second edition) (C744)*

CIRIA (2015). *Environmental Good Practice on Site C692 (fourth edition) (C762*)

CIRIA (2015). *Environmental Good Practice on Site Guide, 4th Edition*

CIRIA. E. Murnane, A. Heap and A. Swain. (2006). *"Guidance on Compliance with Regulation 23 of the Habitats Regulations 1997 - strict protection of certain species/applications for derogation licences"* issued on behalf of the Minister of the Environment, Heritage and Local Government on the 16th of May 2007.

CIRIA. H. Masters-Williams et al (2001). *Control of water pollution from construction sites. Guidance for consultants and contractors (C532). Control of water pollution from linear construction projects. Technical guidance (C648).*

EC (2001). European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001.

Institute of Air Quality Management (IAQM) (2016). *Guidance on the assessment of dust from demolition and construction.*

ISO (2015). ISO 14001:2015 *Environmental management systems -- Requirements with guidance for use*

NRA (2006). *Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub Prior to, During and Post Construction of National Road Schemes*

NRA (2010). *Guidelines on The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads*

TII (2011). *Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes*

TII (2020). *The Management of Invasive Alien Plant Species on National Roads – Technical Guidance*

Appendix A Invasive Species Management Plan

COMER GROUP IRELAND

OVERALL MASTERPLAN FOR RESIDENTIAL DEVELOPMENT, AT CENTRE PARK ROAD,CORK CITY

INVASIVE SPECIES MANAGEMENT PLAN

O'DONOVAN AGRI GROUP
Ballincollig Commercial Park,
Ballincollig, Co. Cork.
Tel: 021 4873020
087 2433194 / 086 1758042
www.odonovanagri.com

MARCH 2022

DOCUMENT QUALITY CONTROL	
CLIENT	Comer Group (Ireland) Ltd.
PROJECT NO	126.21
PROJECT TITLE	Overall Masterplan for Residential Development, Centre Park Road, Cork City
REPORT TITLE	Invasive Species Management Plan

REV.	STATUS	AUTHOR(S)	REVIEWED BY	APPROVED BY	ISSUE DATE
0	Draft	Lisa Dolan	John O' Donovan	Lisa Dolan	10/01/2022
1	Draft Issued	Lisa Dolan	John O' Donovan	Lisa Dolan	09/03/2022

Table of Contents

1.0 INTRODUCTION

1.1 Background

O' Donovan Agri-Environmental Services have been appointed by Comer Group (Ireland) Ltd. to provide specialist Invasive Alien Plant Species (IAPS) advisory services with respect to the presence of Japanese knotweed (*Fallopia japonica*) in the footprint of the "overall masterplan" for proposed residential development, within the former Tedcastles Site on the Centre Park Road in the docklands area of Cork City (see Figures 1.1-1.4).

The overall masterplan for the former Tedcastles Site consists of two separate parcels of land which for the purposes of the invasive species management plan are referred to as Site A - 7.27ha approx. and Site B - 1.31ha approx. in area (see Figures 1.1-.2).

Planning is currently being sought in respect of a 4.7ha subsite within Site A (see Figure 1.3-1.4). The proposed residential development within the 4.7ha subsite includes the "*demolition of the existing structures on site and the construction of a strategic housing development of 823 no. apartments, resident amenity and ancillary commercial areas including childcare facilities. The development will comprise 6 no. buildings. The proposed development also comprises hard and soft landscaping, pedestrian bridges, car parking, bicycle stores and shelters, bin stores, ESB substations, plant rooms and all ancillary site development works. Vehicular access to the proposed development will be provided via Centre Park Road"* (ARUP, 2022).

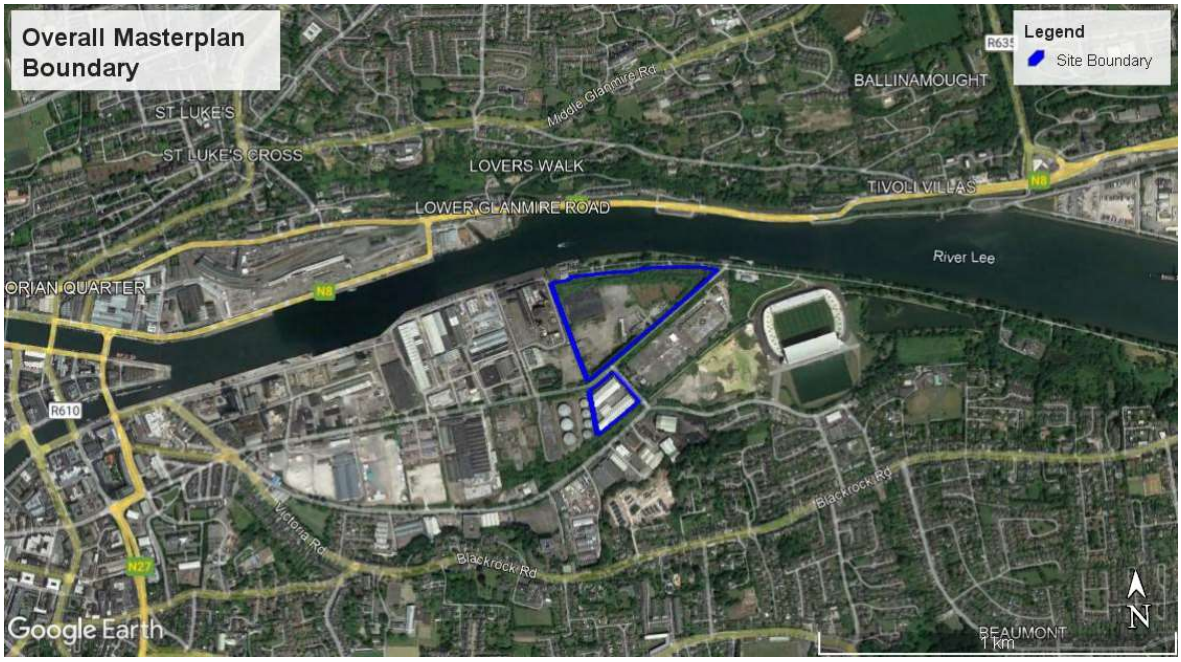
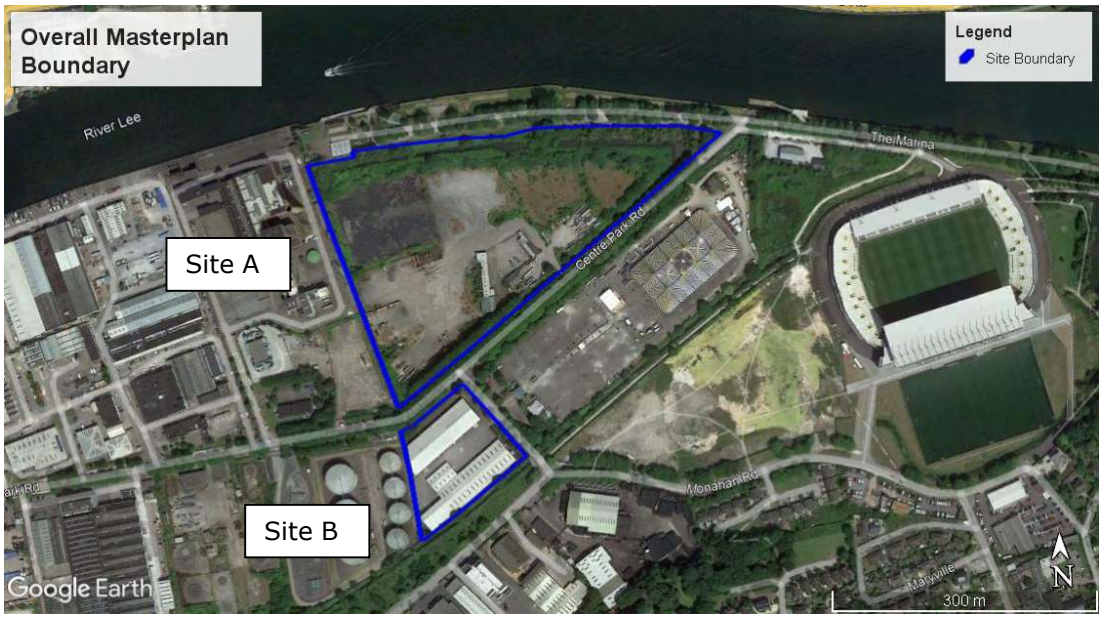
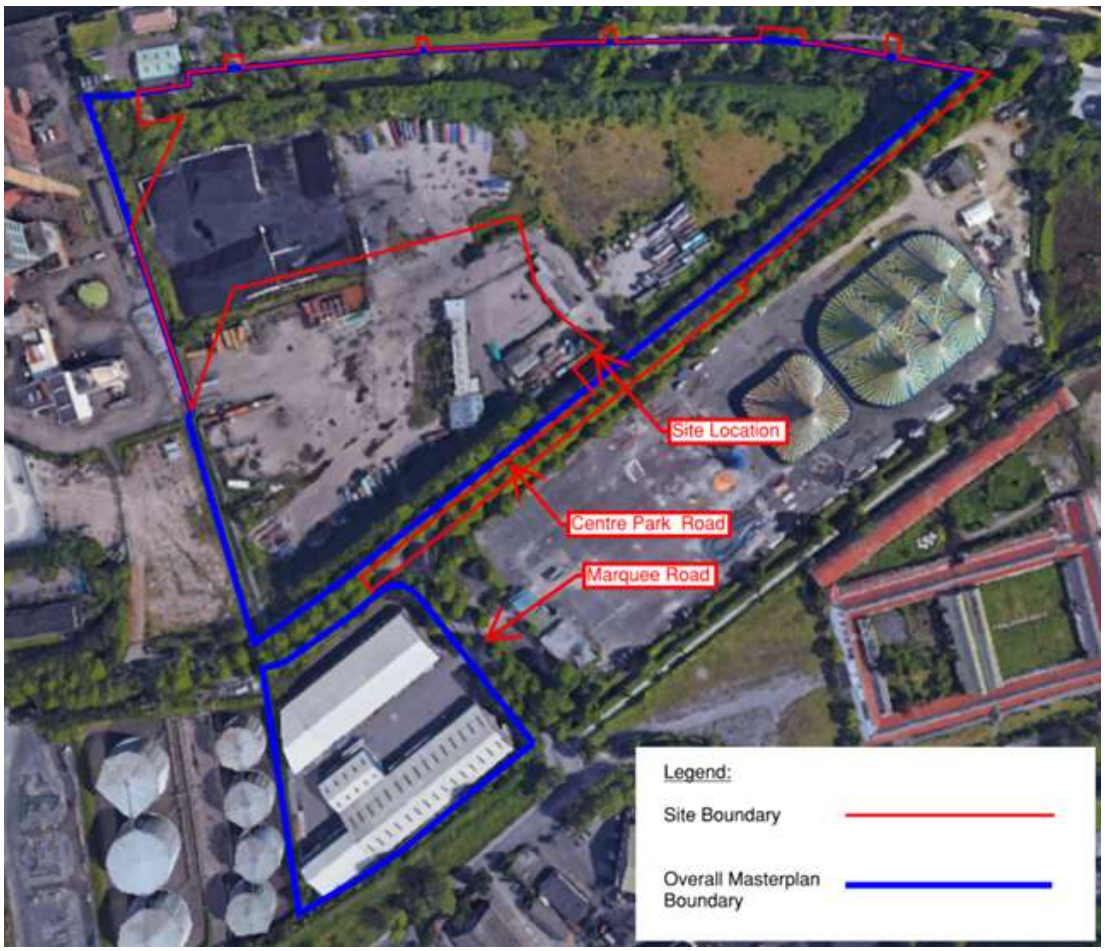


Figure 1.1 Location of lands within the Overall Masterplan Boundary for Proposed Residential Development at Centre Park Road (Source: Google Earth Pro)





Figures 1.2 & 1.3 Location of Site A and B within the Overall Masterplan Boundary at Centre Park Road (Source: Google Earth Pro; ARUP, 2022)

Figure 1.4 Layout of the Proposed 4.7ha Residential Development within Site A at Centre Park Road (Source: ARUP, 2022)

In light of the presence of IAPS, O' Donovan Agri-Environmental Services have been engaged by Comer Group (Ireland) Ltd. to prepare an Invasive Species Management Plan (ISMP) to facilitate the eradication of Japanese knotweed, and any other relevant invasive species, from within the lands of the overall masterplan boundary.

In this regard, a specialist walkover survey was undertaken at Centre Park Road on the 14th December 2021 to inform the preparation of the management plan.

The specialist IAPS services in respect of the lands within the overall masterplan boundary are being led by the following project team:

John O' Donovan is a Specialist Weed Control Consultant with over 20 years' industry experience in the design of specialist chemical herbicide treatment programmes aimed at the successful and timely eradication of Japanese knotweed, and in the research, development, and patenting of innovative specialist equipment for the application of herbicides and species-specific biosecurity equipment.

Lisa M. J. Dolan is an IAPS Specialist Ecological Consultant with over 20 years' industry experience in the preparation of IAPS Management Plans and the onsite management and successful eradication of invasive species, in particular Japanese knotweed. Lisa is experienced in specialist targeted surveys and reporting, environmental impact assessments, design and deployment of specialist biosecurity protocols and equipment, and as a Clients

Representative (for local authorities, state, and semi-state bodies) the preparation of tender documents for the procurement of IAPS Specialist Contractors, site supervision and the management of IAPS Contracts for successful invasive species eradication programmes.

2.0 MANAGEMENT OF INVASIVE ALIEN PLANT SPECIES

2.1 Necessity for a Management Plan

The preparation of an Invasive Species Management Plan is required to meet with legal obligations in terms of avoiding the accidental dispersal of invasive species including vector material during the vegetation removal, site clearance, demolition, construction and landscaping stage of a Project.

A management plan is also necessary to ensure that appropriate measures are taken to avoid the dispersal of invasive species, during the deployment of control and eradication programmes for invasive species within a site.

A management plan should ensure that best practice is deployed to control or eradicate Japanese knotweed in the most cost effective, environmentally sustainable, and timely manner.

A management plan is one of a number of documents required by National Parks and Wildlife Service (NPWS) as part of a license application for the transportation of Japanese knotweed vector material off site for disposal at a licensed receiving facility (see Section 2.3).

Where present on a site the costs of eradicating invasive species generally increase overtime, with the maturity of an infestation, which may be exacerbated by delayed treatment, inappropriate treatment, disturbance regimes and accidental dispersal. In addition to these impacts, delays to the control or eradication of certain invasive species may also pose a risk to adjacent lands and semi-natural habitats, including downstream habitats, depending on the invasive qualities of the IAPS in question (see Appendix II).

In this regard, the management of invasive species within the lands of the overall masterplan boundary is necessary to address or to meet with:

- Environmental legislation
- Future planning conditions
- Risk of further accidental dispersal

And the potential for invasive species to:

- Encroach on downstream native habitats with connectivity to Centre Park Road via the stormwater network *e.g.* River Lee, Cork Harbour SPA, Douglas River Estuary pNHA, Dunkettle Shore pNHA and non-designated SWDTEs and GWDTEs
- Encroach on adjacent land-uses, public footpaths, dwellings, and infrastructure
- Encroach on new structures, footpaths, services, internal access roads and green open spaces within the site of the proposed residential development
- Diminish the ability to use and enjoy the green open spaces within the site of the proposed residential development due to impediments to access
- Encroach on sight lines and signage along the internal access paths
- Result in long-term maintenance requirements

Please be advised that a management plan is a 'live' document and will be updated where required as the project progresses to include the findings of further monitoring surveys and additional eradication or control programmes, where required.

2.2 Preparation of a Management Plan

The first step in the preparation of an Invasive Species Management Plan for the lands within the overall masterplan boundary, is to select the most appropriate management programme (s).

The selection of the most appropriate management programme requires an in-depth assessment of a number of site-specific factors including characteristics of the Japanese knotweed infestation, identification of site-specific constraints and hazards, knowledge of the study area together with best practice guidance, expert opinion, and experience of the authors.

Project constraints will play a significant role in the selection of a programme. Any planning conditions laid down by the local authority; time available to achieve eradication; availability of suitable lands for burial on site; and the budget for the eradication of the Japanese knotweed, will all influence the decision-making process. Site constraints may also feature, for example, where bedrock or the water table is at or near surface level which could rule out burial of the vector material onsite, or indeed, where there is limited access to a site for trucks to facilitate the recovery and transportation of vector material offsite (see Section 3.4.1).

In addition, any hazards (see Tables 3.2 & 3.3) which could impact on the deployment of a management programme need to be identified such as the presence of receptors which are sensitive to the use of chemical herbicides. Restricted areas & receptors as per the Sustainable Use of Pesticides Directive (SUD Directive) and ecological receptors, require careful consideration, as these may pose limitations with regards to use of chemical herbicide (see Sections 3.4.2 & 3.4.3).

Environmental, occupational health & safety hazards should also be noted and tabulated as these may impact on the selection, practical implementation, and successful outcome of any recommended management programmes (see Section 3.4.4).

Table 2.1 Factors which may influence the approach to management

FACTORS
▪ Characteristics of the infestation *e.g.,* maturity, density, extent of rhizomes ▪ Project constraints ▪ Site constraints ▪ Presence of SUD restrictions and receptors ▪ Presence of ecological receptors ▪ Presence of environmental, occupational health & safety hazards ▪ Source of introduced vector material and pathways for dispersal ▪ Presence of disturbance regimes ▪ Potential for additional outliers due to ongoing disturbance regimes ▪ Best practice guidance notes and manuals

The presence of any such hazards and constraints should be identified via a desktop study and a walkover survey of the site of the proposed residential development. The hazards and constraints should be addressed in the preparation of the Risk Assessment and Method Statement for the management of Japanese knotweed, via the inclusion of relevant control measures. The deployment of the control measures will ensure a successful outcome from the selected management programme, in terms of eradication.

The control measures are also necessary to ensure that the management programme is deployed in accordance with best practice, relevant standards and environmental, waste, occupational health & safety legislation (see Section 8.0).

2.3 Types of Management Programmes

Once the most appropriate Management Programme for the eradication of invasive species within the site has been identified, the plan should then elaborate on the best practice methodology to complete the programme.

For example, there are typically 5 no. different management programmes which may be deployed to eradicate Japanese knotweed within a site. Please note a combination of one or more options may be required for some sites.

- Option 1: Deployment of a Chemical Herbicide Treatment Programme (*in situ*)
- Option 2: Recovery of Vector Material & Burial Onsite
- Option 3: Recovery of Vector Material & Disposal Offsite
- Option 4: Installation of Japanese Knotweed Rhizome Barrier
- Option 5: Recovery of Vector Material & Construction of a Bund Facility

Irish and UK best practice guidance notes and manuals are utilised to inform the selection of the most appropriate management programme for a site, and include the following:

- CIRIA (2008) CIRIA C679 Invasive species management for infrastructure managers and the construction industry.
- Environmental Agency (EA, 2013) Managing Japanese Knotweed on Development Sites: The Knotweed Code of Practice (**withdrawn 11th July 2016 by the EA**).
- EA (2016a) Guidance Note: Prevent Japanese knotweed from Spreading. Environment Agency, Natural England, and DEFRA.
- EA (2016b) Treatment & Disposal of Invasive Non-Native Plants: RPS 178.
- NetRegs Environmental guidance for your business in Northern Ireland & Scotland http://www.netregs.org.uk/environmental-topics/land/japanese-knotweed-giant-hogweed-and-other-invasive-weeds/.
- PCA (2014) Code of Practice for the Management of Japanese knotweed. Version 2.7.
- SEPA (2016) Biosecurity and management of invasive non-native species for construction sites and Controlled Activities.
- Welsh Government (2011) The Control of Japanese Knotweed (*Fallopia japonica*) in Construction and Landscape Contracts.

- NRA (2010) NRA Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Road Schemes.
- http://nonnativespecies.ie/risk-assessments/

3.0 METHODS

3.1 Study Site

The overall masterplan boundary encompasses 2 no. parcels of land Site A - 7.27ha approx. (to the north) and Site - B 1.31ha approx. (to the south) in area. Site A and Site B are located on Centre Park Road within the docklands area of Cork City at GPS coordinates 51.900226°, -8.442560° approximately 2km east of Cork City centre (see Figures 1.1-1.4).

3.2 Study Area

Site A and Site B are surrounded by urban industrial buildings, civil infrastructure, a sports stadium, a riverside walkway and marina and city streets categorised as Buildings and artificial surfaces (BL3). Namely, Centre Park Road, by Shandon Rowing Club and the Marina to the north, former ESB power station to the west and Páirc Uí Chaoimh stadium to the east.

In terms of habitats, Recolonising bare ground (ED3), Scrub/transitional woodland (WS1), Drainage ditches (FW4), Scattered trees and parkland (WD5), Ornamental/non-native shrubs (WS3) were recorded within the study area along with the River Lee located to the north which is a Tidal River (CW2) (see Photographs 3.1-3.6).

Site A is described as a "*brownfield site containing several storage containers and external storage areas. Ground levels vary across the site, with a high point along the northern boundary, varying between 5.3m at the western end and 3.6m at the eastern end. There are two open channels, one adjacent to the southern boundary and one adjacent to the northern boundary, which join at the eastern end of the site. The centre of the site generally falls from a high point of 2.67m to the open channels along the northern and southern boundaries"* (ARUP, 2022).

Site B is also a brownfield site containing a standing warehouse and a second partially demolished warehouse.

Bedrock

Both Site A and Site B are underlain by the Lee Valley Gravels Groundwater Body (GWB) IE_SW_G_094. There is no available initial characterisation for the Lee Valley Gravels GWB to describe its main aquifer lithology and other features.

According to the GSI Mapviewer, the bedrock beneath Site A of the proposed residential development, consists of Carboniferous "Flaser-bedded sandstone & mudstone" of the Cuskinny Member (Kinsale Formation) from the Dinantian series (https://dcenr.maps.arcgis.com). It is described as a "Flaser-bedded sandstones and lenticular-bedded mudstones; sand dominant". There is a fault zone located to the north of the site (GSI Mapviewer). Bedrock outcrops were not recorded within the site during the walkover survey.

Beneath Site B, the bedrock consists of a Carboniferous limestone "Dark muddy limestone, shale" of the Ballysteen Formation from the Dinantian series (https://dcenr.maps.arc

gis.com). Again, bedrock outcrops were not recorded within the site during the walkover survey.

Aquifer Classification

The Lee Valley Gravels GWB underlying Site A and majority of Site B, is considered to have bedrock which is Moderately Productive only in Local Zones and is categorised as a Locally Important Aquifer (Ll). The southern parcel is in part underlain by a Regionally Important Aquifer (Rkd) - Karstified (diffuse).

Quaternary Deposits

In terms of the subsoil overburden, both Site A and B are dominated by 'Urban' deposits (GSI Mapviewer).

Soils

According to the Teagasc Soil Maps (GSI Mapviewer) both Site A and Site B are also dominated by 'Made ground' (GSI Mapviewer).

Photographs 3.1 & 3.2 Habitats within Site A
(Source: O' Donovan Agri-Environmental Services)

Photographs 3.4 & 3.5 Habitats within Site A
(Source: O' Donovan Agri-Environmental Services)

Photographs 3.5 & 3.5 Habitats within Site B
(Source: O' Donovan Agri-Environmental Services)

Photographs 3.6 Habitats within Site B
(Source: O' Donovan Agri-Environmental Services)

3.3 Ground & Surface Water Features

3.3.1 Groundwater

Vulnerability

According to the EPA Mapviewer Site B is underlain by an aquifer with 'Moderate vulnerability" while Site A by a "Moderate" to "High vulnerability" aquifer.

Karstified features or landforms were not recorded during the walkover survey. There are no mapped springs, karst features or fault zones within the site (GSI Mapviewer). However, Site B is partially underlain by a karstified aquifer which is of "High vulnerability".

There is a fault zone located to the north of Site A (GSI Mapviewer).

According to the GSI Mapviewer, the closest known karst feature on contemporary mapping is Ballinlough Cave [1707SWK010] which is located 1.0km to the southeast.

Groundwater Flow

Based on the topography and contour data (OSi Webmapper), the overall groundwater flow direction in the bedrock aquifer is inferred as being from south to north towards the River Lee.

3.3.2 Surface water

Site A and Site B are located within the Water Framework Directive (WFD) Catchment Lee, Cork Harbour & Youghal Bay (Catch_ID:19).

There is a surface water feature in the form of a drainage stich on the northern, eastern, and southern boundaries of Site A.

There is also a drainage ditch on the northern boundary of Site B.

The drainage ditches and the storm water gullies within the sites and on the adjacent streets (which are connected to the stormwater network) outflow to the River Lee and Cork Harbour.

3.4 Detailed Desktop Study

In order to inform the selection of the most appropriate management programme for the overall masterplan, it is first necessary to identify any existing and potential site-specific hazards and constraints which could impact on its implementation *e.g.,* project and site constraints; SUD restrictions & receptors, ecological receptors and environmental, health & safety hazards (see Sections 4.4.1-4.4.4).

3.4.1 Project & Site Constraints

Project Constraints

The following project constraints will need to be reviewed with respect to identifying the most appropriate management programme, amongst others:

- Time available to achieve eradication *e.g.* the start and end date of the construction programme
- Volumes of vector material which require burial onsite/disposal offsite
- Budget available for eradication

- Responsibility for a monitoring programme
- Requirement for a Waste License under the Waste Management (Licensing) Regulations 2004 from the EPA to bury onsite
- Stewardship of an onsite burial cell
- Possibility that an onsite burial cell may impinge on future land uses and property values

Site Constraints

In addition to project constraints there are also a number of site constraints which may influence the selection of the management programme including:

- Type and location of existing and proposed infrastructure (above and below ground) within a site relative to the location of the Japanese knotweed infestation
- Distance between the Japanese knotweed infestation and the site boundary
- Risk of flooding events *e.g.,* pluvial, fluvial, or coastal flooding
- Potential for finds of archaeological interest
- Potential for contaminated soils *e.g.,* hydrocarbons, asbestos
- Extent of suitable lands available for burial onsite
- Accessibility to the site for trucks to facilitate the recovery and transportation of vector material offsite
- Requirement for traffic management at the site entrance to facilitate access onto the site by plant machinery and trucks
- Distance from a receiving waste facility for offsite disposal (impact of haulage costs of budgetary constraints)

A number of the project and site constraints will have a specific or greater influence on the practical implementation of certain management programmes as follows:

Option 1: Chemical Herbicide Treatment (*in situ)*

- Time available to achieve eradication (treatment *in situ* requires a number of years to achieve eradication)
- Proximity to an adjacent property
- Presence of receptors which are sensitive to the use of chemical herbicides
- Possibility that the ongoing presence of the infestation may impinge on access and use of a site, imminent construction works, future land uses and property values

Option 2: Recovery & Burial Onsite

- Requires a Waste License under the Waste Management (Licensing) Regulations 2004 from the EPA
- Volumes of vector material which require disposal: will influence size of burial cell; extent of rhizome barrier; and other costs associated with burial onsite
- Extent of suitable lands available for burial onsite *e.g.* depth to bedrock and water table, presence of services, distance from site boundary, infrastructure, watercourses, and designated conservation areas *etc*.
- Presence of overhead and underground power cables and other services
- Monitoring of the onsite burial cell

- Risk of regrowth (whether perceived or actual) from the burial cell
- Possibility that the permanent burial cell may impinge on future land uses and property values

Option 3: Recovery & Disposal Offsite

- Requires a license under Regulation 49(2) of the European Communities (Birds and Natural Habitats) Regulations 2011 to 2015 from NPWS
- Accessibility of the site for articulated or rigid trucks
- Budgetary constraints depending on volumes of vector material which require disposal
- Distance from a receiving waste facility for offsite disposal

3.4.2 SUD Restrictions & Receptors

Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 more commonly referred to as the 'Sustainable Use Directive' or 'SUD', aims to establish a framework for Community action to achieve the sustainable use of pesticides (including chemical herbicides). It was transposed into Irish law by Statutory Instrument No. 155 of 2012, European Communities (Sustainable Use of Pesticides) Regulations 2012. The European Communities (Sustainable Use of Pesticides) Regulations 2012 places additional restrictions and, in some cases, prohibitions, on the use of pesticides in certain restricted and sensitive areas (referred to herein as SUD restrictions & receptors).

These SUD restrictions & receptors include transport routes (such as railway lines); areas used by the general public or defined vulnerable groups (*e.g.* public parks, hospitals, public schools and public playgrounds); groundwater vulnerable landscape features; and Natura 2000 sites (see Table 4.3).

There are also safeguard zones or exclusion zones (see Table 4.1) where no plant protection products can be applied in order to protect surface water abstraction sources (*e.g.* areas for the abstraction of drinking water such as surface waters, springs, wells or boreholes) and groundwater vulnerable landscape features (*e.g.* karst areas, sinkholes or collapse features).

Table 3.1 Safeguard Zones for Open Wells, Boreholes and Water Abstraction Points

Water Source	Distance
Abstraction point of any surface waters, borehole, spring or well used for the abstraction of water for human consumption in a water scheme supplying 100 m^3 or more of water per day or serving 500 or more persons	200 m
Abstraction point of any surface waters, borehole, spring or well used for the abstraction of water for human consumption in a water scheme supplying 10 m^3 or more of water per day or serving 50 – 500 persons	100 m
Abstraction point of any surface waters, borehole, spring or well used for the abstraction of water for human consumption in a water scheme supplying 1-10 m^3 of water per day or serving 10-50 persons	25 m
Abstraction point of any surface waters, borehole, spring or well used for the abstraction of water for human consumption in a water scheme supplying 1m^3 or less of water per day or serving 10 or less persons	5 m

It should be noted that the gathering of data on SUD restrictions & receptors is essential to the preparation of a management plan, as the presence of any such constraints will underpin the ability to deploy chemical herbicides, including the type of chemical herbicide, timing of application and application methods. In this regard, chemical herbicides selected for use on any site should be fit for the purpose for which they are intended.

Details of permitted pesticides authorised for use by the Irish competent authority, the Pesticide Registration and Controls Divisions and the Pesticide Control Laboratory of the Department of Agriculture Food and the Marine (DAFM) can be found at http://www.pcs.agriculture.gov.ie/ (see Appendix I for further details). Consultation should be undertaken with a Registered Pesticide Advisor and/or the Pesticides Control Service where there is any doubt in relation to the safe use of herbicides.

Groundwater Vulnerable Landscape Features & Surface Water Abstraction Sources

In relation to the identification of Groundwater Vulnerable Landscape Features and surface water abstraction sources in the study area, the following Geological Survey of Ireland (GSI) and Environmental Protection Agency (EPA) databases were accessed on the OSI Geohive Mapviewer (http://map.geohive.ie/mapviewer.html), EPA (https://gis.epa.ie/EPAMaps/) and GSI (https: //dcenr.maps.arcgis.com/apps/webappviewer/):

- Groundwater Bodies WFD, EPA Water Maps
- Groundwater Vulnerability, GSI
- Groundwater Drinking Water Protection Areas, GSI
- Groundwater Karst Features, GSI
- Groundwater Wells & Springs, GSI
- Borehole Locations, GSI
- Public Water Supply Protection Areas, GSI
- WFD Register of protected areas (rivers, lakes & groundwater for drinking water), EPA
- Groundwater Bodies, Rivers and Lakes utilised for Drinking Water Abstraction, EPA

Further details on the initial characterisation of the relevant groundwater bodies in the study area was sought from the GSI and WFD websites including the Initial Characterisation of the groundwater body (GSI website) and Water Management Unit Action Plans (WFD website) and https://www.catchments.ie/data/#/waterbody/.

Natura 2000 Sites

A desktop review of the relevant technical literature and databases was undertaken for the site of the proposed residential development in order to identify the presence of any Natura 2000 sites [Special Areas of Conservation (SACs), Special Protection Areas (SPAs)] within the study area which could be impacted upon by the use of chemical herbicide (http://webgis.npws.ie/ npws viewer/).

3.4.3 Ecological Receptors

Aside from the sensitive ecological receptors identified under the SUD Directive, there are other ecological receptors which could be at risk from the use of chemical herbicide.

In this regard, the presence of other designated conservation areas *i.e.* Natural Heritage Areas (NHAs), proposed Natural Heritage Areas (pNHAs) or non-designated sites of ecological/ botanical interest within the site along with notable, rare, or protected flora or fauna were also identified.

There are also local ecological receptors such as trees, hedgerows, woodlands, small mammals, birds, pollinators, and aquatic species which could be impacted by the use of chemical herbicide.

3.4.4 Environmental, Occupational Health & Safety Hazards

In terms of the deployment of a management programme, there are various environmental, occupational health & safety hazards which need to be considered in order to avoid or minimise risks to persons who utilise, work or live within or adjacent to a site as follows:

- As above SUD restrictions and receptors
- Areas of high pedestrian traffic
- Vehicular and pedestrian traffic requiring traffic management
- Areas subject to flooding events *e.g.,* where instream or riverbank works are required
- Presence of overhead and underground power cables and other services
- Presence of other sensitive receptors *e.g.,* livestock, domestic pets, vegetables/crop
- Presence of non-target areas *e.g.,* adjacent dwelling houses, amenity grassland, gardens *etc.*

3.5 Walkover Survey

A detailed walkover survey of the proposed residential development was undertaken on the 14th December 2021. During the walkover survey the characteristics of the invasive species recorded was noted (see Section 4.5.1).

Information was also gathered on the events which may have led to the introduction of the vector material to the site; and, to identify any further risk of dispersal or indeed reintroduction of vector material to the site via a Source – Pathway – Receptor (S-P-R) Analyses.

The walkover survey also afforded an opportunity to identify any additional project and site constraints; and further SUD restrictions & receptors and ecological receptors which may be at risk, again via a Source – Pathway – Receptor (S-P-R) Analyses.

Any environmental, occupational health & safety hazards over and above those identified during the desktop study were also noted (see Sections 4.4.1 – 4.4.4).

3.5.1 Characteristics of the Infestation

During the walkover survey undertaken on the 14th December 2021, I.D. numbers were allocated to each of the infestations for the purposes of reporting on any changes to the baseline going forward. The locations were recorded utilising a GPS (Garmin Oregon 650t). Details of the following baseline information was captured during the walkover survey:

- Accurate records including GPS coordinates and mapping of the extent of above ground plant material and location of outliers during the optimum survey period (where possible) using a trundle wheel and tape measures
- Photographic record of the infestations as a baseline for treatment and monitoring
- Confirmation that a hybrid knotweed species is not present on site
- Nature (maturity, growth patterns, extent of radial or lateral growth) and extent of the infestation including outliers on the site and adjacent lands
- Presence or absence of shade (Japanese knotweed plants under shade often do not flower/seed prior to senescence)
- Seasonal constraints *e.g.* timing, flowering, senescence
- Variations in seasonal plant cycle due to local temperatures (day and night)
- Presence of flowering and seeds *e.g.* inflorescences, seed pods, *etc*.
- Details of plant growth stage *i.e.* shoots, immature plants, mature plants, bonsais, or other sub-lethal growth
- Above and below ground soil conditions (*e.g.* soil type, soil horizon layers, rocky outcrops, parent bedrock type and depth to water table)

Please refer to Section 4.0 for findings of the walkover survey.

3.5.2 Suboptimum Survey Period

The timing of the specialist survey in December 2021 is outside of the optimum survey period for those perennial invasive plant species which die back for the winter months, at the end of each growing season.

During walkovers in the suboptimum period, surveyors make every effort to minimise any seasonal survey constraints using their considerable previous field experience and expertise in carrying out surveys very late or early in the growing season. Typically, a second detailed specialist survey of a site would be undertaken during the optimum survey period; such that the preliminary survey findings can be validated in the absence of any seasonal constraints.

Japanese Knotweed

While Japanese knotweed dies back (goes into senescence) for the winter months and typically does not produce new growth until suitable temperatures are present in spring, the "woody" crowns and dead stems from the previous year's growing period may persist and can still be recorded during surveys carried out in winter and early the following spring.

Whilst such surveys are technically seasonally constrained and do not provide accurate information as to the full extent of an infestation, in the absence of recent disturbance, the presence of crowns and dead woody stems can provide a good proxy for the overall area of an infestation.

There does, however, remain a possibility that surveys undertaken outside of the optimum period could fail to detect the presence of immature plants or indeed an immature infestation which has not yet developed any woody stems (*i.e.* plants which are <2yrs old). Thus, a survey undertaken outside of the optimum survey period can fail to accurately confirm or detect (1) the presence/absence of an immature knotweed infestation (<2 years old) or (2)

the full extent of an infestation where there are immature outlier plants (<2 years old) scattered around a mature infestation.

Spanish Bluebell & Three-cornered Garlic

With respect to Three-cornered garlic (*Allium triquetrum*), new growth may start to appear within a site as early as September while Spanish bluebell (*Hyacinthoides hispanica*) clumps only start to appear in December each year.

Where possible, targeted surveys should be undertaken at the time of year when such species are in leaf *i.e.* Three-cornered garlic is in leaf from September to July, while Spanish Bluebell is typically in leaf from December through to July each year.

There is potential for small clumps of Spanish bluebell to have gone undetected given the extent of cover present, while the survey is outside of the growing period for Three-cornered garlic.

3.5.3 Disturbance & Plant Defence Mechanisms

In addition to seasonal constraints, invasive species may go undetected on a site, if there has been recent disturbance, burial, or soil importation.

It should also be noted that Japanese knotweed can survive for a number of years at considerable buried depths.

Japanese knotweed also exhibits a number of plant defence mechanisms including a response to inappropriate chemical herbicide treatment, known as chemically dormancy, where the plant can remain dormant beneath the ground for a number of years with no above ground leafy green growth (see Appendix II).

It also has the ability to produce a 'bonsai' growth form in response to inappropriate chemical herbicide treatment or cutting. This defence mechanism enables the plants to develop into a cryptic miniature growth form. As a result, it is possible, in the absence of a thorough systematic survey, for outliers to go undetected even if surveys are undertaken during the optimum survey period (see Appendix II).

During walkover surveys, surveyors make every effort to detect the presence Japanese knotweed, using their considerable previous field experience and expertise in carrying out such surveys.

3.5.4 Classification & Legislation

All non-native and potentially invasive species recorded within the site were subsequently checked for a 'listing' under the following risk assessments, classifications, guidance documents and websites (please refer to Appendix I for further details):

- Invasive Species Ireland - risk assessment and classification
- National Biodiversity Data Centre - risk assessment and classification
- NRA (2010 revised) Guidelines on the Management of Noxious Weeds and Non-native Species on National Roads
- Department of Agriculture, Food, and the Marine (DAFM) - Plant Health Trade webpage

All non-native and potentially invasive species recorded were also checked for a listing under the following relevant legislation:

- EU Regulation 1143/2014 on Invasive Alien Species
- Third Schedule: Part 1 of European Communities (Birds and Natural Habitats) Regulations, 2011 (S.I. No. 477 of 2011) to 2015, as amended.

Please refer to Section 4.3 for findings in relation to the classification of the species recorded within the site and relevant legislation.

3.6 Source-Pathway-Receptor Analyses

A Source-Pathway-Receptor (S-P-R) model is typically applied to assist in determining the potential for indirect or secondary impacts. A number of factors need to coexist in order for an indirect or secondary impact to occur. Firstly, there must be a risk enabled by the presence of a "*source*" of impact, followed by the existence of a "*receptor*" in the wider environment and a "*pathway*" connecting the source to the receptor. This is referred to as a complete Source-Pathway-Receptor chain.

The source refers to the confined or discrete point from which the impact is released into the environment, the pathway is the route by which the particular impact then travels through the environment and the receptor is the location where the impact occurs.

With respect to the management of Japanese knotweed S-P-R Analyses is a useful tool which can be utilised to assess potential risk of the following indirect impacts:

- Risk of Dispersal (see Section 3.6.1)
- Risk of Water Pollution (see Section 3.6.2)
- Risk of Exposure to Spray Drift (see Section 3.6.2)

Table 3.2 Risk of Dispersal

Source – Pathway – Receptor (S-P-R) Chains
Sources or Origins ▪ Imported soil, gravel, other stone material ▪ Stem fragments from cutting or strimming ▪ Lateral growth from an adjacent property
Pathways for Dispersal ▪ **Land** *e.g.* disturbed soils ▪ **Air** *e.g.* strimming, seeds ▪ **Water** *e.g.* drainage ditches, streams, rivers, canals, culverted drainage ditches or stream and gullies leading to a waste or storm water network outfalling to a watercourse or other water features
Disturbance Regimes ▪ **Physical** *e.g.* soil disturbance, cutting, grazing ▪ **Chemical** *e.g.* inappropriate spraying ▪ **Natural** *e.g.* rain, flooding, storms

Dispersal mechanisms

- **Biotic** dispersal mechanisms *e.g.* zoochory, hydrochory, anemochory *etc*.
- **Abiotic** dispersal mechanisms *e.g.* agochory, hemerochory, anthropochory *etc.*
- **Vectors** *e.g.* insects, animals, people (footwear), wind, water, tyres of vehicles *etc*.

3.6.1 Risk of Dispersal

With respect to the risk of dispersal of Japanese knotweed vector material within the site of the proposed residential development, an S-P-R Analyses was carried out in order to gather information on the events which led to the introduction of the vector material to the site and to identify any ongoing disturbance regimes which could lead to further dispersal of Japanese knotweed within the site.

The S-P-R Analyses was also utilised to assess the potential risk of vector material being reintroduced to the site at a future date and to identify any control measures which need to be deployed to avoid the repetition of such an event (see Table 4.2).

The following information was collated to inform the S-P-R Analyses:

Dispersal

- Presence of disturbance regimes including disturbed land
- Presence of 'bonsai's', outliers, or evidence of lateral growth
- Presence of sub-lethal bonsai regrowth or chemically dormant Japanese knotweed
- Type and location of existing and proposed infrastructure (above and below ground) within a site relative to the location of the Japanese knotweed infestation
- Distance of the Japanese knotweed infestation from the site boundary
- Socio-demographics of persons with access to the site

Reintroduction

- Planned construction or landscaping works
- Importation of soil, stone to the site
- Presence of Japanese knotweed in adjacent lands

3.6.2 Risk of Water Pollution & Exposure to Spray Drift

An S-P-R Analyses was also completed in respect of the potential for indirect impacts on water quality arising from the use of chemical herbicide or the accidental spillage or release of hydrocarbons from machinery and equipment utilised in the deployment of chemical herbicide. There is also the potential risk of exposure of vulnerable groups, sensitive ecological receptors, and non-target areas to 'spray drift' during the deployment of chemical herbicide. Examples of potential sources, pathways and receptors are detailed in Tables 4.3 and 4.4.

During the walkover survey particular focus was paid to the presence of receptors which may be at risk from the use of chemical herbicide and hydrocarbons. A number of web browsers and geobrowsers Google Streetview, Google Earth Pro and Ordinance Survey Irelands Geohive Mapviewer (http://map.geohive.ie/map viewer.html) were utilised in advance of the walkover to assist in a more targeted survey of these features.

Table 3.3 Risk of Water Pollution & Exposure to Spray Drift

Water Pollution & Exposure to Spray Drift
Sources ▪ Leakage/spillage during pouring/mixing/spraying of chemical herbicide ▪ Spray drift of chemical herbicide due to wind or inappropriate/defective equipment ▪ Leakage/spillage during pouring of hydrocarbons when refuelling, or oils and greases (lubricants) and hydraulic fluids utilised in the maintenance of vehicles or equipment or from poorly maintained or malfunctioning vehicles or equipment
Pathways ▪ Stormwater gullies and stormwater drainage networks ▪ Watercourses ▪ Overland surface water flows ▪ Percolation to groundwater ▪ Karstic systems
Receptors *Chemical Herbicide* ▪ SUD Restrictions & Receptors ▪ Ecological receptors ▪ NPWS Circular Letter 2/08 *i.e.* Natura 2000 sites, Annex IV species, wild birds, and their habitats ▪ Non-target areas *e.g.* dwelling houses, amenity grassland, gardens *etc*. ▪ Any other site-specific sensitive receptors *Hydrocarbons* ▪ As above ▪ Presence of karstified features or landforms, shallow bedrock, fault zones ▪ Any other site-specific sensitive receptors

Table 3.4 Details of SUD Restrictions & Ecological Receptors

SUD Restrictions & Ecological Receptors

SUD Restrictions & Receptors

- Areas of general public use *e.g.,* playgrounds, parks, footpaths
- Presence of defined vulnerable groups *e.g.,* elderly, pregnant mothers, young children
- Transportation routes *e.g.,* railway corridors
- Sealed surfaces
- Groundwater vulnerable landscape features *e.g.* springs, karst features
- Drinking water abstraction sources *e.g.,* well, borehole, spring, surface water
- European Sites *i.e.* Natura 2000 sites
- Any other SUD restrictions and receptors

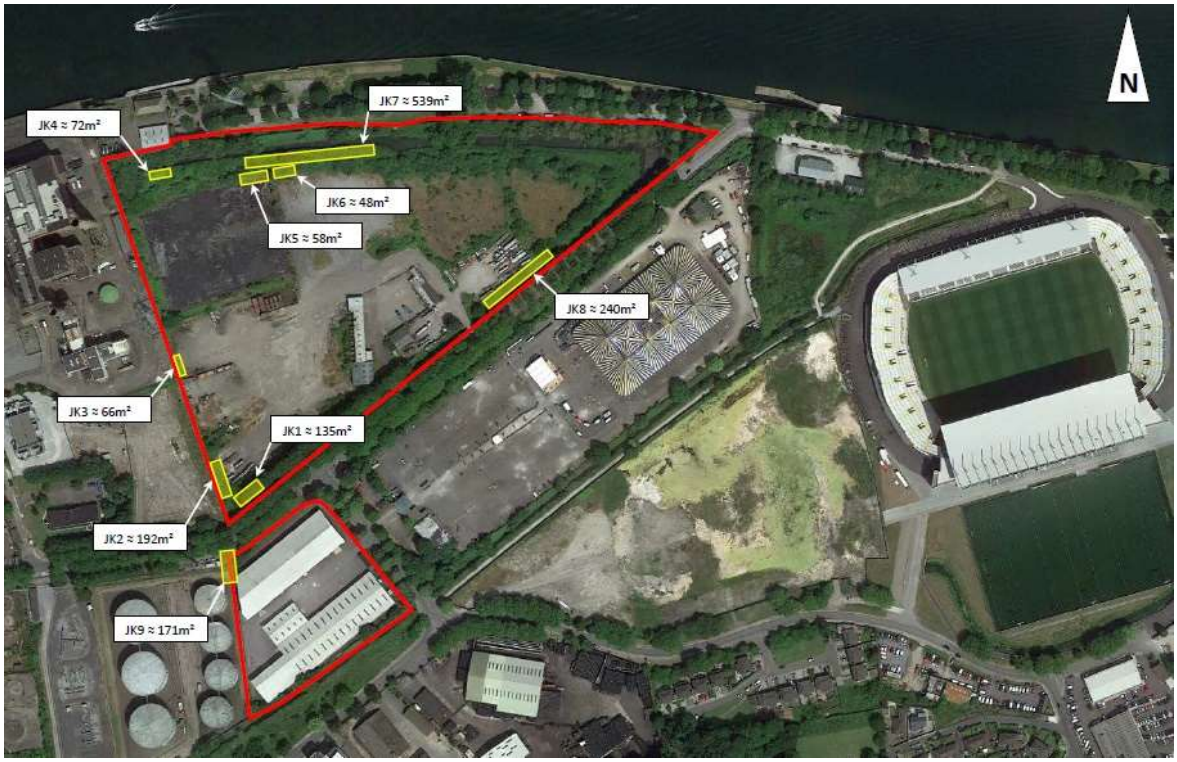
Ecological Receptors

- Other designated conservation areas *i.e.* NHAs and pNHAs
- Habitats and species as per NPWS Circular Letter 2/08 *i.e.* Natura 2000 sites, Annex IV species, wild birds, and their habitats
- Notable, rare, or protected flora and fauna
- Surface waterbodies *e.g.* Drainage ditch (FW4), Depositing lowland river (FW2), Eroding upland river (FW1), ponds, lake, and other aquatic habitats
- Groundwater dependant terrestrial ecosystems (GWDTEs) located down gradient
- Surface water dependant terrestrial ecosystems (SWDTEs) located downstream
- Adjacent ecological receptors *e.g.* trees, hedgerows and woodlands, pollinators, birds, and small mammals
- Any other site-specific ecological constraints

4.0 EXTENT OF INVASIVE SPECIES

4.1 Extent of Japanese Knotweed

During the walkover survey on the 14th December 2021, Japanese knotweed was identified at *n = 8* locations within the overall masterplan boundary (see Figures 4.1-4.2 and Table 4.1).



Photograph 4.1 Extent of Japanese Knotweed within the Overall Masterplan (Source: ARUP)

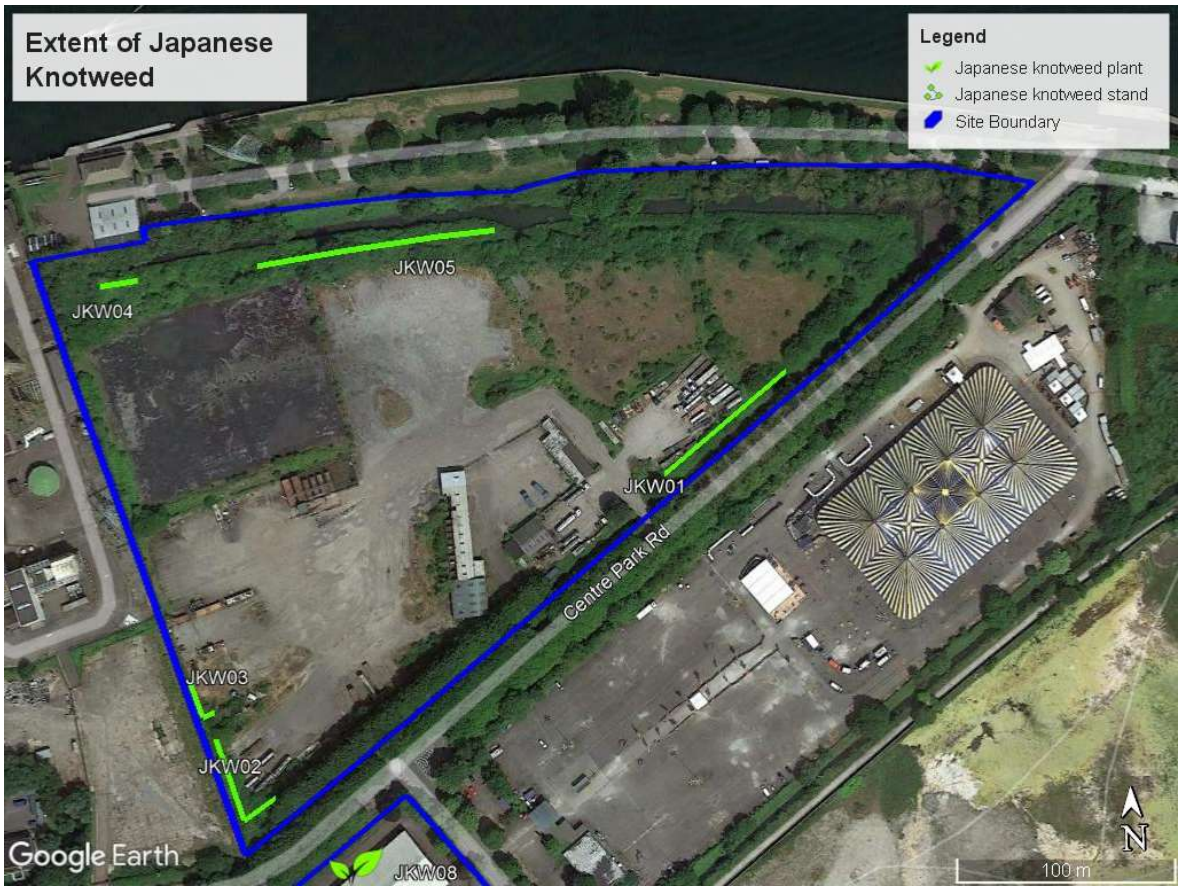
Within Site A, Japanese knotweed was recorded at JKW01–JKW05. The presence and diameter of the "crown" structures, within the stands, would indicate the plants are at least 10 years old. The largest and most mature stands were located at JKW01, JKW04 and JKW05 in the 4.7ha subsite. JKW04 and JKW05 are located along the bank of a large open drainage ditch on the northern boundary of the site (see Figure 4.2).

The specialist survey did not identify Japanese knotweed at JK3 in Site A as per Figure 4.1, however, a knotweed stand (JKW03) was recorded further south along the same boundary (see Figure 4.2). This is likely due to a drafting error.

Japanese knotweed was also recorded within Site B at JKW06-JKW08 (see Figure 4.3).

Additional Japanese knotweed plants over and above those identified in Site B, as per Figure 4.1, were recorded to the rear of the warehouse *i.e.,* JKW07 and JKW08 (see Figures 4.2-4.3). Of note is that JKW07 and JKW08 appear to be growing out from beneath the foundation of the remaining warehouse structure in Site B. JKW06 is located in close proximity to an open drainage ditch on the northern boundary of Site B (see Figure 4.3).

More specific details on the extent of Japanese knotweed in m.sq. at JKW01-JKW08, will be gathered during the targeted specialist site investigation works, to determine volumes of vector material, as the works will make the stands more accessible for surveying (see Section 7.1).



Photograph 4.2 Extent of Japanese Knotweed within Site A
(Source: O' Donovan Agri-Environmental Services)

4.2 Extent of Other Invasive Species

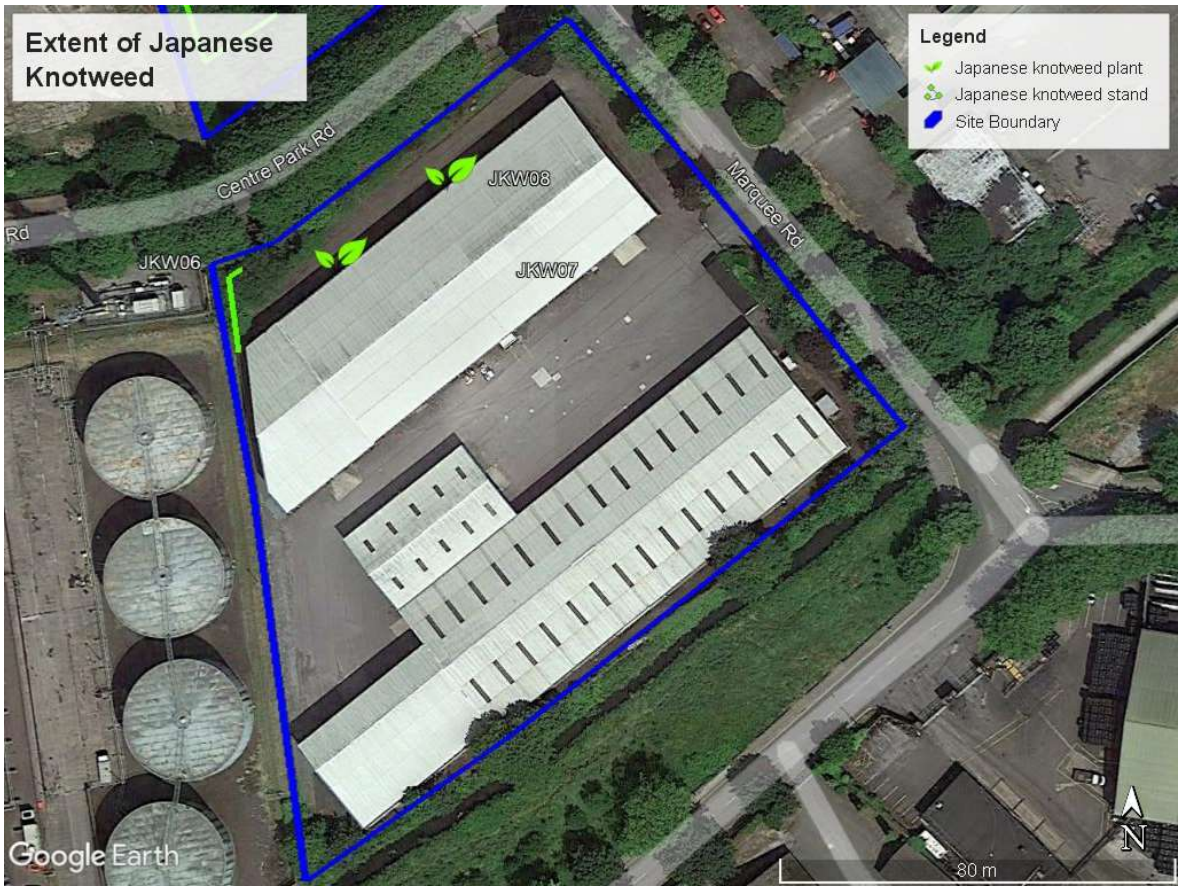
In addition to Japanese knotweed, Buddleia (*Buddleia davidii*), Traveller's joy (*Clematis vitalba*), 2 no. *Cotoneaster* spp., Montbretia (*Crocosmia* x *crocosmiiflora*), Winter heliotrope (*Petasites fragrans*) and Pampas grass (*Cortaderia selloana*) were also recorded at various locations within Site A and Site B (see Table 4.2). Of these species Buddleia was found to be the most dominant invasive species across the entire survey area.

4.3 Classification & Legal Obligations

A total of *n = 8* potentially invasive alien plant species were recorded within the overall masterplan boundary during the walkover survey on the 14th December 2022 (see Table 4.3).

None of the invasives recorded are a regulated species on the "Union list" of 49 No. species under EU Regulation on Invasive Alien Species 1143/2014 ((see http://ec.europa.eu/environment/nature/invasivealien/index_en.htm).

Some of the core provisions of EU Regulation 1143/2014 deal with, among other things, bringing into the territory of the Union, keeping, breeding, transporting, and placing on the market, species included on the list of invasive alien species of Union Concern (*i.e.,* the 'Union list').



Photograph 4.3 Extent of Japanese Knotweed within Site B
(Source: O' Donovan Agri-Environmental Services)

Japanese knotweed is listed under Irish legislation *i.e.* the Third Schedule: Part 1 of the European Union (Birds and Natural Habitats) Regulations 2011 to 2015.

Japanese knotweed is also listed on the Third Schedule: Part 3 which governs the movement of soil or spoil taken from places infested with Japanese knotweed (http://www.irishstatutebook.ie/eli/ 2011 si/477/made/en/print).

Plants listed under the Third Schedule: Part 1: Plants and Part 3: Vector Materials are subject to restrictions under Regulations 49 & 50. Part 3: Vector Materials refers to soil or spoil taken from places infested with Japanese knotweed (*Fallopia japonica*). Regulation 49 deals with the 'Prohibition on introduction and dispersal' while Regulation 50 deals with the 'Prohibition on dealing with and keeping certain species'.

Regulation 50 has yet to be enacted into Irish law. A licence is required from NPWS under Regulation 49(2) to transport vector material off a site.

A Waste License is required under the Waste Management (Licensing) Regulations 2004 from the EPA to bury soil contaminated with vector material within a site.

Table 4.1 Japanese Knotweed at JKW01 – JKW08

Photographs	Details
JKW01	
	Specialist survey on the 14th December 2021
JKW02A	
	Specialist survey on the 14th December 2021

JKW02B	
	Specialist survey on the 14th December 2021

JKW03	
	Specialist survey on the 14th December 2021

JKW04	
	Specialist survey on the 14th December 2021

JKW05A	
	Specialist survey on the 14th December 2021

JKW05B	
	Specialist survey on the 14th December 2021

JKW06A	
	Specialist survey on the 14th December 2021

JKW06B	
	Specialist survey on the 14th December 2021

JKW07	
	Specialist survey on the 14th December 2021

JKW08	
	Specialist survey on the 14th December 2021

Japanese knotweed is classified by the National Biodiversity Data Centre (NBDC) as an invasive species with a "High Impact", while Traveller's joy, Buddleia and Pampas grass are deemed "Medium Impact' species by the NBDC.

Japanese knotweed, Travellers joy, Montbretia, Winter heliotrope and Buddleia are included in the NRA Guidelines on the Management of Noxious Weeds and Non-native Species on National Roads (NRA, 2010) as these species have been shown to have an adverse impact on landscape quality, native biodiversity or infrastructure (https://www.tii.ie/technical-services/environment/planning/).

Japanese knotweed, Traveller's joy and Montbretia are also listed by the Department of Agriculture, Food and Marine (DAFM) on their Plant Health Trade webpage (https://www.agriculture.gov.ie/dontriskit/alieninvasivespecies/).

While Traveller's joy, Montbretia, Winter heliotrope and the 2 no. *Cotoneaster* spp., have not been classified as 'high' and or 'medium' impact species, or have yet to be risk assessed, they are recognised as having invasive qualities and under certain environmental conditions are known to spread locally.

For the purposes of clarity, the 2 no. *Cotoneaster* spp. recorded were not identified as Wall Cotoneaster (*Cotoneaster horizontalis*) a "Medium impact" species.

Table 4.2 Other Invasive Species Recorded Within Site A & B

Photographs	Details
Buddleia	
	Specialist survey on the 14th December 2021
Travellers Joy	
	Specialist survey on the 14th December 2021

Winter Heliotrope	
	Specialist survey on the 14th December 2021

Cotoneaster sp.	
	Specialist survey on the 14th December 2021

***Cotoneaster* sp.**	
	Specialist survey on the 14th December 2021
Pampas Grass	
	Specialist survey on the 14th December 2021

Montbretia	
	Specialist survey on the 14th December 2021

Table 4.3 Invasive Alien Plant Species (IAPS) Recorded

No.	Species Name	EU Regulation 1143/2014	Habitats Regulations 2011 to 2015	NBDC Impact Level	NRA (2010)	DAFM
1	Japanese knotweed		*✓	High Impact	✓	✓
2	Traveller's joy			Medium Impact	✓	✓
3	Buddleia			Medium Impact	✓	
4	Pampas grass			Medium Impact		
5	Montbretia				✓	✓
6	Winter heliotrope				✓	
7/8	*Cotoneaster* spp.					

*Part 1: Plants and Part 3: Vector Materials

5.0 SOURCE-PATHWAY-RECEPTOR ANALYSES

This section of the management plan describes the findings of the Source-Pathway-Receptor Analyses in relation to the risk of dispersing Japanese knotweed within the lands of the overall masterplan boundary and the potential for indirect impacts on water quality arising from the use and/or accidental spillage or release of chemical herbicide or hydrocarbons, from machinery and equipment utilised in the deployment of chemical herbicide.

There is also the potential risk of exposure to 'spray drift' by vulnerable groups, areas of general public use, sensitive ecological receptors and non-target areas during the deployment of chemical herbicide. Examples of potential sources, pathways and receptors are detailed in Tables 5.1 and 5.2.

5.1 Risk of Dispersal

Sources

The walkover survey to identify the potential source of Japanese knotweed vector material and the presence of site-specific disturbance regimes which could result in the dispersal of Japanese knotweed, was undertaken on the 14th December 2021 (see Table 5.1).

It should be noted that there are several potential sources of vector material which could result in the reintroduction and further spread of Japanese knotweed within the overall masterplan boundary in the future (see Table 5.1). These include the importation of vector material within soil, stone, and other material and on machinery or equipment required for site investigation, vegetation removal, demolition, construction, and landscaping works and as a result of the fly-tipping of waste. In the absence of control measures, there is a risk that vector material could be reintroduced to the Site A and Site B via these sources.

Pathways for Dispersal

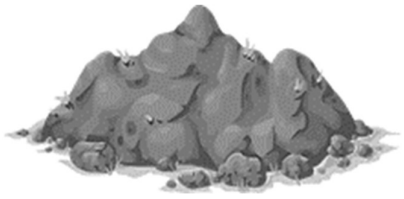
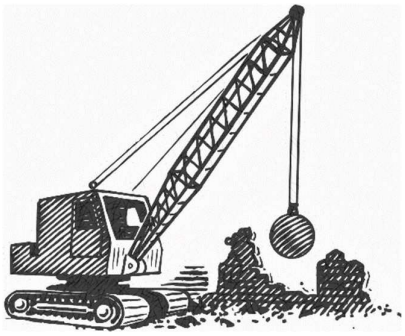
In the event that the Japanese knotweed is not managed in a timely manner there is a high risk that Japanese knotweed will be dispersed within the overall masterplan boundary given the requirement for Geotechnical Site Investigation, vegetation removal, demolition, construction and landscaping works.

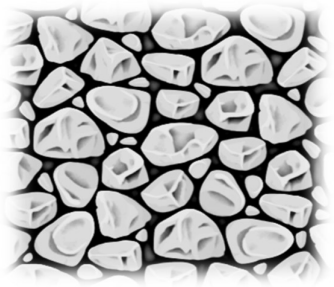
The risk of dispersing Japanese knotweed within the overall masterplan boundary will arise where vector material becomes adhered to (1) the footwear of site personnel/staff, surveyors, and visitors to the site, (2) the tyres of construction related and domestic vehicles in the car park, (3) buckets, tyres, and tracks of plant machinery and on construction/landscaping equipment, or (4) is carried within soil loads.

Vector material could also be transferred to other sites within soil loads, waste arising from demolition and landscaping works, on domestic vehicles, plant machinery and on geotechnical site investigation/vegetation removal/demolition/construction and landscaping equipment.

There is also a risk to land-uses and habitats downstream of the overall masterplan boundary, if viable rhizome or stem fragments were to gain entry into the drainage ditches or washed into stormwater gullies within Site A or Site B, which are connected to the stormwater drainage network which outflow to the River Lee and Cork Harbour.

Table 5.1 Disturbance Regimes at the Proposed Residential Development, Centre Park Road

Disturbance Regime	Description	Control Measures
	**Soil movement** Risk of dispersing vector material in soil loads and on associated plant machinery, site personnel within the site.	Soil movement within the overall masterplan boundary at Centre Park Road should not be undertaken unless authorised by the IAPS Specialist Ecologist.
	**Geotechnical Site Investigation & Demolition works**	Biosecurity measures to be deployed under the supervision of the IAPS Specialist.
	**Mowing, Strimming & Vegetation Removal**	Mowing & strimming, or other vegetation removal is not permitted within the overall masterplan boundary unless authorised by the IAPS Specialist Ecologist.
	**Site Clearance & Main Construction Stage** Risk of dispersing vector material in the form of plant fragments by site personnel, site vehicles, plant machinery and visitors to the site.	Biosecurity measures to be deployed under the supervision of the IAPS Specialist.

Disturbance Regime	Description	Control Measures
	**Chemical Herbicide Treatment**	Chemical herbicide should only be deployed by an IAPS Specialist Contractor.
	**Wind** There is a risk of the dispersal of plant fragments by wind.	Monitoring and walkover surveys should be undertaken to identify any new outliers for incorporation into the management programme.
	**Importation of Topsoil, Subsoil, Stone, or Fill** There is a risk of introducing invasive species to the Residential development, No. 31-33 Centre Park Road.	Imported topsoil, subsoil and stone into the site should be certified to BS 3882:2015 and BS 8601:2013 to ensure that it is free from IAPS vector material.

During the chemical herbicide treatment process and the recovery of Japanese knotweed vector material there is also a risk pertaining to the accidental dispersal of fragments on the footwear of the Registered Professional User's (RPUs) in the absence of appropriate biosecurity measures.

In the event that the Japanese knotweed was left untreated within the site over a prolonged period of time, there is also a risk that it may spread by lateral growth of rhizomes beneath the ground.

Receptors

Where Japanese knotweed is not adequately managed within the overall masterplan boundary, the adjacent land-uses in the vicinity of the site may be at risk from Japanese knotweed (see Section 3.1 for details).

5.2 Risk of Water Pollution & Exposure to Spray Drift

Sources

While a considerable volume of chemical herbicide will need to be deployed to treat the extensive Japanese knotweed within the overall masterplan boundary, in particular Site A, there is a low risk of contaminants entering groundwater flow paths in Site A and in the northern half of Site B given the nature of the overburden and underlying aquifer.

While there is a higher risk of contaminants gaining entry to the karstified aquifer in the southern half of Site B, there are no invasive species present as the Japanese knotweed is confined to the north-eastern boundary of Site B.

There is also a risk of contaminants entering surface waters via the drainage ditches on the boundaries of Site A and Site B. In particular, during the application of chemical herbicide to JKW04 and JKW05 on the banks of the drainage ditch in Site A, and to JKW06 on the banks of the drainage ditch in Site B.

The accidental spillage or release of larger volumes of chemical herbicide or undiluted herbicide during pouring/mixing/spraying could result in the release of a higher concentration or volume of contaminants.

Given the maturity *i.e.* height of the infestation there is a potential requirement for the use of a Mobile Elevated Work Platforms (MEWPs) and/or compact tractor, in the deployment of herbicide within Site A. In this regard, there is also potential for the accidental spillage or release of hydrocarbons in terms of fuels, oils, greases, and hydraulic fluids.

Pathways for Contaminants

It should be noted that contaminants such as chemical herbicides and hydrocarbons, not only cause localised direct impacts at the spill zone but can also gain access to groundwater, enter surface waters via overland flows and stormwater drainage networks (where present), and finally, can enter surface waters and adjacent lands or habitats via seepages.

Given the absence of bedrock at or near the surface, there is limited hydrogeological connectivity via the direct entry of contaminants to the underlying aquifer or percolation through the overburden in Site A and in the northern half of Site B.

Based on the topography, the overall groundwater flow direction in the bedrock aquifer is inferred as being from south to north. Given the overall direction of the groundwater flow paths, any contaminants which manage to gain entry to groundwater could impact on receptors located downgradient, to the north of the overall masterplan boundary, including the drainage ditches on the northern boundaries, the River Lee and Cork Harbour.

There is also hydrological connectivity between the overall lands and the River Lee and Cork Harbour via the drainage ditches and stormwater gullies within and adjacent to the site. The drainage ditches and stormwater gullies are connected to the stormwater drainage network which discharges to the River Lee and Cork Harbour.

The third and final pathway is the risk of spray drift during the foliar application of chemical herbicide in circumstances where chemical herbicide is deployed during windy conditions or

as a result of the use of inappropriate/defective equipment. Spray drift may travel on the wind, from the use of chemical herbicide within the overall masterplan boundary, and into adjacent properties or land uses.

5.3 SUD Restrictions & Receptors

The following sections identify the various SUD restrictions & receptors which are at risk from the use of chemical herbicide via the pathways identified in Section 5.2.

5.3.1 Areas of General Public Use & Defined Vulnerable Groups

Given that the Japanese knotweed is to be treated within an urban environment there is a risk that a defined vulnerable group could be exposed to chemical herbicide *e.g.* pregnant mothers, elderly persons and children utilising the adjacent public footpath on Centre Park Road, the car parking area and riverside walk along the River Lee, and Shandon Boat Club, and any employees working in adjacent civil or industrial infrastructure.

In summary, there is a potential risk of impacts to the following groups, from the deployment of chemical herbicide to Japanese knotweed within the overall masterplan boundary:

- Members of the general public utilising the adjacent footpath on Centre Park Road, the carparking and walkway along the River Lee, and Shandon Boat Club
- Members of vulnerable groups including children, elderly and pregnant mothers utilising the adjacent footpath on Centre Park Road, the car parking and riverside walkway along the River Lee
- Members of the general public working within adjacent civil infrastructure, industrial units and Shandon Boat Club

Control measures should be deployed to ensure that members of these vulnerable groups and the general public, in particular children, the elderly and pregnant mothers do not come into contact with chemical herbicide. The control measures will focus on minimising spray drift and the avoidance of interactions with these groups when deploying chemical herbicide. These measures will include timing of spraying, preventing access to the areas requiring chemical herbicide treatment and strict adherence to best practice guidance and instructions on the Product Label in order to minimise spray drift (see Section 8.0 for further details).

5.3.2 Groundwater Vulnerable Landscape Features

The results of the desktop study confirmed that while there are no mapped groundwater vulnerable landscape features such as springs or fault zones within the site (GSI Mapviewer) which could be at risk from the use of chemical herbicide, a karstified aquifer is present within the southern half of Site B.

Bedrock outcrops, karstified features or landforms were not recorded within the site during the walkover survey. According to the GSI Mapviewer, there is also a fault zone located to the north. The closest known mapped karst feature is Ballinlough Cave 1707SWK010 which is located 1.0km to the southeast (GSI Mapviewer).

As the use of chemical herbicide is not proposed in the southern half of Site B, there is minimal risk to the karstified aquifer.

5.3.3 Surface Water Abstraction Zones/Drinking Water

The potential for Public Water Supply Schemes, Group Water Schemes, and private supplies within 5km of overall masterplan boundary was examined to assess any potential risk to drinking water supplies from the use of chemical herbicide.

Public Water Supply Schemes (PWSSs)

The public water supply for Cork City and environs is the Lee Road Water Treatment Plant (LRWTP) located immediately upstream of the Salmon Weir on the River Lee. While there is hydrological connectivity between the lands within the overall masterplan boundary and the River Lee, the drainage ditches and the stormwater network within Site A and Site B outfall to the River Lee downstream of the Salmon Weir. Therefore, no constraint exists in relation to this drinking water abstraction zone.

There is no known well on site.

National Federation of Group Water Schemes (NFGWS)

There are no NFGWS drinking water abstractions within 5km of the site (Ireland's Group Water Schemes (nfgws.ie).

Table 5.2 Potential Groundwater Abstraction Sources

Abstraction Type	Yield (m^3)	Data Source	Distance	Connectivity
		Groundwater Abstractions		
Borehole 1407SEW065	1527.75 (Excellent)	GSI	1.875m to SW	1955
Borehole 1407SEW061	Unknown	GSI	1010m to W	1964
Conglomerate of boreholes Glover SI Ltd.	Unknown	GSI	935m	2002. Described as window sampler. No connectivity
Ballyphilip WS1707SWW085	27.3 (poor)	GSI	1275 to SE	1899
Conglomerate of boreholes	Unknown	GSI	460m to S	1998

Groundwater Source Protection Area

The closest Groundwater Source Protection Area is located greater than 10km to the north and south of the overall masterplan boundary at Minane Bridge and Carrignavar.

Boreholes, Wells & Springs

The results of the desktop study for vulnerable landscape features identified a number of historic groundwater fed supplies *i.e.* wells and boreholes within the study area in the vicinity of the overall masterplan boundary (see Table 5.2). A conglomerate of recent boreholes

(2002) was identified; however, these were described as being for window sample purposes (GSI Mapviewer).

Consultation is required with Cork City Council to confirm that these wells are no longer in use/there is no risk to water supplies (see Table 5.2).

While there is potential for additional private wells which may not be indicated on the GSI Mapviewer, the city is generally served by the local authority main drinking water supply rather than directly from groundwater wells, therefore, active domestic private wells are not likely to be located within the study area. It is therefore not envisaged that local domestic water supplies will be impacted by the use of chemical herbicides.

In light of the above, it is unlikely that drinking water supplies will be impacted by the use of chemical herbicide within the lands of the overall masterplan boundary.

5.3.4 Natura 2000 Sites

As per Section 5.2, there are hydrological pathways between the overall masterplan boundary and the River Lee/Cork Harbour via the presence of 1st order drainage ditch tributaries and the stormwater drainage network which also outfalls to the River Lee and Cork Harbour.

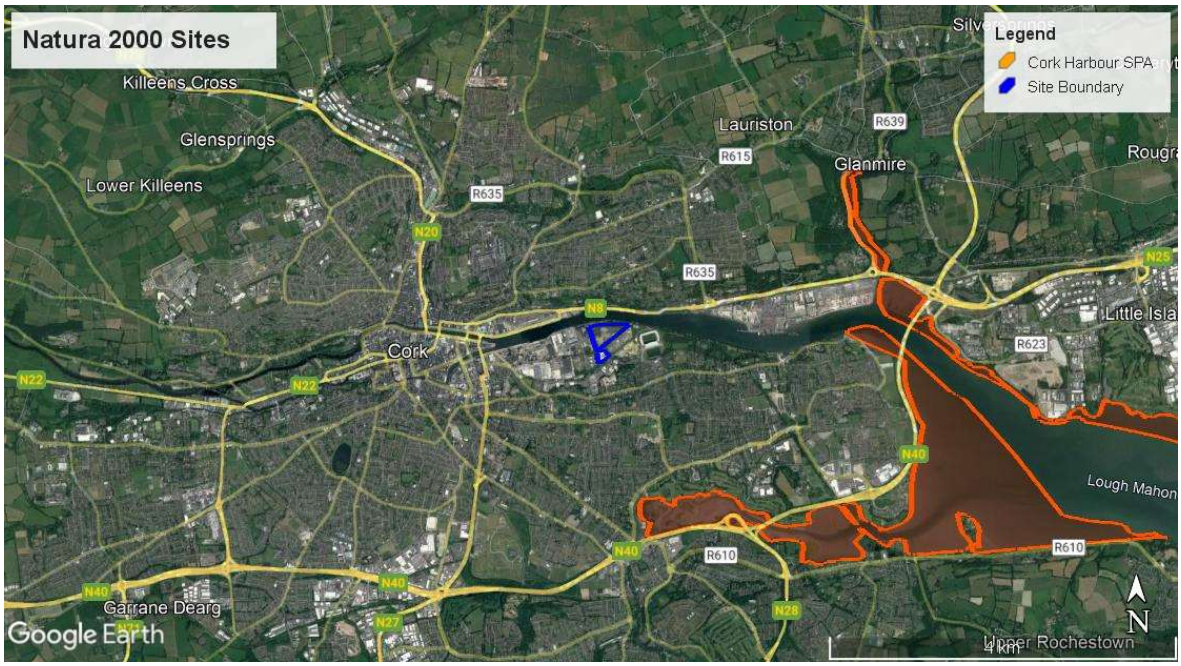


Figure 5.1 Distance from Natura 2000 Sites
(Source: Google Earth Pro and NPWS Map Data)

While a karstified aquifer, underlies the southern half of Site B, there is no requirement to utilise chemical herbicide at this location, given that the Japanese knotweed in Site B is confined to the north-eastern boundary. In this regard there is limited potential hydrogeological pathways between the lands within the overall masterplan boundary and any ecological receptors located downgradient or to the north of the proposed residential development *i.e.* the River Lee and Cork Harbour.

In the event that chemical herbicide was to percolate into the karstified aquifer or gain entry to the drainage ditches or stormwater network (via storm water gullies within the site) there is a low risk of impacts to the lower reaches or the brackish intertidal zone of the River Lee and the marine habitats of Cork Harbour which are designated as Cork Harbour SPA (Site Code: 004030), located at least 2.4km (at its closest point) to the east of proposed residential development, given the distance and dilution effects.

5.4 Ecological Receptors

In addition to the Natura 2000 sites identified in Section 5.3.4, the lower reaches of the River Lee and the marine habitats of Cork Harbour are also designated as Douglas River Estuary proposed National Heritage Area [1]pNHA (Site Code: 001046) and Dunkettle shore pNHA (Site Code: 001082).

In the event that chemical herbicide was to percolate into the karstified aquifer or gain entry to the drainage ditches or stormwater network (via storm water gullies within the site) there is a low risk of impacts to Douglas River Estuary pNHA and Dunkettle Shore pNHA located at least 1.9km (at the closest point) to the east of the overall masterplan site, given the distance and dilution effects.

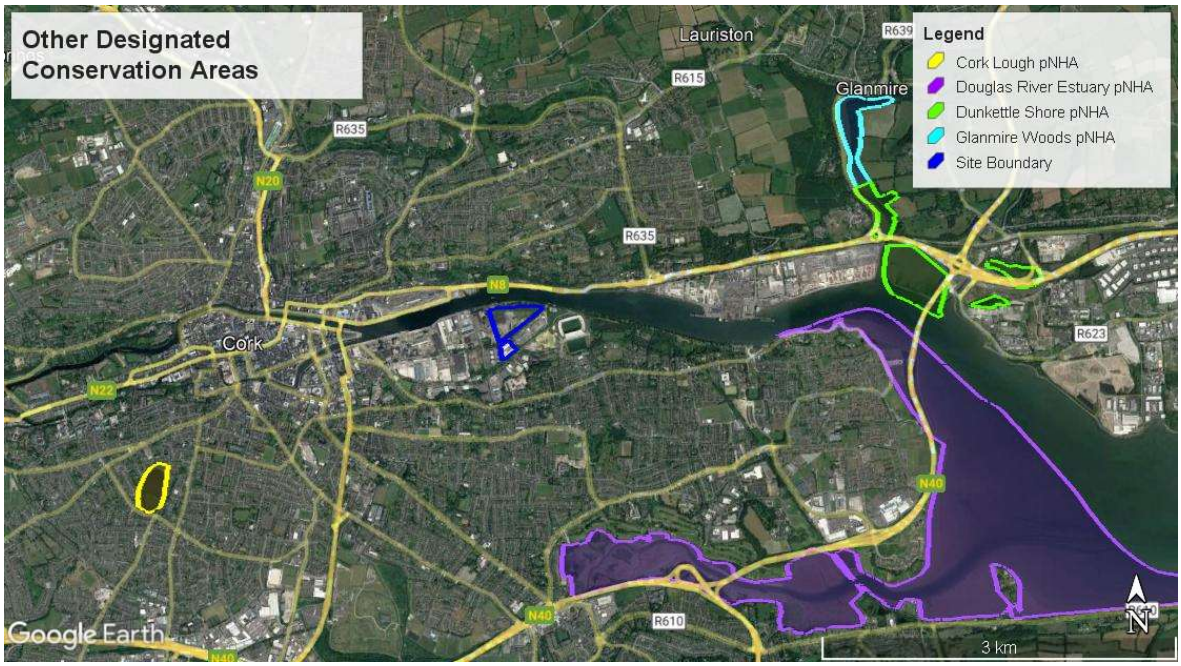


Figure 5.2 Distance from Other Designated Conservation Areas
(Source: Google Earth Pro and NPWS Map Data)

[1] The Irish Wildlife (Amendment) Act 2000 provides for the designation and conservation of Natural Heritage Areas (NHAs); which are sites that support features of importance at a national level. A list of approximately 630 No. proposed NHAs (or pNHAs) was published on a non-statutory basis in 1995, however, these pNHAs have not been statutorily proposed or designated since that time. The pNHAs cover approximately 65,000ha and designation is to proceed on a phased basis over the coming years. Prior to statutory designation, pNHAs are subject to limited protection (see https://www.npws.ie/protected-sites/nha for details).

While the lands within the overall masterplan boundary are located at least 2.9km northeast of Cork Lough pNHA (Site Code: 001081) there is limited hydrological or hydrogeological connectivity given the overall direction of groundwater flow and the fact that the stormwater network outfalls to the River Lee.

Outside of the designated conservation areas within Cork Harbour, there are non-designated groundwater (GWDTEs), surface water dependant terrestrial ecosystems (SWDTEs) and aquatic species within the River Lee which could be impacted upon by the spillage of chemical herbicide given the presence of drainage ditches and the stormwater drainage network which discharge directly to the River Lee. There are limited terrestrial ecosystems adjacent to the overall masterplan boundary which could be impacted, given the contextual framework of the surrounding urban environment.

Aside from designated and non-designated habitats in the wider landscape, there are also local ecological receptors within or adjacent to the site which could be impacted by spray drift including:

- Woody scrub/shrub/trees supporting pollinators, birds, and small mammals
- Pollinators, birds, and small mammals

Pollinators, birds, and small mammals may utilise vegetation including Japanese knotweed and other invasive species for cover, nesting, or foraging. Therefore, pollinators, birds and small mammals are at risk from the use of chemical herbicide, where it is directly applied to Japanese knotweed, or from the effects of spray drift on adjacent woody scrub/shrub/tree vegetation and non-target areas.

Control measures should be deployed to protect ecological receptors from indirect impacts arising from the use of chemical herbicides.

5.5 Environmental, Occupational Health & Safety Hazards

Aside from the SUD restrictions and receptors outlined in Section 5.4, there is a potential risk of impacts to other groups of people from the deployment of chemical herbicide including:

- RPUs deploying the chemical herbicide to Japanese knotweed
- Site personnel/staff completing site investigation, vegetation removal, demolition and construction works
- Surveyors gathering data for ecological assessments, engineering purposes *etc*
- Caretakers for the site

Control measures should be deployed to ensure that caretakers, surveyor and site staff at the site investigation, vegetation removal, demolition, construction and landscaping stage do not come into contact with chemical herbicide.

Registered Professional User's (RPUs) involved in the handling of chemical herbicide, and the operation of sprayers, may also interact with chemical herbicide via direct contact with skin, inhalation, and ingestion, where appropriate Personal Protective Equipment (PPE) such as gloves and breathing apparatus are not worn.

In addition, there is a risk to non-target areas including the adjacent industrial unit, civil infrastructure and the riverside walk from spray drift or accidental spraying. Control measures should also be deployed to minimise spray drift and accidental spraying.

The IAPS Specialist Contractor should acquire information pertaining to the presence of overhead and underground cables and other services at the site in order to inform the Method Statement and Risk Assessment for any management programme where equipment or plant machinery could come into contact with services present within the works area.

Traffic management may also be necessary to facilitate access by plant machinery to the lands within the overall masterplan boundary during the management of Japanese knotweed, given the site is located off an urban street Centre Park Road.

6.0 PROJECT & SITE CONSTRAINTS

Of the 8 no. invasive species recorded, Japanese knotweed is the only species which is listed in environmental legislation, and which could interfere with future infrastructure within the overall masterplan boundary, in terms of accessing existing weaknesses or joints in bitumen, concrete work, stone masonry and hard standing areas; thus, causing impacts to hard landscaping or services (see Section A. of Appendix II).

There are extensive mature stands of Japanese knotweed within the lands of the overall masterplan boundary. In particular, stands JKW01, JKW04 and JKW05 are well established and are at least 10 years old. These stands are located in the 4.7ha subplot of Site A, for which planning is currently being sought. As such the eradication of Japanese knotweed from these locations is time sensitive, given the intention to develop these lands, if and, when planning is granted.

Japanese knotweed plants can exhibit a tolerance for chemical herbicide and can deploy plant defense mechanisms where a sub-lethal dose is applied, leading to the production of sub-lethal bonsai regrowth and/or chemical dormancy (see Section A. Japanese knotweed of Appendix II).

Available information would suggest that the Japanese knotweed within Site A and Site B has not been treated previously with chemical herbicide or at least in recent times. Therefore, the possibility that mature rhizome networks may be lying dormant below ground outside of the recorded stands at JKW01-JKW08, as a result of past chemical herbicide use within the site, is deemed unlikely. Similarly, the presence of cryptic sub-lethal regrowth is not anticipated (see Table A.3 in Appendix II).

There is, however, a possibility that Japanese knotweed may have been missed given: (1) the timing of the survey was outside of the optimum survey period, (2) the presence of disturbance regimes, (3) difficulties gaining access due to dense vegetation, and (4) due to the steep vegetated banks of the drainage ditches in Site A.

The lands within the overall masterplan have been the subject of a number of disturbance regimes including past demolition works, and possibly fly-tipping, which could have disturbed and/or buried knotweed. JKW06 is growing from a spoil heap of construction and demolition waste in Site B.

Of note is that the Japanese knotweed stands at JKW04, JKW05 and JKW06 are located in close vicinity to drainage ditches. The application of chemical herbicide in these areas needs to take into account the presence of hydrological connectivity with the River Lee and Cork Harbour.

The Japanese knotweed at JKW07 and JKW08 appears to be growing out from underneath the foundations of the warehouse in Site B. The plants growing out from underneath the foundations of the structure need to be treated *in situ* with chemical herbicide via foliar application of herbicide and stem filling to accelerate the eradication process prior to the completion of demolition works to facilitate future proposed residential development.

The deployment of a 3 yr (up to 5yr) chemical herbicide treatment programme *in situ* is not considered a feasible option in respect of the overall masterplan boundary, as the eradication of Japanese knotweed from JKW01-JKW08 is time sensitive, given the intention to develop these lands.

The Japanese knotweed at JKW01-JKW08 was treated by foliar application of chemical herbicide in October 2021 and is due to undergo stem harvesting followed by stem filling with chemical herbicide in the coming weeks (see Section 7.1.5).

Given the extent of lands present within the overall masterplan boundary, the option of burial onsite should be considered. The feasibility of burying vector material onsite will depend on the layout of the future planned residential development within the overall masterplan boundary, and on a number of other factors which need to be taken into account in the selection of a suitable onsite burial location (see Section 7.1). A number of these factors may limit the dimensions of a burial cell, and hence the volumes of vector material which can be buried onsite *e.g.,* depth to bedrock. It should be noted that the permanent presence of an onsite burial cell will impinge on future land uses in the footprint of the cell and will require monitoring.

The potential presence of contaminants within the sites, such as hydrocarbons, could also influence the ability to bury Japanese knotweed vector material onsite, where hydrocarbons are detected within the vector material.

Aside from potential difficulties of soils contaminated with hydrocarbons, the onsite burial of vector material requires a Waste License under the Waste Management (Licensing) Regulations 2004. A Waste Licence application could result in delays to the construction programme and as well as the costs associated with providing the necessary documentation and environmental assessments to inform the process.

An alternative option is to transport the vector material offsite to a licensed waste facility for deep burial or for thermal treatment.

A cost-benefit analysis of disposal offsite versus burial onsite is required, given the potential presence of contaminated soils and the pending construction programme. It should be noted that the presence of other contaminants within the vector material may also have a cost implication, as the cost per tonne for disposal offsite is likely to be higher.

In circumstances, where there aren't immediate plans to develop all lands within the overall masterplan boundary, an alternative option would be to recover the vector material from JKW01, JKW04 and JKW05 within the 4.7ha subplot and consolidate it at a location such as JKW02 and JKW03 within Site A, where it can be stored in a temporary holding facility for further treatment to reduce the volumes of viable vector material. The location of JKW02 and JKW03 would be ideal, given the existing presence of Japanese knotweed which would avoid the setting up of such a facility on lands which do not already contain Japanese knotweed.

In order, for this option to be feasible a minimum of 3 years would be required to facilitate treatment at JKW02/JKW03 which would impede the development of these lands within the overall masterplan boundary for this extended period of time. Any remaining viable vector

material, in Year 3, could be transported offsite under licence from NPWS. The feasibility of this approach would depend on future plans and timing of the construction programme for this land.

7.0 BEST PRACTICE METHODOLOGY

There are a number of best practice management programmes which can be deployed to control or eradicate Japanese knotweed from the lands within the overall masterplan boundary as follows:

- Option 1: Chemical Herbicide Programme (treatment *in situ*)
- Option 2: Recovery of Vector Material & Burial Onsite
- Option 3: Recovery of Vector Material & Disposal Offsite
- Option 4: Installation of Japanese Knotweed Rhizome Barrier
- Option 5: Recovery of Vector Material & Construction of a Bund Facility

In light of the project constraints discussed in Section 6.0, the most practical management programmes for Japanese knotweed within the lands of the overall masterplan boundary are **Option 2 - Recovery & Burial Onsite** or **Option 3 - Disposal Offsite** of the vector material (see Section 7.1 and 7.2 for details). Table 7.1 and 7.2 details the optimum periods for the deployment of these management programmes.

Table 7.1 Optimum Periods for the Management of Japanese Knotweed

Management Programmes	J	F	M	A	M	J	J	A	S	O	N	D
1. Chemical Herbicide Programme												
*Spraying												
#Stem Filling												
#Stem Injecting												
2. Recovery & Burial Onsite												
Site Investigation												
#Pre-treatment (see Table 7.2)												
Recovery and burial onsite												
3. Recovery & Disposal Offsite												
Site Investigation												
#Pre-treatment (see Table 7.2)												
Recovery and Disposal Offsite												
4. Installation of a Rhizome Barrier												
Installation of a Rhizome Barrier												

Table 7.2 Optimum Periods for Pre-Treatment prior to Recovery

Pre-treatment	J	F	M	A	M	J	J	A	S	O	N	D
*Spraying only								■	■	■		
#Spraying and Stem Filling Combination			■	■	■	■	■	■	■	■	■	
#Spraying and Stem Filling Combination			■	■	■	■	■	■	■	■	■	

*Timing is dependent on seasonal factors *i.e.* onset of flowering/seeding and before senescence

#Ideally stem filling and stem injecting should also be undertaken during the optimum treatment period to achieve a maximum effective reduction in the viability of the underground rhizome network

7.1 Option 2 - Recovery & Burial Onsite

This management programme involves the recovery of the vector material followed by encapsulation within a burial cell onsite.

There are a number of site constraints which will determine the feasibility of burying vector material onsite (see Section 6.0). In particular, burial onsite requires the availability of suitable lands for the construction of cell. The dimensions of the burial cell will depend on the volumes of vector material and extent of suitable lands available for burial, including the presence of underground services, depth to bedrock and the water table.

The site-specific tasks which need to be completed in respect of this management programme are outlined in Table 7.3.

Most notably a Waste License is required under the Waste Management (Licensing) Regulations 2004 from the EPA to bury soil contaminated with vector material within a site.

Table 7.3 Site-Specific Tasks

Tasks	Description	Status
Task 1	IAPS Specialist Ecologist to undertake a specialist walkover survey of the lands within the overall masterplan boundary at Centre Park Road	Completed on the 14th December 2021
Task 2	Comer Group (Ireland) Ltd. to implement Biosecurity Protocols and Control Measures in conjunction with the IAPS Specialist Ecologist to avoid further spread: ▪ Set up of Exclusion Zones Avoid disturbance regimes highlighted in Table 5.1	Completed
Task 3	IAPS Specialist Ecologist to prepare an Invasive Species Management Plan	Completed (subject of this document)

Tasks	Description	Status
Task 4	IAPS Specialist Ecologist to prepare a Risk Assessment & Method Statement for the recovery of vector material	To be completed
Task 5	Soil testing to be undertaken to ensure that the vector material is acceptable for burial onsite *i.e.,* Waste Acceptance Criteria (WAC) Analysis	To be completed
Task 6	IAPS Specialist Ecologist to supervise specialist site investigation works to inform volumes for disposal	To be completed
Task 7	Comer Group (Ireland) Ltd. to undertake targeted geotechnical site investigations at the location of the proposed onsite burial cell to determine suitability of lands	To be completed
Task 8	Comer Group (Ireland) Ltd. to apply to the EPA for a Waste Licence	To be completed
Task 9	Comer Group (Ireland) Ltd. to excavate the burial cell to accommodate the vector material	To be completed
Task 10	IAPS Specialist Ecologist to supervise the lining of the burial cell, and the recovery and encapsulation of the vector material	To be completed
Task 11	O' Donovan Agri-Environmental Services to undertake a 2-yr Monitoring Programme for Japanese knotweed regrowth. Spot treatment with chemical herbicide will be undertaken where required	To be completed

7.1.1 Assessment of Land Suitability

Burial onsite requires the availability of suitable lands for the construction of a burial cell.

A. When undertaking a suitability assessment for the establishment of a burial cell on site, the following should be considered:
   - A 10m setback from a site boundary
   - An appropriate setback from a watercourse, wetland or other sensitive receptor
   - An appropriate setback from a designated conservation area
   - Depth to water table
   - Depth to bedrock
   - Depth to/or absence of services
   - An appropriate setback from existing and proposed infrastructure
   - Preference for green open space or car park area (*i.e.* little or no infrastructure constructed above or in the vicinity of the cell)

B. Depth of the burial cell (depends on volumes and extent of lands available). There are two options available:
   i. **2m buried depth** if fully lined/encapsulated with a rhizome barrier. All seams should be overlapped and sealed with lap tape before backfilling to 2m deep with suitable material such as inert fill or topsoil
   ii. **>5m buried depth** if unlined. A horizontal layer of rhizome barrier should be placed over the vector material. All seams should be overlapped and sealed with lap tape before backfilling to 5m deep with inert fill or topsoil

C. Nature, type, location and extent of infrastructure, land-use and future works proposed on the site relative to the proposed location for a burial cell

7.1.2 Typical Sequence of Works

The typical sequence of works for burial onsite is as follows:

1. Complete a specialist walkover survey
2. Pre-treatment of the Japanese knotweed with a non-persistent chemical herbicide to achieve tissue viability reduction prior to recovery
3. Complete targeted site investigation to determine an estimate of volumes of vector material for disposal
4. Excavate and prepare the burial cell and line with rhizome barrier
5. Recover *i.e.,* excavate the vector material from within the 7m buffer (depending on results of site investigation) and place within the burial cell or a temporary holding facility until such time as the burial cell is ready to receive the vector material, under strict biosecurity protocols
6. Seal the rhizome barrier within the burial cell once all vector material has been added
7. Backfill the excavation to a depth of 2m
8. Take GPS coordinates of the burial cell location
9. Undertake monitoring

A rhizome barrier is required to facilitate the encapsulation of knotweed in a lined onsite burial cell 2m deep (or as a horizontal layer over vector material buried to a depth of 5m).

Hy-tex C3 root barrier is an example of a triple coated linear barrier, which is UV stabilised and highly resistant to natural acids, alkalis, bacteria, and fungi. The barrier is predicted to be durable for over 50 years in natural soils with a pH of between 4 and 9 and soil temperature lower than 25°C. All joints should be overlapped and sealed with HDPE backed bitumen Root Barrier Lap tape which is supplied in 300mm x 20m reels (https://www.hy-tex.co.uk/docs/geotextiles/Root_Barrier_C3/r_rbc3_03.pdf). Hy-tex C3 membrane can be supplied in rolls up to 4.00m x 100.00m long, as a special order, to reduce laps and the membrane can be site welded to form larger sheets with improved joint integrity.

7.1.3 Geotechnical Site Investigation

Geotechnical site investigation of the proposed location for the burial cell and details of existing services, which may be present within the proposed burial site, is required to confirm suitability/extent of available lands.

Geotechnical site investigation should include the opening up of a trial pit in the selected burial location in advance of the commencement of recovery works to determine suitability of the lands in terms of depth to bedrock, water table and presence/absence of services *etc*.

7.1.4 Targeted Specialist Site Investigation

Specialist Japanese Knotweed site investigation works are required to determine the volumes of vector material for burial on site.

While the standard conservative radial buffer zone proposed for the potential lateral growth of rhizomes is 7m with a below ground vertical buffer zone of 4m deep (NRA, 2010), based on the experience of the authors and recent published scientific literature, rhizomes do not typically extent beyond 3m laterally and 2.5m deep (see Section 8.2). In this regard, it is recommended that targeted site investigation is undertaken to determine the actual extent of rhizomes and to determine more accurate volumes of vector material which may require recovery and burial onsite. Typically, site investigation will reduce the volume of vector material for burial onsite or transportation offsite in comparison with the standard conservative 7m radial buffer zone proposed by NRA (2010).

It is recommended that site investigation works are undertaken by an IAPS Specialist Contractor to determine the actual extent of rhizomes and vector material. The works should be carried out under strict biosecurity & site hygiene protocols and should be supervised by the IAPS Specialist Ecologist.

Care should be taken to minimise the disturbance and fragmentation of rhizomes during this process, where possible.

Once the volumes for recovery are known, this information can be utilised to inform the size of the burial cell. Where the volumes identified from the site investigation process can be accommodated via burial onsite, the Japanese knotweed should be pre-treated prior to recovery to reduce the viability of the rhizomatous material to be excavated and buried.

7.1.5 Pre-treatment

Prior to recovery, it is first necessary to pre-treat the Japanese knotweed *in situ* with an appropriate chemical herbicide to reduce the viability of any above ground or below ground material, and to minimise dispersal of viable material during recovery process.

Based on the extensive experience of the specialist project team in the successful eradication of IAPS from sites, it is deemed **extremely effective**, beneficial, and advisable to pre-treat invasive rhizomatous material, with a suitable non-persistent chemical herbicide, to minimise the risk of accidentally dispersing highly viable rhizomes during the recovery of vector material, and indeed, the transportation of highly viable vector material on the public road network and for deep burial at the receiving facility. Pre-treatment will reduce the risk of regrowth within the lands of the overall landscape masterplan and at the receiving waste facility.

Pre-treatment is therefore a pre-requisite when dealing with problematic invasive species which can regrow from fragments of rhizomes or stems.

Ideally pre-treatment should take place during the optimum treatment period where feasible (see Tables 7.1 and 7.2) subject to the plant's growth stage and local day and night temperatures. Pre-treatment can involve the foliar application of chemical herbicide only and stem harvesting followed by stem fillings where time constraints allow (see Table 7.2)

In this regard, the timing of the recovery works needs to strike a balance between deploying herbicide during the optimum treatment period for Japanese knotweed, allowing a sufficient period of time for the maximum effective dose of herbicide to accomplish a reduction in tissue viability, and the need to meet with contractual commitments *i.e.* the construction programme.

As discussed in Section 6.0 the Japanese knotweed plants within the overall masterplan boundary were treated with chemical herbicide by O' Donovan Agri-Environmental Services in October 2021.

It is important that a non-persistent herbicide is utilised in the pre-treatment of Japanese knotweed, which is proposed for burial onsite, in order to avoid classification of the soil containing the vector material as hazardous; which would deem the vector material unsuitable for burial onsite and result in the material needing to be disposed of offsite at a licenced receiving facility.

7.1.6 Recovery Process

The excavation of the IAPS vector material should be supervised by an IAPS Specialist Ecologist to ensure (1) compliance with biosecurity & site hygiene protocols, and (2) that all visible rhizomatous material is recovered.

Utilising the presence of surface vegetation and findings of the site investigation process, in relation to the extent of rhizomes as a guide, care should be taken to recover all rhizomatous material within the footprint of the stands to minimise the risk of regrowth.

The excavator should dig and extract the vector material and set it into the pre-lined burial cell, if burying 2m deep, or into an unlined cell if 5m deep, or load in onto a dumper for

transportation to a temporary holding facility within the site, for burial at a later date; until such time as the cell is ready (see Section 7.1.6).

During the recovery process, the excavator should be operated so as to facilitate the monitoring of the excavation by the IAPS Specialist Ecologist, by gently pulling back the soil layers to expose the rhizomes such that they can be tracked until the growing tip (white where new growth is present) is located.

Depending on the depth of rhizomes uncovered, the Topsoil and Subsoil *i.e.* Horizon A and B soil layers may need to be removed until the Horizon C layer, consisting of loose weathered parent bedrock, is exposed. The loose parent bedrock material within the Horizon C layer should be carefully scraped with the bucket of the machine to track and remove any rhizomes which have penetrated crevices, crack, or fissures in the bedrock. Where required a rock breaker should be utilised to open up any friable bedrock layers to remove rhizomes which may have penetrated crevices, crack or fissures in the bedrock. The use of hand tools such as hammers and chisels, in localised areas, should also be considered. All contaminated rock material should be recovered.

There may also be a requirement for waste separation, for example, where Japanese knotweed is growing through construction and demolition waste or large pieces of woody debris. Such works should be supervised by the IAPS Specialist Ecologist, in order to identify waste which can be declared free of vector material, and which can enter normal waste disposal streams.

7.1.7 Temporary Holding Facilities

Temporary storage and doubling handling of the vector material should be avoided where possible. However, where required excavated materials can be stockpiled within an existing area already contaminated with vector material or on 1200-gauge polythene (or similar heavy-duty plastic) via side casting with the excavator and covered, where required, until such time as it is ready to be transported off site (or to a burial cell).

7.1.8 Monitoring Programme

The location of the burial cell should be surveyed, to record accurate GPS Coordinates, to inform any future maintenance or construction works at the location of, or in the vicinity of the burial cell.

Monitoring involves an assessment of the presence/absence of above ground regrowth or new growth of IAPS at both the donor site (former location of the Japanese knotweed stands) and at the recipient site (location of the burial cell) based on a detailed walkover, to be undertaken at the beginning, in the middle of and on completion of the growing season by an IAPS Specialist Ecologist for a minimum of 2 yrs post-completion of burial onsite. Spot treatment of growth from any remaining Japanese knotweed vector material is be undertaken as required.

7.2 Option 3 - Recovery & Disposal Offsite

All other options need to be thoroughly explored prior to arriving at the decision to select offsite disposal as a solution for Japanese knotweed control/eradication.

Offsite disposal is typically the last resort when dealing with Japanese knotweed, because of the risk of dispersal associated with recovering and transporting knotweed, and the possible prohibitive costs.

The positives of disposal offsite relate to the fact that there will be no permanent burial cell beneath the site, which could pose a risk of regrowth (whether perceived or actual), and which could impinge on future land uses and possibly even property values.

Offsite disposal options include deep burial at EPA licensed landfill facilities in Ireland, or any other sites where approval/licenses can be acquired from the EPA and NPWS. As there is a limited number of waste facilities in Ireland which can accommodate Japanese knotweed, export to mainland Europe for thermal treatment is also a viable disposal route.

Prior to recovery, it is first necessary to pre-treat the Japanese knotweed *in situ* with an appropriate chemical herbicide to reduce the viability of any above ground or below ground material and to the minimise dispersal of viable material during recovery and transportation. Pre-treatment will also reduce the risk of regrowth at the site and at the receiving waste facility (if going for deep burial). Once completed the vector material can be recovered and transported off site in order to permit construction works to proceed.

A license is required from NPWS in order to facilitate the offsite disposal of Japanese knotweed vector material at a receiving facility. The following information is required by NPWS to process a license application:

- Letter of acceptance from the receiving facility
- Waste Collection Permit Number from the National Waste Collection Permit Office (NWCPO) for the haulage company
- Japanese Knotweed Management Plan
- Method Statement and Risk Assessment

The site-specific tasks which need to be completed in respect of this management programme are outlined in Table 7.4.

Table 7.4 Site-Specific Tasks

Tasks	Description	Status
Task 1	IAPS Specialist Ecologist to undertake a specialist walkover survey at the site of the proposed residential development at No. Centre Park Road	Completed on the 14th December 2021
Task 2	IAPS Specialist Ecologist to supervise specialist site investigation works to inform volumes for disposal	To be completed

Tasks	Description	Status
Task 3	IAPS Specialist Ecologist to prepare an Invasive Species Management Plan	Completed (subject of this document)
Task 4	IAPS Specialist Ecologist to prepare a Risk Assessment & Method Statement for the recovery of vector material	To be completed
Task 5	Comer Group (Ireland) Ltd. to implement Biosecurity Protocols and Control Measures in conjunction with the IAPS Specialist Ecologist to avoid further spread: ▪ Set up of Exclusion Zones ▪ Avoid disturbance regimes highlighted in Table 5.1	Completed
Task 6	Soil testing to be undertaken to ensure that the vector material is acceptable to the receiving facility *i.e.,* [2]Waste Acceptance Criteria (WAC) Analysis	To be completed
Task 7	Identify a suitable receiving facility *e.g.,* a licensed EPA landfill facility or other waste receiving facility for thermal treatment	To be completed
Task 8	Comer Group (Ireland) Ltd. to apply for a Letter of Acceptance from the receiving facility	To be completed
Task 9	Acquire details of the waste permit number from the haulage company who will be transporting the vector material to the receiving facility	To be completed
Task 10	Comer Group (Ireland) Ltd. to provide a letter confirming responsibility for and duration of the monitoring programme	To be completed
Task 11	IAPS Specialist Ecologist to apply to NPWS for a licence for the transportation of vector material offsite	To be completed
Task 12	IAPS Specialist Ecologist to supervise the recovery works and loading of trucks	To be completed
Task 13	O' Donovan Agri-Environmental Services to undertake a 2-yr Monitoring Programme for Japanese knotweed regrowth. Spot treatment with chemical herbicide will be undertaken where required	To be completed

[2] WAC stands for Waste Acceptance Criteria and is used to determine whether the soil will be accepted at a particular type of landfill. WAC testing is used to determine how a waste will behave once it's buried in a landfill. This is carried out primarily through analysis of leachate derived from that waste during laboratory analysis.

7.2.1 Typical Sequence of Works

The typical sequence of works for the recovery of vector material and offsite disposal is as follows:

1. Complete a specialist walkover survey
2. Pre-treatment of the Japanese knotweed with a non-persistent chemical herbicide to achieve tissue viability reduction prior to recovery
3. Complete targeted site investigation to determine an estimate of volumes of vector material for disposal
4. Recover *i.e.,* excavate the vector material from within the 7m buffer (depending on results of site investigation)
5. Load the vector material directly onto waiting trucks, or place the recovered vector material in a temporary holding facility in preparation for removal off site, under strict biosecurity protocols
6. Remove vector material offsite in a sealed truck with a tipper body and a roll over cover under licence from NPWS to the approved receiving facility
7. Install a rhizome barrier to protect infrastructure, where deemed necessary

7.2.2 Pre-treatment

Based on the extensive experience of the specialist project team in the successful eradication of IAPS from sites, it is deemed **extremely effective**, beneficial, and advisable to pre-treat invasive species, with a suitable non-persistent chemical herbicide, to minimise the risk of accidentally dispersing highly viable rhizomatous material during the recovery process, and indeed, the transportation of highly viable vector material on the public road network for deep burial at the receiving facility. Pre-treatment will reduce the risk of regrowth within the lands of the overall landscape masterplan and at the receiving waste facility.

It is important that a non-persistent herbicide is utilised in the pre-treatment of Japanese knotweed, which is to be transported offsite for disposal at a licensed waste facility, in order to avoid the potential classification of the vector material as a hazardous material. This could have an implication, in that the cost per tonne for disposal offsite is likely to be higher.

See Section 7.1.5 for further details on pre-treatment.

7.2.3 Recovery Process

The excavator should dig and extract the vector material and load it directly onto waiting trucks, or a dumper for transportation to a temporary holding facility within the site, for loading at a later date (see Sections 7.1.6-7.1.7 for details).

7.2.4 Temporary Holding Facility

See Section 7.1.7.

7.2.5 Monitoring Programme

Monitoring involves as assessment of the presence/absence of above ground regrowth or new growth of IAPS based on a detailed walkover, to be undertaken at the beginning, in the middle of and on completion of the growing season for a set period time post-completion of recovery and transportation of the vector material offsite. Spot treatment of growth from any remaining Japanese knotweed vector material is be undertaken as required.

8.0 SITE-SPECIFIC CONTROL MEASURES

In light of the risk of dispersal, it is recommended that the recovery & disposal offsite of Japanese knotweed is deployed in order to eradicate the Japanese knotweed in a timely manner.

The selected management programmes will need to be deployed as soon as practically possible in light of the potential for further dispersal of Japanese knotweed vector material, within overall masterplan boundary, which could impact on the success of the selected management programme.

Where a 'do nothing' approached is taken, further dispersal of Japanese knotweed may occur within the lands of the overall masterplan boundary. Without any intervention there is a risk that Japanese knotweed may in the long-term have the potential to:

- Encroach on downstream native habitats with connectivity to Site A and Site B via the drainage ditches and the stormwater network *e.g.* River Lee, Cork Harbour SPA, Douglas River Estuary pNHA, Dunkettle shore pNHA and non-designated SWDTEs and GWDTEs
- Encroach on adjacent land-uses, public footpaths, dwellings, and infrastructure
- Encroach on new structures, footpaths, services, internal access roads and green open spaces within the site of the proposed residential development
- Diminish the ability to use and enjoy the green open spaces within the site of the proposed residential development due to impediments to access
- Encroach on sight lines and signage along the internal access paths
- Result in long-term maintenance requirements

The risk of dispersing Japanese knotweed within the lands of the overall masterplan boundary will arise where vector material becomes adhered to (1) the footwear of surveyors, site personnel/staff, and visitors to the site, (2) on the tyres of construction related and domestic vehicles in the car park; and (3) on tyres and tracks of plant machinery and on geotechnical site investigation/vegetation removal/demolition/construction/landscaping equipment.

There is also a low risk that surveyors, site personnel/staff and visitors to the site could transport viable vector material offsite on footwear and tyres of domestic vehicles. Vector material could also be transferred to other sites within in soil loads, on plant machinery and on construction/landscaping equipment. In addition, if viable Japanese knotweed stem or rhizome fragments were to gain entry to the drainage ditches and the stormwater network via the gullies within and adjacent to Site A and Site B, this could result in the spread of Japanese knotweed to the River Lee and Cork Harbour (see Section 5.2, 5.3.4 and 5.4 for further details).

Site-specific control measures are required to address the dispersal of Japanese knotweed vector material. These control measures are detailed below in Sections 8.1–8.5.

8.1 Preparation of a Site-Specific RAMS

A site-specific Risk Assessment and Method Statement (RAMS) should be prepared by the IAPS Specialist Ecologist prior to the deployment of the management programmes and should include details of the following site related background information, site related activities and

control measures required to avoid or reduce the risks associated with the implementation of the management programmes including the dispersal of Japanese knotweed.

The RAMS should be distributed to all site personnel in advance of the commencement of works to control or eradicate IAPS. The RAMS should contain the following information at a minimum:

- Site description for the proposed residential development
- Details of locations of IAPS infested areas
- Step by step details for the implementation of the management programmes
- Details of site hygiene and biosecurity protocols
- Details of site-specific hazards/constraints
- Details of hazard/environmental control measures (identified in the risk assessment)
- Details of ecological control measures (identified in the risk assessment)
- Details of site specific and seasonal constraints
- Specific details of duration and timing of site supervision
- Details and timing of monitoring requirements

The preparation of the site-specific Risk Assessment and Method Statement is a concurrent process.

The site-specific Risk Assessment will identify low, medium, and high-risk factors associated with the hazards and constraints identified during the preparation of the management plan and the Method Statement for the recovery of the Japanese knotweed vector material.

Where appropriate, the control measures will need to be deployed by the Contractor under the supervision of the IAPS Specialist Ecologist, during the recovery of the vector material within Site A and Site B; and by any other subcontractors which need access to the site of the proposed residential development to undertake works.

Specific control measures will be required in the Risk Assessment and Method Statement to address or minimise risk to the following:

- Dispersal of Vector Material (see Section 8.2)
- Accidental spillage, Spraying or Spray Drift of Chemical Herbicide (see Section 8.3)
- SUD Restrictions & Receptors (see Section 8.3)
- Environmental, Occupational Health & Safety Receptors (see Section 8.3)
- Ecological Receptors & Non-target Areas (see Section 8.4)
- Monitoring Programme (see Section 8.5)

8.2 Control Measures to Reduce Dispersal

It is recommended that the following biosecurity, site supervision and & site hygiene control measures are supervised by, or deployed by the IAPS Specialist Ecologist, within Site A and Site B in order to avoid dispersal/introduction of Japanese knotweed during the recovery and disposal offsite of the vector material:

- Provision of toolbox talks to ground operatives by the IAPS Specialist Ecologist.
- Installation of an Exclusion Zone in the form of temporary fencing around the infestation(s)

- Supervision of the installation of a dedicated biosecurity wash facility for footwear and tools within the site to treat equipment and personal footwear on entry and exiting the infested areas.
- Checks on biosecurity protocols *e.g.* use of appropriate biosecurity signage and temporary fencing, minimising site access and footfall, use of the footwear wash facility by ground operatives and adherence to dedicated entry and exit points.
- Checks for the provision of temporary fencing to minimise site access and foot fall by pedestrians where required.
- Checks for the creation of a delineated access track (to be maintained free of IAPS through the site) to minimise the spread of IAPS by permitted plant machinery and equipment accessing the site.
- Checks on the control and minimisation of movement of all plant and equipment, site personnel and visitors in and out of the site during the excavation of vector material.
- Supervision of the treatment of vehicles wheels/tyres, undercarriage of machines and chassis of trucks and tractors, tracks, back actors, buckets, hand tools (shovels, trowels) to eradicate/reduce the viability of any vector material present.
- Checks on footwear and equipment for any vector material. Any fragments should be treated with suitable chemical herbicide and disposed of within the temporary holding facility.
- Plant machinery, site vehicles and equipment may only be removed from the site after being checked and cleared to do so by the IAPS Specialist Ecologist.
- Checks for IAPS on imported soil and stone required for construction works at source and at arrival on site.

In accordance with legal obligations and/or best practice, the various risk assessments, and method statements to be prepared by other Contractors who may require access to the site will also need to include biosecurity and site hygiene control measures to avoid the disturbance and further dispersal of Japanese knotweed within the site of the proposed residential development. This is to ensure that viable plant material is not accidentally or otherwise dispersed by surveyors, site personnel/staff or visitors to the site either on their footwear, equipment, or tyres/tracks of vehicles. These control measures, required to avoid or limit dispersal, are necessary to ensure compliance with the European Union (Birds and Natural Habitats) Regulations 2011 to 2015.

Setting up of Exclusion Zones

The standard 7m rule or buffer zone described in Irish and UK government guideline documents, suggests that mature Japanese knotweed rhizomes may extend seven metres laterally from a parent plant (*e.g.* NRA, 2010; Environment Agency, 2013) and 4m deep (NRA, 2010). However, based on the authors experience of recovering Japanese knotweed vector material from a broad range of sites across Ireland, rhizomes of Japanese knotweed have rarely been found to extend beyond 3m laterally and 2.5m deep.

Fennell *et al*. (2018) demonstrated that even large stands of Japanese knotweed do not usually produce rhizomes that extend further than 4m. The study found that Japanese knotweed rhizomes rarely extend more than 4m from above ground plants and are typically found within 2m for small stands and 2.5m for large stands. Similarly, the mean vertical extent recorded averaged between 1.02m for the small stands and 1.64m for the large stands, (with a maximum of 3.2m recorded). The study concluded that the 7m rule is not a statistically robust tool for estimating likely rhizome extension (Fennel *et al*., 2018).

In this regard, the IAPS Specialist Ecologist shall provide site specific advice onsite pertaining to the required Exclusion Zone for the Japanese knotweed at JKW01-08 within Site A and Site B, based on the maturity and other characteristics of the infestation.

Recovery Works & Use of Plant Machinery

Prior to the commencement of the recovery works, a CAT scanner should be deployed to check for existing services.

A small toothless digging (or grading) bucket on a rubber tracked excavator are generally recommended for use. A grading bucket will permit a clean cut through the soil layers such that the rhizomes can be more easily tracked. Typically, a rubber tracked excavator is selected for such works to minimise the extent of soils which may be caught between the tracks and the fragmentation of rhizomes on or just below the surface. The rubber tracks should be kept out of the known locations of vector material, where possible.

These works should be carried out under strict biosecurity & site hygiene protocols and supervised by the IAPS Specialist Ecologist.

The excavator should be operated in such a manner so as to prevent further dispersal and contamination of the site during works, as follows:

- Avoid spillage of vector material from the bucket
- Laying down and changing bucket – ensure that it remains within the contaminated area and is not temporarily stored outside of the contaminated area
- Ensure that the tracks of the machine remain outside the contaminated area where possible. Where tracks have to enter the contaminated area, the driver should ensure that they do not contaminate additional lands by straying outside of the contaminated area. The contaminated area should be covered with heavy duty plastic and plywood to prevent the disturbance of rhizomes at or near the surface (the plastic and plywood should be appropriately cleaned or disposed of)
- The method of work of work should ensure that the machine does not have to track over an area which has already been stripped of vector material resulting in the recontamination of an area
- The machine driver should not step off the machine in the contaminated area, and contaminate additional lands by straying (on foot) outside of the contaminated area or into the area which has already been stripped of vector material resulting in the recontamination of the excavation

- The machine should not be brought outside of the contaminated area until biosecurity protocols have been deployed to decontaminate machine

Temporary Storage

The doubling handling and temporary storage of vector material should be avoided where possible. However, where required excavated vector material can be stockpiled within a temporary holding facility under strict biosecurity protocols and under the supervision of an IAPS Specialist Ecologist until such time as it is ready to be removed off site.

The location of the temporary holding facility should be agreed in advance as it needs to be positioned to allow for the use of a decontamination area and for the loading of the vector material via side casting onto the trucks. The holding facility should ideally be located on an existing contaminated area, or on a hard surface lined with 1200-gauge polythene or similar heavy-duty plastic/material or stored in one-tonne bags (lined with heavy duty plastic). The material should be stockpiled to facilitate efficient loading of the trucks.

Where considered appropriate the material within the temporary holding facility should be covered, until such time as it is to be transported offsite to the approved receiving facility, in a sealed truck with a tipper body and a roll over cover, under license from NPWS.

8.3 Control Measures for Chemical Herbicide Use

Areas of General Public Use & Defined Vulnerable Groups

There is potential for interaction with the following groups during the deployment of chemical herbicides under the management programme:

- Members of the general public utilising the adjacent footpath on Centre Park Road, the carparking and walkway along the River Lee, and Shandon Boat Club
- Members of vulnerable groups including children, elderly and pregnant mothers utilising the adjacent footpath on Centre Park Road, the car parking and riverside walkway along the River Lee
- Members of the general public working within adjacent civil infrastructure, industrial units and Shandon Boat Club

Environmental, Occupational Health & Safety Receptors

There is also potential for interactions with the following receptors:

- RPUs deploying the chemical herbicide to Japanese knotweed
- Site personnel/staff completing site investigation, vegetation removal, demolition and construction works
- Surveyors gathering data for ecological assessments, engineering purposes *etc*
- Caretakers for the site

A number of control measures should be deployed to ensure that these groups and receptors do not come into contact with chemical herbicide including:

- Erection of an Exclusion Zone *i.e.* temporary fencing around the treatment area
- Warning signage in advance of spraying operations
- Consultation in advance of spraying operations

- Timing of treatment to avoid peak pedestrian traffic times on Cotters Street
- Minimisation of spray drift and accidental spraying of adjacent areas
- Cessation of treatment where members of the public, children or domestic pets gain access to the treatment area
- Adherence to the SUD Directive and Plant Protection Products Regulations
- Adherence to Regulation 12 of SUD Directive in terms of the requirement to complete specific site records as part of pre- and post-treatment reporting
- Adherence to the Product Label and MSDS sheet
- Use of appropriate PPE
- Avoidance of spillage of chemical herbicide (see Section 8.4)
- Consultation with a Registered Pesticide Advisor and/or the Pesticides Control Service where there is any doubt in relation to the safe use of herbicides
- Site supervision by the IAPS Specialist Ecologist

Natura 2000 Sites

There is 1 No. Natura 2000 site at risk from the accidental spillage or release of chemical herbicide (during pouring/mixing/spraying) as follows:

- Cork Harbour SPA (Site Code: 004030)

A hydrological pathway has been identified between the site and this Natura 2000 sites *i.e.* chemical herbicide or hydrocarbons may gain entry to the drainage ditches or the stormwater network via storm water gullies within Site A and Site B (and in the adjacent streets) which discharge to the River Lee and Cork Harbour; located 2.4km to the east. There is limited hydrogeological connectivity (see Section 5.3.4).

Specific control measures will be required in the Risk Assessment and Method Statement to reduce the risks of accidental spillage or release of chemical herbicide. It is anticipated that the risk of spillage and entry to surface water pathways and the stormwater network will significantly be reduced by the implementation of the control measures.

Given the control measures which are to be deployed, distance from the site and dilution effects, significant impacts on this Natura 2000 site is considered unlikely.

8.4 Ecological Control Measures & Non-target Areas

The Risk Assessment will also identify control measures to minimise impacts on ecological receptors and non-target areas within the zone of influence of the proposed residential development.

Ecological receptors and non-target areas within or adjacent to the site, which could be impacted by spray drift or accidental spraying include:

Ecological Receptors

- Natura 2000 sites (see Section 8.3)
- Douglas River Estuary pNHA and Dunkettle Shore pNHA
- Woody scrub/shrub vegetation supporting pollinators, birds, and small mammals
- Pollinators, birds, and small mammals

Non-target Areas

- Adjacent terraced houses/apartment blocks
- Adjacent offices
- Adjacent commercial units

The following control measures should be included in the Risk Assessment and Method Statement to protect ecological receptors and non-target areas from chemical herbicides:

Herbicides

- Undertake regular checks on spraying equipment for defects
- Use bunded equipment and twin-lined or double hoses
- Provide trays for mixing of herbicide
- Ensure chemical herbicide spill kits are available at all times
- Provide a source of water for mixing of herbicide (other than a local water body)
- Avoid the creation of spray drift
- Avoid spraying during poor weather conditions *i.e.* in the rain and wind and when rain is forecasted in accordance with the Product Label
- Disturb vegetation to ensure that pollinators, birds, and small mammals take evasive action and move out of vegetation which is to be sprayed with chemical herbicide
- Comply with Circular Letter NPWS 2/08

Hydrocarbons

- Adhere to defined setback distance from drainage ditches storm water gullies for refuelling, use of lubricants and vehicle maintenance
- Ensure hydrocarbon spill kits are available at all times
- Undertake regular maintenance and checks on plant machinery and equipment

While some literature recommends the use of herbicides in the evening, to avoid impacts to pollinators, the use of herbicides may be impacted by high moisture levels associated with heavy dew fall and the closure of stomata which could reduce the efficacy of the herbicide treatment. In this regard, the IAPS Specialist Ecologist will disturb Japanese Knotweed and adjacent vegetation prior to commencement of spraying to ensure that pollinators, birds, and any small mammals have moved out of the zone of influence.

In order to ensure that the use of chemical herbicides does not contravene environmental legislation, the IAPS Specialist Contractor must comply with Circular Letter NPWS 2/08 which deals with the application of chemical herbicides to non-target areas as well as the SUD Regulations.

8.5 Monitoring Programme

Monitoring involves as assessment of the presence/absence of regrowth or new growth of Japanese knotweed based on a detailed walkover, to be undertaken at the beginning, in the middle of and on completion of the growing season for a set period time post-completion of the recovery works. Spot treatment of growth from any remaining Japanese knotweed vector material is undertaken as required.

A minimum 3-year monitoring programme is recommended for the lands within the overall masterplan boundary which will commence from the date of the recovery works and will continue to the end of the growing season in Year 3 (at least).

The importance of a monitoring programme cannot be underestimated in the context of the lands within the overall masterplan boundary, given recent disturbance activities. In an undisturbed site, if vector material is recovered from all known locations of above ground plant material, this would minimise the risk of future growth. However, given that the survey was undertaken outside of the optimum survey period and the identification of recent disturbance regimes, there is a risk that plants are located elsewhere within Site A and Site B which have yet to be identified.

There is an ongoing risk of the reintroduction of vector material to the lands within the overall masterplan boundary via the same sources and pathways which resulted in the introduction of viable plant fragments on previous occasions including fly-tipping of waste.

It is of paramount importance, that control measures are deployed to ensure that all contractors involved in the proposed residential development are made aware of best practice guidance to minimise the risk of importing vector material, onto the site as a result of geotechnical site investigation, vegetation removal, demolition, construction and in particular, via landscaping works (see Section 5.3.1 for details).

9.0 CONCLUSION

It is recommended that the Japanese knotweed vector material at JKW01-08 is pre-treated with chemical herbicide prior to the recovery and disposal of the vector material offsite or burial onsite.

Pre-treatment of the knotweed should ideally be completed during the optimum treatment period in late summer/autumn 2022, subject to the plant's growth stage and local day and night temperatures. In this regard, JKW01-JKW08 were treated with chemical herbicide by O' Donovan Agri-Environmental Services in October 2021 and will undergo stem filling in the coming weeks.

Given that a residential development is proposed within the 4.7ha subsite of Site A, it would be prudent to commence with the recovery & offsite disposal or burial onsite works as soon as practically feasible to allow sufficient time to complete the recovery process and to facilitate a monitoring where practically feasible.

Other Invasive Species

It is recommended that any growth of Buddleia, Traveller's joy, 2 no. *Cotoneaster* spp., Montbretia, Winter heliotrope and Pampas grass within Site A and Site B are treated, where required, with chemical herbicide during the optimum treatment period to avoid any future encroachment by these IAPS and to minimise long-term landscape maintenance requirements.

In relation to the existing seed bank the rapid growth of new outliers of Buddleia within the site is likely during the main construction stage, due to the fecundity of this species. These plants should be dealt with, as they emerge, as part of the chemical herbicide treatment to be deployed in preparation for the hard and soft landscaping works to be undertaken within the site.

The remaining invasive species identified within the overall masterplan boundary will also regrow from the existing seed bank, but at a slower rate than the aforementioned. These species should be dealt with as they emerge as part of the chemical herbicide treatment to be deployed in preparation for the hard and soft landscaping works which are to be undertaken within the site (see Appendix II for details).

10.0 REFERENCES

Species I.D. Cards

- http://www.nonnativespecies.org/index.cfm?sectionid=47
- https://www.agriculture.gov.ie/farmingsectors/planthealthtrade/alieninvasiveplantspecies/
- http://www.biodiversityireland.ie/projects/invasive-species/id-guides/
- https://www.fisheriesireland.ie/Research/invasive-species.html
- https://invasivespeciesireland.com/species-accounts/
- http://staffweb.itsligo.ie/staff/dcotton/Alien_Species.html

CIRIA (2008) CIRIA C679 Invasive species management for infrastructure managers and the construction industry.

Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive) and Directive 2009/147/EC (codified version of Directive 79/409/EEC as amended) (Birds Directive) – transposed into Irish law as European Communities (Birds and Natural Habitats) Regulations 2011 (SI 477/2011).

Environmental Agency (2013) Managing Japanese Knotweed on Development Sites: The Knotweed Code of Practice. Noted withdrawal by EA in 2016.

Environmental Agency (2013) Managing Japanese Knotweed on Development Sites: The Knotweed Code of Practice (**please note that this guidance was withdrawn on the 11th July 2016).**

Environmental Agency (2016a) Guidance Note: Prevent Japanese knotweed from Spreading. Environment Agency, Natural England and Department for the Environment, Food and Rural Affairs. March, 2016

Environmental Agency (2016b) Treatment and Disposal of Invasive Non-Native Plants: RPS 178. November, 2016.

EPA website: http://www.epa.ie.

European Communities (Conservation of Wild Birds) Regulations – http://www.irishstatutebook.ie.

European Communities (Environmental Impact Assessment) Regulations, 1989 to 2001.

European Communities (Natural Habitats) Regulations – http://www.irishstatutebook.ie.

Fossitt, J. A. (2000). A Guide to Habitats in Ireland. The Heritage Council.

Habitats Directive (92/43/EEC)

IEEM (2005) Institute of Ecology and Environmental Management Draft Guidelines for Ecological Impact Assessment.

Invasive Species Ireland. Best Practice Management Guidelines Japanese Knotweed Fallopia japonica.

Irish Water Information and Guidance Document on Japanese Knotweed Asset Strategy and Sustainability.

NetRegs Environmental guidance for your business in Northern Ireland & Scotland http://www.netregs.org.uk/environmental-topics/land/japanese-knotweed-giant-hogweed-and-other-invasive-weeds/

NRA (2004) Environmental Impact Assessment of National Road Schemes – A Practical Guide, National Roads Authority.

NRA (2006) A Guide to Landscape Treatments for National Road Schemes in Ireland. Dublin: National Roads Authority.

NRA (2006) Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub Prior to, During and Post-Construction of National Road Schemes. Dublin: National Roads Authority.

NRA (2008) Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes.

NRA (2008) Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan.

NRA (2008) The Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads.

NRA (2010) NRA Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Road Schemes

Property Care Association (2014) Code of Practice for the Management of Japanese knotweed Version 2.7. Property Care Association.

SEPA (2016) Biosecurity and management of invasive non-native species for construction sites and Controlled Activities January 2016.

Welsh Government (2011) The Control of Japanese Knotweed (*Fallopia japonica*) in Construction and Landscape Contracts.

Appendix I

DEFINITION, CLASSIFICATION, LEGISLATION & BEST PRACTICE

Definition of Invasive Alien Plant Species

Alien (or non-native) plants are defined as those plants which have been introduced into Ireland by humans and their activities, either purposefully or accidentally.

Alien (or non-native) **invasive** species are so-called as they typically display one or more of the following characteristics or features: (1) prolific reproduction through seed dispersal and/or re-growth from plant fragments; (2) rapid growth patterns; and (3) resistance to standard weed control methods.

Where a non-native species displays invasive qualities, and is not managed appropriately, it can potentially: (1) outcompete native vegetation, affecting plant community structure and habitat for wildlife; (2) cause damage to infrastructure including road carriageways, footpaths, walls and foundations; (3) result in soil erosion; (4) have an adverse effect on landscape quality through a loss of naturalness, aesthetics and regional identity; and, (5) impact on road safety (Dolan, 2004).

The introduction of *Rhododendron ponticum,* to Glengarriff Nature Reserve and Killarney National Park was perhaps the most widely cited example of an invasion by a non-native invasive species which has had a significant effect on the Irish landscape and elements within it. However, Japanese knotweed has recently become the focus of much media attention given the rate at which it has spread and its potential for infrastructural impacts.

Classification of Invasive Alien Plant Species

A number of Irish agencies are monitoring and classifying invasive alien species in an effort to focus research programs, further monitoring, risk assessments, management and action plans and to meet with statutory obligations associated with the introduction of recent and future legislation.

Invasive Species Ireland

Invasive Species Ireland (www.invasivespeciesireland.com) a joint initiative by the Northern Ireland Environment Agency and NPWS, previously classified invasive species under the following headings based on a risk assessment:

- Most Unwanted: Established Threat
- High Risk: Recorded Species
- Amber List: Recorded Species (which under the right conditions could represent a significant impact on native species or habitats)
- Amber List: Uncertain Risk (their ecological impact remains uncertain due to lack of data showing impact or lack of impact)

The classification was based on the publication Kelly *et al*. (2013) Risk Analysis and prioritisation for invasive and non-native invasive species in Ireland and Northern Ireland (http://invasivespeciesireland.com/wp-content/uploads/2013/03/Risk-analysis-andprioritization-29032012-FINAL.pdf). The Invasive Species Ireland website currently lists a number of species under 'Established' or 'Potential'.

National Biodiversity Data Centre

The National Biodiversity Data Centre (http://www.biodiversityireland.ie/projects/invasive-species/species-lists/) has prepared a catalogue of invasive alien plant species and has risk assessed and classified a number of species into the following headings

- High Impact (http://www.biodiversityireland.ie/wordpress/wp-content/uploads/Invasives _taggedlist_HighImpact_2013RA-1.pdf)
- Medium Impact (http://www.biodiversityireland.ie/wordpress/wp-content/uploads/Invasives_taggedMediumImpact_2013RA-2.pdf)
- Watch List Species (http://www.biodiversityireland.ie/wordpress/wp-content/uploads/Invasives_tagged_PotentialHighmpact_2013RA-1.pdf)

A detailed risk assessment for 41 of these species was undertaken in 2014 (http://nonnativespecies.ie.) The detailed risk assessment is called NAPRA Ireland.

The classification is also based on the publication Kelly *et al*. (2013).

National Roads Authority/Transport Infrastructure Ireland (NRA/TII)

In 2008, the NRA first prepared Guidelines on the Management of Noxious Weeds and Non-native Species on National Roads (NRA, 2010 revised) and identified 9 No. invasive species which have been shown to have an adverse impact on landscape quality, native biodiversity

or infrastructure; and are likely to be encountered during road schemes as follows:

- Japanese knotweed
- Giant hogweed
- Himalayan balsam
- Giant rhubarb
- Montbretia
- Winter heliotrope
- Old man's beard
- Common or Pontic rhododendron
- Buddleia

Department of Agriculture, Food and the Marine (DAFM)

The Department of Agricultural, Food and Marine have named 7 No. Alien Invasive Plant Species *i.e.* Giant hogweed, Giant rhubarb, Himalayan balsam, Japanese knotweed, Montbretia, Old man's beard and Rhododendron on its Plant Health Trade webpage (https://www.agriculture.gov.ie/farmingsectors/planthealthtrade/alieninvasiveplantspecies/

CERIS

It is understood that the control of Winter Heliotrope is currently the subject of an EPA funded project led by CERIS, Institute of Technology, Sligo which is targeting the Prevention, Control and Eradication of Invasive Alien Species (IAS) on the Island of Ireland.

RELEVANT LEGISLATION

There is a range of legislation under which statutory obligations directly or indirectly apply to invasive species, and indeed, conventions which underpin the requirement to survey for and manage IAPS where they occur:

- EU Regulation 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species [2014] OJ L 317/35
- European Communities (Birds and Natural Habitats) Regulations, 2011 (S.I. No. 477 of 2011) to 2015, as amended
- Wildlife Acts, 1976 to 2012, as amended
- European Conventions

The main pieces of legislation are discussed in this section.

EU Regulation 1143/2014 on Invasive Alien Species

The EU Regulation 1143/2014 on Invasive Alien Species came into force on the 3rd August 2016. Some of the core provisions of EU Regulation 1143/2014 deal with, among other things, bringing into the territory of the Union, keeping, breeding, transporting and placing on the market, species included on the list of invasive alien species of Union Concern (the 'Union list'). This first "Union List" of 37 No. species consisting of 23 animals and 14 plants came into force, following the publication of the Commission Implementing Regulation (2016/1141), in the Official Journal of the Union on the 14th July 2016. The 'Union list' comprises species whose potential adverse impacts across the European Union are such that concerted action across Member States is required (https://www.npws.ie/sites/default/files/files/Union%20 list%20of%20IAS.pdf). Japanese knotweed is not included on the Union List.

On the 13th July 2017, Giant rhubarb along with a further 11 other species were added to the 'Union List' under EU Regulation 1143/2014 as per the Commission Implementing Regulation 2017/1263.

European Communities (Birds and Natural Habitats) Regulations 2011 to 2015

There are statutory obligations under S.I. 477 of 2011 of the European Communities (Birds and Natural Habitats) Regulations 2011 to 2015 to address invasive species in Ireland. There are a number of plant species including Japanese knotweed listed under the 3rd Schedule: Part 1 – Plants and Part 3: Vector Materials which are subject to restrictions under Regulations 49 & 50. Part 3: Vector Materials refers to soil or spoil taken from places infested with Japanese knotweed (*Fallopia japonica*), Giant knotweed (*Fallopia sachalinensis*) or their hybrid Bohemian knotweed (*Fallopia* x *bohemica*). Regulation 49 deals with the 'Prohibition on introduction and dispersal' while Regulation 50 deals with the 'Prohibition on dealing with and keeping certain species'. Regulation 50 has yet to be brought into Irish law (http://www.irishstatutebook.ie/eli/2011/si/477/made/en/print and http://www.Irishstatutebook.ie/eli/2015/si/355/made/en/print). A license application to NPWS is required under

Regulation 49(2) in order to transport soil or spoil *i.e.,* vector material containing Japanese knotweed, Giant knotweed and Bohemian knotweed off site.

Further to consultation with Gerry Lecky of the Wildlife Licensing Unit of NPWS, an invasive species management plan, a method statement, a letter of acceptance from the receiving waste facility and the Waste Collection Permit Number from the National Waste Collection Permit Office (NWCPO) for the haulage company is required as part of the license submission.

Where treatment of an IAPS which poses a threat to the Conservation Objectives of a Natura 2000 site (European Site), is required, a licence pursuant to 49(14) [an amendment to the 2011 Regulations under Regulation 12 of the European Communities (Birds and Natural Habitats) (Amendment) Regulations 2015] may be required. Where it is determined that an invasive species poses a threat to the conservation status of a habitat or species, and it is necessary to treat an invasive species during the overwintering period, a licence under Regulation 49(13) may be required.

The treatment of an invasive species within a Natura 2000 site may also require Ministerial Consent under Regulation 30.

The Wildlife Acts

The Wildlife Acts, 1976 to 2012, contain a number of provisions relating to invasive species covering several sections and subsections of the Acts. With regard to exotic species, it is prohibited without a licence to plant or otherwise cause to grow in a wild state, in any place in the State, any species of flora, or the flowers, roots, seeds or spores of flora.

In relation to the management of invasive species, the Wildlife Amendment Act 2000 (S.46.1) provides that it is an offence to cut, grub, burn or destroy any vegetation on uncultivated land or such growing in any hedge or ditch from the 1st March to the 31st August. Exemptions include the clearance of vegetation in the course of road or other construction works or in the development or preparation of sites on which any building or other structure is intended to be provided.

European Conventions

Ireland has also ratified a number of European conventions including

- Convention on Biological Diversity
- Bern Convention
- International Plant Protection Convention

The ratification of these conventions obliges the Irish government to address the issue of invasive alien plant species.

SUD Directive and PPP Regulations

The main method of managing IAPS is through the use of pesticides *i.e.* herbicides and the burial of recovered spoil. In addition to the statutory obligations discussed above the following are relevant to the management of invasive species using herbicides and burial of recovered spoil:

- Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides *i.e.* the 'Sustainable Use of Pesticides Directive' or 'SUD'
- European Communities (Sustainable Use of Pesticides) Regulations, 2012, (S.I. No. 155 of 2012)
- Regulation (EC) No. 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC- 'Plant Protection Products Regulation'
- European Communities (Plant Protection Products) Regulations, 2012 (S.I. No. 159 of 2012)
- Waste Management Acts, 1996 to 2013, and related legislation.

Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 more commonly referred to as "the Sustainable Use Directive" or "SUD", aims to establish a framework for Community action to achieve the sustainable use of pesticides. It was transposed into Irish law by Statutory Instrument No. 155 of 2012, European Communities (Sustainable Use of Pesticides) Regulations 2012. The European Communities Sustainable Use of Pesticides Regulations 2012 (S.I. 155 of 2012) places additional restrictions and, in some cases, prohibitions, on the use of pesticides in certain restricted and sensitive areas (referred to herein as SUD restrictions and restricted/sensitive areas). These SUD restrictions and restricted/sensitive areas include transport routes (such as railway lines); areas used by the general public or defined vulnerable groups (*e.g.* public parks, hospitals, public schools and public playgrounds); and Natura 2000 sites.

There are also safeguard zones or exclusion zones (see Table 1.1) where no plant protection products can be applied in order to protect surface water abstraction sources (*e.g.* areas for the abstraction of drinking water such as surface waters, springs, wells or boreholes) and groundwater vulnerable landscape features (*e.g.* karst areas, sinkholes, collapse features).

Table 1.1 Safeguard Zones for Open Wells, Boreholes and water abstraction points

Water Source	Distance
Abstraction point of any surface waters, borehole, spring or well used for the abstraction of water for human consumption in a water scheme supplying 100 m^3 or more of water per day or serving 500 or more persons	200 m
Abstraction point of any surface waters, borehole, spring or well used for the abstraction of water for human consumption in a water scheme supplying 10 m^3 or more of water per day or serving 50 – 500 persons	100 m
Abstraction point of any surface waters, borehole, spring or well used for the abstraction of water for human consumption in a water scheme supplying 1-10 m^3 of water per day or serving 10-50 persons	25 m
Abstraction point of any surface waters, borehole, spring or well used for the abstraction of water for human consumption in a water scheme supplying 1m^3 or less of water per day or serving 10 or less persons	5 m

It should be noted that the gathering of data on SUDS Restrictions and Restricted/Sensitive Areas is essential to the preparation of an IAPS management plan, as the presence of any such constraints will underpin the ability to deploy chemical herbicides, the selection of chemical herbicide, timing and application methods. In this regard, pesticides selected for use on any site should be fit for the purpose for which they are intended. Details of permitted pesticides authorised for use by the Irish competent authority, the Pesticide Registration and Controls Divisions and the Pesticide Control Laboratory of the Department of Agriculture Food and the Marine (DAFM) can be found at http://www.pcs.agriculture.gov.ie/.

Only a Registered Professional User (RPU) with the Department of Agriculture, Food and Marine can apply herbicides authorised for professional use from the 26th November 2015. A risk assessment and method statement for the management of IAPS should be prepared by an IAPS Specialist Ecologist in conjunction with an IAPS Specialist Contractor to take into account the various constraints/disturbance regimes/SUDS restrictions identified in an IAPS management plan and should propose and detail site specific control measures to avoid or minimise these risks including adherence to Regulation 12 of SUD Directive which identifies the requirement to complete specific site records as part of pre- and post-treatment reporting.

Waste Management

Specific obligations under the Waste Management Acts, 1996 to 2013, and related legislation pertaining to the waste categorisation of spoil and burial onsite or offsite are unclear in the absence of guidance from the Environmental Protection Agency (EPA) for Japanese knotweed contaminated soil.

The EPA has recently clarified that a Waste License is required under the Waste Management (Licensing) Regulations 2004 to bury soil contaminated with vector material within a site.

As discussed above a license application to NPWS is required under Regulation 49(2) European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2011) in order to transport soil or spoil *i.e.* vector material containing Japanese knotweed, Giant knotweed and Bohemian knotweed off site.

Appendix II

INVASIVE SPECIES

A. JAPANESE KNOTWEED

A.1 Species Description & Ecology

Native to Japan, northern China, Taiwan, and the Korea peninsula, Japanese Knotweed (*Fallopia japonica*) is an invasive perennial herbaceous plant which was introduced to Europe in the 1820's.

The first record for Japanese knotweed in Europe appears to be from an artificial wetland habitat in Chiswick, London from 1825. A second introduction to Europe is known from 1847, to a nursery in Leiden, The Netherlands. In 1850, Japanese knotweed plants arrived at the Royal Botanical Gardens at Kew, UK, and by 1854, the plant, had also arrived at the Royal Botanic Gardens in Edinburgh.

Japanese knotweed plants were subsequently sold by commercial nurseries around the UK and Europe as it became one of the most popular garden plants of the 19th Century. During this period the sharing of cuttings and the discarding of unwanted rhizomes was the primary pathway for dispersal. While it was originally planted for its foliage and "attractive" white flowers, in later years Japanese knotweed was also promoted as a potential source of animal fodder. Of note is that the plant could still be found widely available for sale in garden centres in the 1930s and even up until the 1980s in the UK (Bailey & Connolly, 2000; History of Japanese Knotweed in Europe — University of Leicester).

The first naturalised record of Japanese Knotweed in Ireland is dated 1905 from a garden in Dublin. Since its introduction to Ireland, it has spread across the island, particularly along watercourses, transport routes and in waste or disturbed ground. During the 'Celtic Tiger' years, in particular, rhizome fragments were dispersed as a result of soil movement associated with road building and other construction projects.

A.2 Invasive Qualities

In its native countries, it is found growing along riverbanks, roadside verges, managed pastures and in sunny places on hills and high mountains. Over thousands of years, it has evolved to become one of the first species to colonise lands within 20 years of volcanic activity and is replaced by other herbaceous species after 50 years or so. It typically reaches 0.3 - 1.5m tall and is attacked by a suite of 226 natural enemies, including insects and fungi, which keep it in check.

In Ireland (and other countries to which it has been introduced worldwide), the absence of natural enemies combined with its ability to colonise volcanic landscapes means that the plant can grow unchecked reaching heights of up to 3-4m, to form dense colonies, and like a number of tree species is capable of accessing existing weaknesses or joints in bitumen, concrete, stone masonry and hard standing areas; thus, causing impacts to hard landscaping or services (see Photographs A.1, A.2 and A.4).

Japanese knotweed has an underground network of stems known as rhizomes. In more mature Japanese Knotweed plants, a central rhizome 'crown', develops from which the main stems emerge above ground (see Table A.1 for details of the plants life cycle). The ability to penetrate existing weaknesses and joints comes from its underground rhizome network.

Underneath, the central crown, the radial rhizomes twist together to form a sizeable and considerable upward penetrating force. As the plant matures the crown expands thus opening up existing weaknesses such as cracks or joints which may cause damage to hard landscaping or services. However, while Japanese knotweed has the ability to cause damage, it rarely does so, as rhizomes will typically grow around any objects and structures which they encounter.

Photograph A.1 Japanese Knotweed breaking through a bituminous surface in Cork City (Source: John O' Donovan, O' Donovan Agri-Environmental Services)

The crown also acts as the plants' carbohydrate food store during the winter months when the leaves die back. While most of the plants' rhizomes are found in the top 0.25m of the soil, they can also go deep into the soil and extend up to several metres out from the plant, depending on ground conditions and disturbance regimes. Based on the authors experience of recovering Japanese knotweed vector material from a broad range of sites across Ireland, rhizomes of Japanese knotweed have rarely been found to extend beyond 3m laterally and 2.5m deep.

Fennell *et al*. (2018) demonstrated that even large stands of Japanese knotweed do not usually produce rhizomes that extend further than 4m. The study found that Japanese knotweed rhizomes rarely extend more than 4m from above ground plants and are typically found within 2m for small stands and 2.5m for large stands. Similarly, the mean vertical

extent recorded averaged between 1.02m for the small stands and 1.64m for the large stands, (with a maximum of 3.2m recorded).

While Japanese Knotweed is generally not considered capable of producing viable seeds in Ireland (in simplistic terms only female cloned plants are present), the species displays an extraordinary ability to disperse and rapidly regenerate predominantly from rhizome (but also stem) fragments to colonise and invade disturbed land. Previous studies indicated that less than 0.7g of a rhizome can produce roots and shoots in 10 days, however, current research indicates that viable rhizome fragments are typically larger (see Table A.2).

Photograph A.2 Japanese Knotweed having gained internal access to a private dwelling in Co. Cork (Source: O' Donovan Agri-Environmental Services)

Under favourable conditions it can grow up to 10cm a day and can rapidly invade disturbed ground in the absence of native vegetation. No correlation between soil type, plant size or vigour has been identified, suggesting that it can grow on any substrate.

While Japanese Knotweed is generally not considered capable of producing viable seed, it has evolved in terms of its ability to hybridise with close relatives *e.g.* Giant Knotweed to produce Bohemian Knotweed which is capable of producing viable seed.

It also has a number of plant defence mechanisms which it may deploy when under threat including an ability to remain dormant underground for a number of years following chemical herbicide treatment; known as chemical dormancy. It can also produce bonsai regrowth in

response to cutting and sub-lethal bonsai regrowth in response to chemical herbicide treatment (see Table A.3). Bonsai regrowth is cryptic given its small size, unusual stem and leaf colour and morphology and is therefore easily overlooked in the absence of a specialist survey (see Photograph A.3).

Photograph A.3 Bonsais of Japanese Knotweed within amenity grassland in Cork City (Source: Lisa M. J. Dolan, Ecosystem Services)

Knotweed has the ability to execute the following plant defence mechanisms in response to herbicide:

- Sub-lethal bonsai regrowth (see Photograph A.3)
- Lateral growth of rhizomes and development of new radial shoots
- Chemical dormancy - rhizomes can lay dormant and viable for a number of years before regrowth
- Compartmentalisation
- Resistance or tolerance to standard chemical herbicide-based programmes

Japanese Knotweed can also respond to cutting or burial by deploying a number of other plant defence mechanisms. Therefore, to cut, flail, mow, dig or bury the plant may only result in:

- Dispersal of plant fragments which can regrow elsewhere
- Bonsai regrowth
- Rapid regrowth and increase in the height and extent of the plant
- Lateral growth of rhizomes and the development of new radial shoots
- Regrowth from buried depths of <5m
- Buried rhizomes can survive for up to 20 years

Given the plant defence mechanisms displayed by this species, herbicides should only be applied by those who are qualified and have knowledge and understanding of the ecology of the plant and industry best practice treatment options to eradicate the species.

Photograph A.4 Japanese Knotweed breaking through cavity blocks resulting in a structural crack in the wall of a garden in Co. Cork (Source: Lisa M. J. Dolan, Ecosystem Services)

A.3 Impacts from Japanese Knotweed

In terms of ecology, landscapes and amenities, Japanese knotweed is known to have potential significant negative ecological impacts on native habitats and species, on landscape character and quality, and on visual and recreational amenities.

In relation to semi-natural habitats, the species out-competes native herbaceous and juvenile woody plants, reducing species diversity (see Photograph A.5). Once established the height, dense canopy and aggressive nature of the plant essentially excludes other species.

In addition, Japanese Knotweed has also been shown to have allelopathic effects on native vegetation, permitting germination but limiting biomass.

Along riverbanks, new shoots have been observed developing primarily from floating stems from which fragments can be broken off by floods which lodge downstream to form new outlier populations; therefore, an upstream catchment wide management approach is required to achieve eradication of knotweed species along habitats where there is upstream surface water connectivity.

Photograph A.5 Japanese Knotweed dominating riverbanks of a stream in Co. Kerry (Source: Lisa Dolan, Ecosystem Services)

In Ireland, Japanese Knotweed is often associated with roadsides, railways, car parks, car wash facilities, quarries, maintenance depots, abandoned/waste ground; in particular, disturbed areas where native vegetation is absent and where fly-tipping of spoil has occurred.

During landscaping and construction activities Japanese Knotweed can be disturbed by machinery, and spread within or be brought onto a site, in the form of plant fragments within the soil load or on the tyres of machinery and dumpsters, especially on machinery with tracks. The maintenance of Japanese Knotweed by mechanical methods such as cutting and strimming can distribute fragments, which can then be carried along road corridors by wind or on the tyres of vehicles including cars (see Wace, 1977; Wilcox, 1989). Fragments can also be carried on the footwear of pedestrians. Cutting and mowing results in the creation of bonsai regrowth which can go undetected.

With regards to increased flood risk, Japanese knotweed once established can dominate watercourses where it may impede water flow through the obstruction of conveyance (or drainage) in ditches, streams, and rivers, particularly when water levels are high; thus,

contributing to flooding. During senescence or winter dieback, Japanese knotweed may leave riverbanks exposed to erosion, leading to bank collapse.

Land use and access to lands and infrastructure can also be impacted or restricted where large dense monospecific stands block access routes, invade landscaped areas and open spaces such as gardens and urban parks/woodlands, impact on the quiet enjoyment and use of domestic gardens, encroach on roadways and agricultural fields, and occupy large swathes of unmanaged lands. Signage and sightlines on roadways can also be impinged. In addition to these impacts, Japanese knotweed, like certain tree species, also has the ability to access existing weaknesses and joints and may in certa*in situ*ations cause damage to footpaths and hard landscaping and based on experience may impact on more vulnerable structures such as old stone masonry walls and walls constructed from cavity blocks. However, while Japanese knotweed has the ability to cause damage, it rarely does so, as rhizomes will typically grow around any objects and structures which they encounter.

Table A.1 Life Cycle of Japanese Knotweed

Details	Photographs
An excavated crown structure in winter. Old dead stems from previous years growth are scattered on the ground	
Crown *in situ* with pink buds and stems emerging in early spring	

Details	Photographs
Red stems turning green as the plant grows, red leaves unfurl in late spring	
Red leaves changing to green as stems grow in early summer	
Fully opened leaves in summer	

Details	Photographs
Japanese knotweed commences flowering from July onwards	
Senescence or winder dieback occurs after flowering and depends on local day and night temperatures and other environmental stress factors. Typically occurs from September onwards	
After leaf fall, only the crown structures with dead stems remain in winter. The dead stems may persist over winter or break off and fall to the ground.	

Japanese knotweed has acquired its infamous reputation, as it exhibits a number of characteristics which are not typically displayed by those tree species whose roots have the potential to damage infrastructure. Namely, it is a rhizomatous species which can be easily dispersed, it exhibits a rapid growth pattern and is considerably more tolerant to chemical herbicide, thus making it significantly more difficult to eradicate than most trees. However, onsite experience and recent research has shown that it does not live up the reputation it has previously been afforded in terms of risk to infrastructure (see Fennell *et al*., 2018 for further details).

A.4 Legal Obligations

In light of the potential risk of negative impacts posed by Japanese knotweed on semi-natural habitats, it is a 'listed' species under Irish legislation *i.e.,* the Third Schedule: Part 1 of the European Communities (Birds and Natural Habitats) Regulations 2011 to 2015 which is a list of invasive alien plant species subject to restrictions under Regulations 49 & 50.

Regulation 49 of the European Communities (Birds and Natural Habitats) Regulations 2011 to 2015 deals with the 'Prohibition on introduction and dispersal' while Regulation 50 deals with the 'Prohibition on dealing with and keeping certain species'. Regulation 50 has yet to be enacted into Irish law (http://www.irishstatutebook.ie/eli/2011/si/477/made/en /print and http://www.Irishstatutebook.ie/eli/2015/si/355/made/en/print).

Japanese knotweed is also listed under the Third Schedule: Part 3 Vector Materials of the European Communities (Birds and Natural Habitats) Regulations 2011 to 2015. Part 3 governs the movement of soil or spoil taken from places infested with Japanese knotweed, Giant knotweed (*Fallopia sachalinensis*) or their hybrid Bohemian knotweed (*Fallopia* x *bohemica*). A license application to National Parks and Wildlife Service (NPWS) is required under Regulation 49(2) in order to transport soil or spoil *i.e.* vector material containing Japanese knotweed, Giant knotweed and Bohemian knotweed off a site.

Table A.2 Establishment of Japanese Knotweed from a Rhizome Fragment

Details	Photographs
Rhizome fragment recovered from the ground	

Details	Photographs
Transverse section through the rhizome fragment showing evidence of viable (**orange**) tissue when cut open.	
Signs of new rhizome growth are visible on the old rhizome fragment. New white rhizomes are emerging.	
The **growing tip** of the rhizome is initially white. The rhizome becomes dark brown, thick and woody with a knotty appearance as it matures.	

Details	Photographs
New leaves emerging from a rhizome fragment	
New plant leaf appearing above ground from a buried rhizome fragment	
Young plant emerging from a buried fragment in the ground	

Details	Photographs
Multiple young plants emerging from buried rhizome fragments	
Leaves will change from red to green and start photosynthesising as the growing season progresses. After 4 years of spring/summer growth and winter dieback the plant will start to develop a crown structure as per Table 2.1.	

The licensing process is required to ensure that in circumstances where vector material is to be taken off site for disposal, that it is appropriately disposed of at a licensed receiving facility.

The licencing process also requires that best practice is deployed throughout all stages of the recovery process *i.e.* during excavation of the vector material at the donor site, transportation by the haulage company along the public road network and during disposal at the receiving facility. This level of scrutiny is necessary as any fragments of rhizomes or stems which are accidentally dispersed during the recovery process can readily sprout shoots and establish new plants within the donor site, along the public road network, or indeed, at the receiving facility.

A.5 Control & Management Programmes

The foliar application of chemical herbicide usually requires up to 3 years (+) of treatment to acquire an effective reduction in the viability and eradication of the underground rhizome network; as sufficient herbicide has to enter the plant via the leaves and travel to the underground network to achieve eradication. Alternative methods of delivering a higher and

more effective dose of herbicide to the underground rhizome network via the stem, are referred to as stem injection or stem filling. As the names suggest these methods involve directly introducing herbicide to the stem of the plant such that a larger dose of herbicide reaches the underground rhizomes. This achieves a higher effective kill and/or eradication of the underground rhizome network in a shorter period of time, reducing future risk to a development by reducing the extent of any regrowth. As stem injection and stem filling are labour intensive, and more costly to deploy than foliar application, they are only deployed where time is a limiting factor, or where sensitive habitats exist in close proximity to the Japanese knotweed (which could be indirectly impacted from spray drift during the foliar application of herbicide), or where crowns are found to be growing up against infrastructure.

Treatment via the foliar application of chemical herbicide should be undertaken during the optimum treatment period. The optimum treatment period for the deployment of chemical herbicide treatment (on an annual basis), to Japanese knotweed is dependent on the timing of the plants' annual growth cycle, its unusual plant physiology, seasonal factors and local day and night temperatures. It is considered best practice to spray after the commencement of flowering and before the first frost *i.e.* the commencement of senescence. Flowering typically commences between July and October each year. Japanese knotweed goes into senescence (commences winter die back) after the first frost. It is important that Japanese knotweed is sprayed each year before the commencement of senescence to ensure that a maximum effective dose is delivered to the underground rhizome network of the plant and to avoid triggering the plants defence mechanisms.

A treatment programme should be followed by monitoring and viability testing of the underground rhizomes of Japanese knotweed at the location of each infestation to determine the presence/absence of viable plant tissue in the underground rhizome network as per Paragraph B2.8 of The Control of Japanese Knotweed (*Fallopia japonica*) in Construction and Landscape Contracts (Welsh Government, 2011) on completion of the growing season in the fourth and fifth year following a 3 yr treatment programme. Whether 'eradication' of Japanese knotweed has been achieved should be determined by the IAPS Specialist Ecologist.

Inappropriate Treatment

It should be noted that the inappropriate deployment of herbicide during the treatment of knotweed species can result in the following:

D. Above ground kill of leafy vegetation *i.e.* '**Top Kill**' only (with viable stems remaining post-treatment)
E. **'Partial'** above ground kill of vegetation (green leaves and/or viable stems remaining post-treatment)

'Top Kill' or 'Partial Kill' of leafy vegetation and stem tissue may trigger:

I. The creation of dormant rhizomes below ground which can go undetected for several years before regrowth
II. Rapid regrowth the following April resulting in an increase in the height of the infestation

III. The activation of dormant rhizomes the following April resulting in an increase in the extent of the infestation and the active rhizome network
IV. Lateral growth in the rhizome network the following April resulting in an increase in the extent of the infestation
V. Slow regrowth of the plants with smaller, curled, or red leaves and red stems which are cryptic; known as sub-lethal 'bonsai' regrowth the following growing season. Plants displaying sub-lethal bonsai regrowth are not receptive to herbicide treatment.

'Top Kill' or 'Partial Kill' are most likely to occur where:

I. An incorrect chemical herbicide is used
II. A sub-lethal dose of chemical herbicide is used (too little or too much herbicide)
III. The correct chemical herbicide is used outside of the optimum treatment period *i.e.* at the incorrect time of year or seasonal plant cycle /plant growth stage
IV. Weather conditions are not suitable *i.e.* significant spray drift/volatilisation or rain/dew pre- or post-treatment
V. Poor application methods are deployed
   - The equipment utilised is not to the standard required
   - Herbicide is not applied to the canopy/leaves in accordance with best practice
   - Herbicide is not applied to entire canopy; access not gained to the adjacent property or to the necessary height in order to treat the entire stand

Consequences for a Development Site

The main consequences of Top or Partial Kill in relation to a development site are as follows:

Top Kill

- The viability of plant tissue in the underground rhizome network will not have been effectively reduced and continues to remain highly viable. The treatment will therefore have been rendered ineffectual.
- The unproductive use of herbicide in the environment
- The creation of a protracted *in situ* treatment regime going forward with associated costs and delays to commencement of Site Clearance and construction at the site.
- Plants may exhibit a greater resistance to chemical herbicides in the following growing season

Partial Kill

- The viability of plant tissue in the underground rhizome network will not have been effectively reduced and continues to remain highly viable. The treatment will therefore have been rendered ineffectual.
- The plant will be in a position to transport carbohydrates to the crown for food storage for the winter months
- The remaining presence of highly viable rhizome tissue post treatment means that there will continue to be a high risk of dispersal and regrowth from these plant fragments *e.g.* where it is proposed to remove the soil containing vector material of

Japanese Knotweed off site there is a higher risk of regrowth and the donor and receiving facility.

- The unproductive use of herbicide in the environment
- The creation of a protracted *in situ* treatment regime going forward with associated costs and delays to commencement of Site Clearance and construction at the site.
- Plants may exhibit a greater resistance to chemical herbicides in the following growing season

Inappropriate Biosecurity Measures

The inappropriate deployment or lack of biosecurity measures during the treatment of knotweed species can result in the dispersal of viable plant fragments by the following vectors:

A. Accidental physical disturbance during the deployment of herbicides or recovery of soils resulting in the dispersal of plant fragments on tools, footwear, wheels of vehicles, in surface water runoff *etc*.
B. Where mechanical cutting methods are selected to gain access to a stand to 'assist' treatment of large stands resulting in the dispersal of plant fragments and the reduced receptivity of the plant to herbicide and therefore effectiveness of the treatment

As a result, there will be a higher risk of dispersal of viable plant fragments within a site and off site to adjacent lands, semi-natural habitats, watercourses, licensed waste facilities, plant hire facilities, waste segregation hire facilities, other development sites, refuelling depots, service areas, private residences, road networks and other sites.

Details of the classification, risk assessment and legislative requirements in relation Japanese knotweed, are presented in Appendix I.

Table A.3 Bonsai and Sub-lethal Bonsai Regrowth

Details	Photographs
Bonsai regrowth is a particular miniature growth form of Japanese knotweed which is triggered by the plants defence mechanisms in response to frequent cutting. The bonsai plant will persist unless the mowing regime ceases.	

Details	Photographs
Sub-lethal bonsai regrowth is another particular miniature growth form of Japanese knotweed which is triggered by the plants defence mechanisms in response to the inappropriate use of chemical herbicide.	

B. BUDDLEIA

B.1 Species Description & Ecology

Buddleia (*Buddleja davidii*) is a deciduous shrub native to China, that grows 1-4m tall with arching stems. The leaves are opposite, 10-20 cm long, and lanced-shaped with a slightly serrated edge and a felted-velvety whitish under surface.

It typically flowers during the period June to September, when dense clusters of tubular flowers develop. These flowers have 4 petals and can be purple, white, or pink. The flowers produce high quantities of nectar and are attractive to butterflies, hence the common name – Butterfly Bush.

The desiccated flower heads and seed capsules may remain on the shrub over winter. The developing seed pods are small upright and ovate and may not be readily visible through the remnants of the flower. When mature, the pods area a dark brown and opened at the tip. The seeds produced are extremely small and numerous with up to 3 million produced per plant. The seeds are dust-like particles which can easily be distributed by the wind. They can also remain viable in soils and gravels for many years (https://www.invasiveplantatlas.org/subject. html?sub=11608; NRA, 2010).

Although butterflies use Buddleia as a nectar source, their larvae cannot survive on it. By replacing native larval food source plants, Buddleia can have a negative impact on wildlife (https://www.invasiveplantatlas.org/subject.html?sub=11608).

B.2 Invasive Qualities of Buddleia

Buddleia as a prolific reseeder can quickly establish scrub transitional communities, in particular disturbed sites. Like many invasives, it can rapidly colonise bare ground forming mono-typic stands.

As buddleia can tolerate nutrient poor soils, it is capable of growing on walls, rocky outcrops or sub-soils. Buddleia can also readily establish on very dry hard standing areas constructed

from gravel, and other similar compacted loose materials, and in cracks and crevices in old concrete and bituminous finished surfaces.

In particular, Buddleia creates issues on road schemes where features are being left to re-colonise naturally as in rock cuttings, eskers, *etc*. (NRA, 2010) for wildlife conservation purposes.

It can result in considerable maintenance of landscaped areas and hard standing, in particular car parks, yards, brownfield sites, building sites, quarries and road schemes.

B.3 Control & Management Programmes

According to Ream (2006) formulations of glyphosate effectively control Buddleia up to two years old; where required it should be followed up at 6 monthly intervals.

For more mature plants a combination of spraying the entire plant and painting herbicide concentrate on recently cut stumps is effective in controlling Buddleia (Ream, 2006), thus preventing the dispersal of seeds within a site and into the surrounding landscape.

According to NRA (2010) recommended practice for the application of herbicides requires the cutting back of plants to a basal stump during active growth (late spring to early summer) which is then treated (brushed on) immediately with a systemic weed killer mix (Starr *et al*., 2003).

Even after the Buddleia shrub has been cut down, a new sprout may grow from the stump. In order to completely eradicate the shrub, it may be necessary to remove the stump using a stump grinder or similar to grind the stump down to ground level, followed by digging out major connecting roots.

It is also possible to kill the stump using accelerated decay to rot the stump before removing it. To use this method, a series of holes are drilled into the top and sides of the stump. The holes are then filled with slow-release fertilizer and watered well before the stump is covered with a mound of soil to begin the process of decay. After a few weeks, the stump will have rotted from the inside out and ready for removal.

Management methods such as digging it out (grubbing) are applicable only to minor infestations at the initial stage of invasion. Hand-picking of young plants is feasible but should be undertaken with care to avoid soil disturbance which can give rise to a flush of new seedling. Grubbing of mature stands as a sole attempt at control is not recommended for the same reason.

After uprooting, it is essential to monitor for regrowth and treat with chemical herbicide or to plant the ground in order to prevent a flush of new seedling growth. Mowing of young plants does not provide control as they re-sprout with vigour.

Where removal of mature plants is not feasible in the short term, the flower heads should be cut off in June before seeds are released. Where desiccated flower heads and seed capsules remain on the tree over winter these can also carefully be removed to minimise further dispersal.

C. THREE-CORNERED GARLIC

C.1 Species Description & Ecology

Three-cornered garlic (*Allium triquetrum*) is native to the west and central Mediterranean (Preston *et al*., 2002; Stace, 1997) including Portugal, Southern Spain (including the Balearics), France (including Corsica), Italy (including Sardinia and Sicily) and Africa: Algeria, Morocco and Tunisia (Dowen, 2011).

It is thought to have been introduced to Ireland some three-hundred years ago (Devlin, 2014) and has become established in the south and southeast of Ireland, outside of which it has a scattered occurrence (Preston *et al*, 2002; Reynolds, 2002; Stace, 1997). A large discrepancy between the Botanical Society of Britain and Ireland (BSBI) maps and those of the National Biodiversity Data Centre (NBDC) suggest that the true extent of the species in Ireland may be greater. It is likely, as in the case with many alien plants, to be poorly reported in that many of the sites it grows in are in large demesnes or wild gardens, many of which are privately owned and often not recorded as 'wild' places as they border the margins of cultivation. The extent of Waterford and Wexford records is largely due to intensive floristic work in these two counties.

C.2 Invasive Qualities

Typical habitats where it is known to invade or naturalise include hedgerows, parks, footpaths, roadsides, waste areas, disturbed/cultivated sites, orchards, open woodlands, forests, moist pastures, riparian areas (Reynolds, 2002; Stace, 1997) and gardens. The species is also intentionally planted in gardens.

In Ireland the Three-Cornered Leek flowers from April to June. In Western Australia, time to first flower from seed is 2 years with a medium seedbank persistence of 1 to 5 years and generally survives fire (https://florabase.dpaw.wa.gov.au/browse/profile/1378).

Three-Cornered Leek is known to spread via natural and human assisted dispersal. Human assisted dispersal plays a greater role in the long distance spread of the species relative to natural dispersal.

Localised spread of the species is likely underpinned by natural dispersal. It can spread vegetatively in clumps producing daughter bulbs, while seeds are spread by ants (BSBI, 2011; Preston *et al*., 2002). According to Davies (1992) the seeds have an oil-bearing appendage which is attractive to ants. Thus, the ants carry the seed away to eat the oil and then discard the seed, thus aiding dispersal of the plant.

Anthropogenic dispersal occurs through garden waste, transportation of bulbils and/or seeds on grass-cutting equipment, while the seed can also be transported in the air turbulence created by vehicles along road corridors which is likely to be the most significant means of future long distance spread of the species, with roadside verges the most at risk habitat to future spread (Dowen, 2011, BSBI, 2011).

Further spread of the species is dependent on suitable climatic conditions, which are likely to manifest over the coming years as a result of global warming. Habitat availability is not expected to be a limiting factor to future spread.

There is no published literature on the impact Three-cornered Leek on biodiversity in Ireland to-date. It is known to become dominant in grass swards where it has been present for over 10 years, total cover can be as high as 10-33%. There is no data on the effects of such cover on native species especially as many other cultivated species (Narcissus, Crocus, Hyacinthoides *etc*.) are often present. In Australia, Three-Cornered Leek has been shown to reduce understory biodiversity significantly and to affect regeneration of native flora. It forms monocultures and its allelopathic traits endanger species such as orchids, native lilies and grasses (Tehranchian, 2011) (cited in http://nonnativespecies.ie/wp-content/uploads/2014/03/Allium-triquetrum-Three-cornered-Leek1.pdf).

C.3 Control & Management Programmes

There are no known eradication campaigns currently in place in Ireland for this species. Control in other countries has been shown to require a combination of manual cultivation, removal and herbicide spraying of the exposed bulbs (HerbiGuide, 2014). Recovery is easier to do in spring when surface vegetation is present, providing an indicator of the extent of the infestation and, ensuring that all bulbous material is removed.

In addition to Glyphosate and 2-4, D a number of other chemical herbicides have been identified in the literature, however, none of these are suitable for use or approved for use by the Pesticide Control Service for use in Ireland.

Annual spraying in early flowering stage *i.e.* before April is recommended as this will result in the application of herbicide at the bulb exhaustion stage.

When applying foliar herbicides, it is advised to use a wetting agent, especially on young plants as they are hard to wet given the limited surface area and run off associated with the narrow lanceolate waxy leaves and associated run off (https://florabase.dpaw.wa.gov.au/browse /profile/1378). Ideally leaves should be allowed to mature to provide maximum surface area for absorption of chemical and the waxy leaves should be bruised or trampled to increase uptake.

D. SPANISH BLUEBELL

D.1 Species Description & Ecology

The Spanish Bluebell (*Hyacinthoides hispanica*) is native to the western Iberian Peninsula (Portugal and western Spain) and North Africa (Hackney, 2008; Meek, 2011; Parnell and Curtis, 2012; Taylor, 2002). The common Bluebell, (*H. non-scripta*), is native to Ireland, Britain & western Europe as far south as central Spain (Hackney, 2008; Kohn *et al*., 2009 Taylor, 2002). The Hybrid Bluebell, (*H. hispanica* x *H. non-scripta*), is perhaps the commonest cultivated bluebell in gardens. In the wild this hybrid is said to arise spontaneously where the native and/or introduced ranges of the parents meet (Taylor, 2002). There are unresolved questions, however, about the taxonomic status of these taxa; whether the 'Spanish' Bluebell is the same as the bluebells in Spain and whether it is merely a subspecies of the common bluebell, as the two hybridise freely (BSBI, 2010; Rix, 2004; Taylor, 2002).

The Spanish Bluebell was introduced as a garden plant more than 300 years ago, but it took another 200 years before it was present in the wild. In the UK, the increasing distribution of the Spanish and Hybrid bluebell was recognised in the late 1980s (Kohn *et al*. 2009).

Spanish Bluebells have a localised distribution in Ireland, with most existing records of the species concentrated in the southeast and south, respective (Taylor, 2002; BSBI, 2010,). The hybrid bluebell's range and frequency are increasing but it is still unevenly recorded (Taylor, 2002). The Spanish Bluebell may be continuing to increase slowly, but it has long been confused with the hybrid and probably remains somewhat over recorded in error for the hybrid (Reynolds, 2002; Taylor, 2002; Hackney, 2008). A key to distinguish the different *Hyacinthoides* spp. can be found in Grundmann *et al*. (2010).

Spanish and Hybrid Bluebells are intentionally planted domestically in horticultural habitat *e.g.,* gardens demesnes, parkland, churchyards, cemeteries. From cultivation in horticultural habitat, the species can spread via natural and human assisted dispersal into the wild *e.g.,* woodlands, roadsides and waste ground. Spanish and Hybrid Bluebell are also intentionally planted in the wild, particularly woodland areas for perceived 'landscape improvement' and 'wildlife value'.

The Spanish and Hybrid bluebell are spring-flowering, bulbous perennials, producing the fresh season's leaves in about December (Kohn *et al*., 2009).

The Spanish Bluebell and Hybrid is fully fertile and produces abundant seed. All bluebells retain much of their seed in the papery fruits until well into the winter and leaves die back completely from about the end of summer (Hackney, 2008). The plant can establish from seed sown at any time of the year (Seedaholic, 2014). The seeds of Spanish Bluebell take five years to reach the mature stage (Merryweather & Fitter 1995a; Van der Veken *et al*. 2007) and is likely due to plants taking time to accumulate enough resources to develop a bulb before allocating resources to flower production. Rix (2004) also reports that Spanish Bluebell typically only flowers after four years of age, indicating that flowering is dependent on resource accumulation rather than some internal mechanism that takes exactly five seasons of growth (cited in Allum, Lill, Natalie, 2016). Flower spikes appear in April and May and the flowers are insect-pollinated (Hackney, 2008). It is said to have no, to some, self-compatibility, with insect pollinators consisting mainly of Bombus species and syrphids (Corbet, 1998).

The longevity of the seed is not known, and no dormancy has been detected beyond the ability to remain quiescent through their first winter (Blackman and Rutter, 1954; Meek, 2011; Thompson and Grime, 1979). (cited in http://nonnativespecies.ie/wp-content/uploads/2014/03/Hyacinthoides-hispanica-Spanish-Bluebell-and-Hybrid.pdf). The bulb is entirely renewed annually and as a result flowering and plant size are sensitive to drought and leaf loss experienced in the previous year (Blackman and Rutter, 1954; Littlemore and Barker, 2001). The bulb renewal process can sometimes lead to the bulb splitting in two *i.e.* clonal reproduction (Wilson 1959; Grabham & Packham 1983; Merryweather & Fitter 1995a). Seeds have no apparent adaptations for dispersal (Knight, 1964) (cited in Allum, Lill, Natalie, 2016). Seedling survival and establishment is facilitated by mycorrhizal associations (Merryweather and Fitter, 1995).

There is a dearth of information to be found in the literature about the fecundity and dispersal of Spanish Bluebell and the native Bluebell. Spanish Bluebells are however considered to be poor natural dispersers and spread of the taxa is thought to be largely depended on human-

assisted dispersal. (cited in http://nonnativespecies.ie/wp-content/uploads/2014/03/Hyacinthoides-hispanica-Spanish-Bluebell-and-Hybrid.pdf). Natural seed dispersal is achieved when the raceme and fruit dry and the plants collapse or are knocked to the ground by wind action or by animals, *i.e.* barochory (Honnay *et al*. 1999). Van der Veken *et al*. (2007) reported very slow spread for the English Bluebell, and due to their similar dispersal method, this is likely also true for the Spanish Bluebell. Kohn *et al*. (2009) suggest that, if the spread is indeed equally slow, then hybridisation is likely the bigger threat to the native Bluebell (cited in cited in Allum, Lill, Natalie, 2016).

D.2 Control & Management Programmes

Bluebells are resistant to many herbicides commonly used in the garden. Applications of herbicide are best made after the plant has flowered in April and May. Flower heads should be cut to prevent the formation of seed. Repeat applications may be required to deplete the soil seed bank, although a persistent seed bank is not associated with Spanish Bluebell as no dormancy has been detected beyond the ability to remain quiescent through their first winter (Blackman and Rutter, 1954; Meek, 2011; Thompson and Grime, 1979). The seeds of Spanish Bluebell take five years to reach flowering (Merryweather & Fitter 1995a; Van der Veken *et al*. 2007).

The plants and bulbs can be mechanically excavated and removed. The best time to undertake mechanical control is early spring before the plant starts flowering. These perennial plants form large clumps via self-seeding and are said to send out underground runners that spread rapidly and form new bulbs, although the presence of runners is disputed by some. It is important to ensure to uproot all of the bulbous material and associated runners where present. Where all bulbous material is not removed regular follow up will be required with chemical herbicide to deal with regrowth from bulbs or split bulbous material.

E. WINTER HELIOTROPE

The recommended optimum treatment period for the deployment of Glyphosate to Winter Heliotrope is February and March after flowering or in mid to late summer according to the NRA (2010). New foliage begins to appear after flowering later in spring (though last years' foliage may not dieback completely). Winter Heliotrope flowers between January and March and in certain climatic conditions the plants flower between November and March (http://www.irishwildflowers.ie/pages/200a.html;(http://www.irishwildflowers.ie/pages/200a.html; http://www.irishwildflowers.ie/pages/433a.html).

According to NRA (2010) the recovery of Winter Heliotrope vector material can be undertaken at any time of year. It is important to ensure to uproot the entire rhizome network. Where all rhizomes are not removed regular follow-ups will be required to deal with regrowth from rhizomes. Deep burial (more than 2m deep) of recovered material is recommended (NRA, 2010).

It is understood that the control of Winter Heliotrope is currently the subject of an EPA funded project led by CERIS, Institute of Technology, Sligo which is targeting the Prevention, Control and Eradication of Invasive Alien Species (IAS) on the Island of Ireland.

F. MONTBRETIA

Non-chemical treatment, chemical treatment, or a combination of both can be employed to remove this species.

Physical control of Montbretia is difficult as the corms break up from their chains very readily and cause re-infestation or further spread. Where infestations are limited in extent, the entire stand of Montbretia can be controlled by removing the plants and corms (NRA, 2010; Weeds of New Zealand, 2016) and burying them to a depth of at least 2m, alternatively they can be incinerated or disposed of to a licensed landfill. Corms should be disposed properly in order to avoid re-sprouts. It should be noted that the corms are very hardy and are not suitable for composting.

As Montbretia is capable of regeneration from corms and small fragments of rhizome, all material must be handled and disposed of in a way which does not result in the potential for further spread. Small pieces of plant material may be spread unintentionally on shoes, clothes, and agricultural equipment; therefore, biosecurity protocols should be strictly adhered to at all times.

According to DAFM, the most effective time to excavate Montbretia is just before full flowering occurs in summer, while NRA (2010) states that excavation can take place at any time of the year, when the soil is suitably dry.

Due to the potential for reinfestation from corms and fragments of rhizomes, regular follow-up with chemical herbicide may be required for a number of years to deal with any regrowth (NRA, 2010;(https://www.agriculture.gov.ie/media/migration/farmingschemesandpayments/glastraining/MontbretiaFinalDraft230616.pdf).

Chemical control can be achieved using glyphosate or Metsulfuron during active growth in late spring or summer with foliar spray, wiper applicator or spot treatment (NRA, 2010). In Australia and New Zealand, herbicides such as glyphosate and Metsulfuron-methyl have been used to control infestations of Montbretia (Ensbey *et al*., 2011; Weeds of New Zealand, 2016; https://www.cabi.org/isc/datasheet/107826/aqb).

Complete eradication of Montbretia from a site may take a number of years. Non-chemical treatment, chemical treatment, or a combination of both can be employed to remove the species. As Montbretia is capable of regeneration from corms and small fragments of rhizome, all material must be handled and disposed of in a way which does not result in the potential for further spread. Small pieces of plant material may be spread unintentionally on shoes, clothes, and agricultural equipment. The most effective time to remove Montbretia is just before full flowering occurs in summer. Please note that control will require continued input and follow-up over a number of years to deal with any re-growth by corms or rhizomes (https://www.agriculture.gov.ie/media/migration/farmingschemesandpayments/glastraining/MontbretiaFinalDraft230616.pdf).

G. SYCAMORE

Sycamore trees can be felled and with herbicide applied immediately to the stump with a brush. Even after the sycamore tree has been cut down, a new sprout may grow from the stump. In order to completely eradicate the tree, the stump should be removed using a stump grinder to grind the stump down to ground level, followed by digging out major connecting roots. It is also possible to kill the stump using accelerated decay to rot the stump before removing it. To use this method, a series of holes are drilled into the top and sides of the stump. The holes are then filled with slow-release fertilizer and watered well before the stump is covered with a mound of soil to begin the process of decay. After a few weeks, the stump will have rotted from the inside out and ready for removal (https://homeguides.sfgate.com/methods-killing-sycamore-trees-27914.html).

H. TRAVELLERS JOY

Glyphosate can be used as a foliar spray or as a spot treatment for Traveller's Joy and should be applied in summer during active growth before senescence, when it is not very hot or during drought. Following control, regular monitoring will be required with appropriate follow up to deal with regrowth or new seedling germination over a period of 2–3 years.

For mature plants, they can be physically removed from the ground, or the vines can be cut back to ground level or waist height in winter or spring with a straight horizontal cut. Herbicide is then applied immediately to the wound with a brush and the subsequent regrowth can be then foliar sprayed. This method will avoid impacting on the host plant the vine may be covering. The plants should be left *in situ* until they are dead. Where plants are not killed in a single application, wait until re growth before re spraying.