

B Construction Activities and Management

4 **Construction Activities**

4.1 Introduction

This chapter describes the construction activities and sequencing for the proposed drainage scheme and outlines the general mitigation measures which will be implemented to ensure the potential impacts of the construction activities on the environment are avoided, prevented or reduced. Construction mitigation measures for specific issues such as biodiversity and ecology are detailed in the relevant chapters.

A construction environmental management plan (CEMP) will be prepared prior to construction commencing. The CEMP will comprise all of the construction mitigation measures, which are set out in this EIS, and any additional measures which are required by any conditions attached to the Minister for Public Expenditure's statutory confirmation of the Scheme under the Arterial Drainage Acts.

Implementation of the CEMP will ensure disruption and nuisance are kept to a minimum. The plan will have regard to the guidance contained in the handbook published by Construction Industry Research and Information Association (CIRIA) in the UK, Environmental Good Practice on Site Guide, 4th Edition (CIRIA 2015).

It is anticipated that, with the proper implementation, phasing and management of construction activities described in this chapter, the construction phase of the development will have no significant or long-term impact.

4.2 Main elements of the drainage scheme

The main aspects of the drainage scheme comprise construction works entailing the following:

- Replacement of a number of existing culverts;
- Replacement of Hazelwood Shopping Centre bridge with a larger vehicular bridge;
- 1 new flood relief channel and culvert at Hazelwood Avenue;
- Replacement of existing flood defence walls and construction of new flood defence walls;
- Modification to an existing earthen flood defence embankment and construction of a new earthen flood defence embankment;
- Five new surface water pumping stations and one foul pumping station;
- Localised in-channel conveyance improvements at culvert/bridge structures;

- Provision of civil works such as road/footpath re-grading at a number of locations;
- Protecting drainage outlets along the line of flood defence works with non-return flap valves;
- Non flood defence retaining walls; and
- Flow control structure on a millrace.

There will also be a number of trees and vegetation which will require removal to facilitate the works throughout the scheme area. The trees to be removed are shown in Drawing Series No 700, detailed in **Appendix 3.2** of this EIS.

It is also noted that many of the linear defences will require the temporary removal of boundary walls and fences to facilitate construction access (generally parallel with watercourses). These boundary walls/fences will be reinstated on completion in agreement with the landowners.

An outline of the methodology to construct the major elements of the works is described below.

4.3 **Outline Construction methodology**

4.3.1 General environmental considerations

The construction of the drainage scheme will be undertaken using industry standard construction methodologies. The anticipated construction methodology for the major elements of the scheme is described hereunder.

Traffic management will be set up for the works as required. Temporary road diversions and closures are likely to be required. Alternative access routes will be agreed with Cork County Council and An Garda Siochána. Refer also to the relevant chapters for specific construction details such as construction traffic management (**Chapter 14 Roads and Traffic**).

In-stream works associated with the drainage scheme will be carried out under the supervision of a suitably qualified and experienced ecologist. All in-stream works will be designed and carried out in consultation with Inland Fisheries Ireland (IFI) and in accordance with the IFI 2016 *Guidelines on protection of fisheries during construction works in and adjacent to waters*.

Where possible, it is expected that the Contractor will primarily gain access from the river banks; however temporary working areas within the river channel may be required for certain works. It is expected that access to construct the proposed flood defences which are located away from the river's edge (e.g. embankments) will be from the landward side in order to avoid any impact to the river. Where instream works are proposed, machine movements in the river will be minimised.

Where access to the river channel is required, detailed method statements will be drawn up which deal specifically with the works proposed.

The method statements will be drawn up in consultation with the supervising ecologist and will be agreed with the NPWS and Inland Fisheries Ireland (IFI) prior to the commencement of works.

Detailed silt control methods will be required for all in-stream works. Any works will require effective control of silt and it is expected that a variety of methods may be required i.e. silt curtains, dewatering, silt sumps etc. Detailed measures for control of silt will need to designed and agreed with the IFI and NPWS.

4.3.2 New culverts, culvert replacements and or extensions

The construction of new culverts, replacement of culverts and/or extensions to culverts will generally be undertaken by excavating and removing the existing culverts before craning in new precast culvert units in short lengths. Some isolated sections of in-situ culvert may be required at changes in direction.

The works area will be isolated and traffic management set up as required. In general, single lane traffic will be maintained where possible but temporary road closures and diversions may be required for short discrete periods, if it does not prove possible to maintain one lane of the existing road open at all times. Refer to **Chapter 14 Roads and Traffic** for further details on construction traffic and traffic management.

Temporary works will be put in place, including silt barrages, and flow diversions/ over pumping where in stream works are required. In general the culverts will be constructed on the footprint of the existing river channel or in some cases offline (e.g. in Sallybrook Industrial Estate). The foundations will be excavated down to formation level. Utilities and drainage pipes will be diverted as required. Excavated material will be transported off site to a licenced facility or stored for reuse on site, where appropriate. Blinding concrete will be poured. The precast concrete culverts will be placed in position and where in situ culverts are required, formwork will be prepared and reinforcement bars fixed, followed by the pouring of the concrete. Utilities and drainage pipes will be diverted into permanent positions as required. The excavations will then be backfilled and road surfaces reinstated.

In the case of culverts constructed under the public road, permanent reinstatement may be required approximately six months following reopening of the road.

4.3.3 Bridge Replacement along Glashaboy River at Hazelwood Shopping Centre

The bridge at Hazelwood shopping centre will be replaced in order to increase the conveyance of the Glashaboy river. The works area will be isolated and traffic management set up as required. During the bridge replacement, both vehicular and pedestrian access between the shopping centre and the commercial centre will be maintained via the existing access to the commercial centre along Hazelwood Avenue. It is expected that access via the Hazelwood shopping centre bridge will be restricted for approximately 12 to 16 weeks. Access will be fully restored on completion of the bridge replacement works.

Due to the potential in-stream works (including preparatory work) on a watercourse supporting salmonids, it is envisaged that this work will be undertaken in a window from July to September (inclusive) and in consultation with IFI to avoid accidental damage or siltation of spawning beds.

Temporary works will be put in place, including silt barrages.

It is envisaged that the existing bridge deck will initially be dismantled / deconstructed, which will likely involve some in-channel works, but these will be minimised and of short duration.

Following this, it is envisaged that a temporary cofferdam will be constructed around each of the existing bridge abutments, to allow for the existing abutments to be removed, and new abutments constructed in the dry, whilst maintaining the Glashaboy flow between the two cofferdams, and minimising pollution risk.

The new bridge will be constructed using reinforced concrete abutments placed in situ with a precast concrete deck.

Construction of the reinforced concrete bridge abutments would typically involve:

- Fixing of reinforcement for abutments and piers;
- Placing of formwork for abutments and piers;
- Placing of cast in-situ concrete for abutments and piers; and
- Stripping of formwork.

Once the abutments are in place, the temporary cofferdam will be removed, allowing the placing and fixing of a precast concrete bridge deck, followed by the following:

- Construction of bridge parapets;
- Excavated material will be transported off site to a licensed facility or stored for reuse on site. The excavation will be backfilled, the area reinstated, and the works area reopened; and
- Permanent reinstatement of road surfaces may be required approximately six months following reopening of the road.

Any utility diversions necessary to facilitate the construction of the bridge will be completed prior to and after its construction.

Refer to Chapter 14 Roads and Traffic for further details on construction traffic.

4.3.4 Flood relief channel and culvert parallel to Glashaboy River at Hazelwood Avenue

In relation to the flood relief culvert on Hazelwood Avenue, it is envisaged that this will be constructed in two halves, allowing a minimum of a single lane to remain open at all times, and for at least part of the duration, 2 lane traffic will be possible due to the generous width of the existing road. As the flood relief culvert and approach channels at Hazelwood Avenue are offline from the main Glashaboy river channel, they can be constructed in the dry and are therefore not seasonally constrained. If feasible, the reinforced concrete, cast in situ, flood relief culvert will be constructed during a period of school holidays when traffic volumes will be reduced. A construction period of circa 4 to 8 weeks is envisaged.

The works will be constrained such that work on the Hazelwood Avenue flood relief culvert will not be allowed at the same time as works in the Shopping Centre/Commercial Centre, to minimise temporary traffic impacts.

It is likely that the flood relief culvert will be constructed in advance of regrading the flood relief channels at the upstream and downstream ends to ensure that the culvert can be placed in the dry.

A flood relief channel will then be constructed parallel to the Glashaboy River just east of Hazelwood Avenue bridge to facilitate high flows during a flood event.

The channel will consist of the excavation of the left bank of the river (looking downstream) both north and south of Hazelwood Avenue. Refer to the exhibition drawings for details.

Connection of the flood relief channel to the Glashaboy river (via removal of sections of the bank) will only be carried out once all of the other works to the flood relief channel have been completed.

The preliminary design has been agreed with Inland Fisheries Ireland (IFI) and consultation will continue during the detailed design and construction stages. The construction methodology for the culvert beneath Hazelwood Avenue will be similar to the methodology described above for the other culvert works.

4.3.5 Reinforced Concrete Flood Walls

Reinforced concrete flood walls will be constructed using industry standard techniques including excavation of foundations, fixing of steel reinforcement, pouring concrete and reinstatement of the works area. Any excavated material that cannot be reused in the works will be transported to a suitable licensed waste facility.

The construction of the reinforced concrete flood defence walls is likely to comprise the following activities:

- isolation of works area, including traffic management where the work area will overlap with a public road / pedestrianised area;
- temporary works including silt barrages where in stream works are required (the vast majority of new walls do not require any in-channel works);
- excavation for foundations;
- blinding of formation;
- fixing of reinforcement;

- placing of formwork; and
- placing of concrete.

The construction of the reinforced concrete walls will be undertaken from the bank of the river for the majority of the scheme. Any utility diversions required for the construction of the walls will be completed prior to excavating the foundations.

4.3.6 Modifications to existing embankment along Glashaboy River at Sallybrook

The proposed embankment at Sallybrook will be constructed on the land side of the existing embankment to allow for retention of the existing tree line along the river bank. It will be constructed by placing low permeability cohesive soils to the required flood defence level. Topsoil will be placed on top of the embankment and seeded. All material excavated during the construction will be reused where feasible. Any material that is not suitable for use elsewhere in the scheme will be disposed of off-site. It is likely that it will be necessary to import most of the cohesive soils required to construct the embankment as it is unlikely that sufficient quantities of suitable excavated soil will be available from elsewhere in the project. The construction of the embankment will be undertaken from the river bank with no in channel works required.

Any utility diversions necessary to facilitate the construction of the embankment will be completed prior to the construction of the embankment.

4.3.7 **Pumping Stations**

The footprint of the pumping stations will be set out. Where the proposed excavation is located in a paved area, the pavement will be saw cut. Where the proposed excavation is located in a grassed area, the topsoil will be removed and stored in close proximity to the excavation. The excavation will take place to the required depth. Sheet piling will likely be required in order to facilitate construction of deep excavations in an urban area. Excavated material unsuitable for use as backfill material will be disposed of to an approved waste management facility. Lean mix concrete blinding will be placed, followed by formwork and steel fixing. Once concrete has been poured and has cured, the formwork will be stripped and the area outside the pumping station will be backfilled. Excavations in grassed areas will be backfilled with suitable excavated material, following which the original topsoil will be replaced. Excavations in paved areas will be backfilled with granular material and reinstated to their original condition. Mechanical and electrical fit out of pumping stations will take place following backfilling.

4.3.8 Channel modifications of Glenmore Stream at Brooklodge Grove

Channel modifications will generally be undertaken from the bank of the watercourse using an excavator. Temporary works will be put in place, including silt barrages, and flow diversions/ over pumping where in stream works are required. Any material unsuitable for reuse in the project will be disposed at a licensed waste facility. Any utility diversions required to widen and deepen the watercourse will be completed prior to the widening and deepening works commencing.

4.3.9 Future Maintenance Regime

A channel maintenance programme will be required throughout the reach of the watercourses impacted by the proposed works. The channel maintenance programme will pay particular attention to locations where silt, gravel and debris are likely to accumulate, such as at structures, sharp bends, culvert inlets, blockages from trees etc.

The proposed pumping stations will require regular maintenance and it will be necessary to jet the surface water sewers to maintain the hydraulic capacity to drain flood waters.

Other measures will include regular inspections of flood walls and embankments, regular scheduled maintenance of the river channel and pruning of trees (including removal of tress where necessary), planning and control measures. The inspection regime will ensure that there is no deterioration in the structural integrity of the defences which may occur as a result of a collision for example. It is expected that the flood defences will otherwise be relatively maintenance free. In general, maintenance will typically consist of the following activities:

- The channels will be monitored by means of a walkover survey from the banks on a regular basis (likely quarterly, and also following a flood event). The walkover surveys would aim to identify issues with implications for flood risk (e.g. fallen trees, excessive vegetation build-up, overgrown trees, illegal dumping, accumulation of granular deposits, etc.). In-channel debris will typically be removed by a long reach excavator working from the banks. Excessive overhanging vegetation will typically be pruned back or removed by hand using a cherrypicker, depending on access.
- The structures will be monitored by means of a walkover survey from the banks on a bi-annual basis. The walkover surveys would aim to identify issues with implications for flood risk (e.g. damage to structures, settlement of embankments, etc.).
- Culverts will be inspected by means of man-entry on an annual basis, or following a significant flood event. Any debris present in the culvert will be cleared by hand. A full CCTV survey and clearing of silt/sediment from the culvert is expected to take place approximately every five years. Removal of debris will be carried out as required.

The relevant stakeholders will be consulted with as necessary during the planning of these maintenance works including landowners, IFI, the National Monuments Service (NMS), Cork County Council (CCC) and National Parks and Wildlife Service (NPWS) to ensure that the works are carried out with minimal environmental impact.

In certain locations, where there is a possibility of excessive seepage of flood water underneath the flood defence foundations, either sheet piles or grouting techniques will be required to provide a cut-off barrier. The sheet piles may be metal or plastic and will be driven to the required depth using a piling hammer or similar.

4.4 Construction Site Layout

4.4.1 Construction Access

Detailed of the proposed Works Areas and potential access routes are illustrated on Series 5 of the Scheme Exhibition Drawings.

It is noted that many of the linear defences will require the temporary removal of boundary walls and fences to facilitate construction access (generally parallel with watercourses). These boundary walls / fences will be reinstated on completion in agreement with the landowners.

4.4.2 Construction Compounds

A number of potential locations for the construction compounds, in the immediate vicinity of the works, have been considered and are shown on Series 5 of the Exhibition Drawings. The final selection of the compound(s) will be made by the Contractor appointed to construct the works in consultation with the Office of Public Works and the project ecologist. Due to the length of channel involved, the Contractor may choose to move the compound during the construction period, in which case the same selection process shall apply. Site compounds will be bound by the mitigation measures identified within this EIS.

4.4.3 Construction Site Drainage

The construction site drainage within the construction compounds will be designed in such a manner so as to minimise the risk of contamination of the surrounding soil, surface water and groundwater. Rainwater run-off from the contractor's compounds will be controlled via a temporary surface water control system comprising measures such as swales (ditches) and settlement ponds (or similar system) which will minimise the risk of pollution to soil, surface water or groundwater. The temporary surface water control system will be subject to a daily visual inspection as well as routine maintenance. The inspection frequency will be increased during periods of exceptional high rainfall. Written procedures will be maintained and a log recorded for the inspections.

The contractor facilities will contain toilets, canteen, construction containers and site office. A grease trap will also be installed at the canteen. The disposal of sanitary effluent during construction will be via tankers.

Storm water will be managed carefully during construction. Any areas which will involve the storage of fuel will be paved and bunded and hydrocarbon interceptors installed to ensure no spillages will get into the surface water or groundwater. Daily plant and machinery checks will be carried out as per contract requirements on all construction plant and machinery. Drip trays will be used both for refuelling and overnight parking and spill kits will be on hand at all times. Further details are provided below in **Section 4.7**.

4.5 **Duration, Phasing and Employment**

Construction works are expected to commence in Quarter 3 of 2017 and the proposed construction period is estimated at circa 18 months. The total 18 month construction period has been estimated to allow for poor weather over the winter months, mobilisation between sites and seasonal ecological restrictions. The estimated period for individual locations is presented in **Table 4.1** below.

Area of Works	General Location	Overview of Works	Estimated construction period (weeks)
1	Sallybrook	Culvert replacement along Bleach Hill stream at Cuil Chluthair, direct defences (embankment & flood walls) along Glashaboy River, Infilling of existing ditch along unnamed watercourse and provision of culvert. Flow control structure at Mill race at Grandons Garage and pumping Station	16 – 20 weeks
2	Hazelwood	Culvert replacements at Cois na Gleann Stream (R615 & R639), flood wall along R639 and curving around onto Hazelwood Avenue, across Hazelwood Avenue Bridge. Flood relief channel parallel to river under Hazelwood Avenue, Bridge replacement at Hazelwood Shopping Centre and flood wall along Glashaboy River, Road re-grading and pumping stations	32 – 40 weeks
3	Meadowbrook	Flood Walls along Glashaboy River, culvert replacement and extension along Springmount stream (R639) and road re-grading works along Riverstown Bridge and approaches, removal of existing manhole from the bridge arch and pumping stations	16 – 20 weeks
4-2	Copper Valley Vue Brooklodge Grove	Culvert upgrades, road re-grading and grouting of existing walls, channel modification flood walls along Glenmore Stream, re-grading of small area of land adjacent to Glenmore stream to facilitate overland flow	12 – 16 weeks
4-3	Lidl	Modification to boundary wall along Butlerstown Stream to facilitate overland flow	2-3 weeks
5	The Grove	Access track and flood wall along Glashaboy River (parallel to R369)	4 – 6 weeks

Table 4.1: Estimated Duration of Construction Works. Refer also to Figure 1.1 for location of works areas

Whilst the majority of geotechnical investigation work has been completed, some further minor infill geotechnical investigations may be required prior to construction. These would consist of a mixture of shell and augur boreholes, cable percussive boreholes, rotary drilled boreholes, trial pits and slit trenches at the locations of the proposed structures. As discussed above, the construction works themselves will last approximately eighteen months and will be subject to the following programme constraints:

- In-stream works (including preparatory work) on all watercourses supporting salmonids shall normally be undertaken between July and September (inclusive) and in consultation with IFI (except in exceptional circumstances and in agreement with IFI) to avoid accidental damage or siltation of spawning beds. The appropriate window for in-stream works can vary depending on the nature of the fishery resource concerned and the existence of other factors such as catchment or sub catchment specific Bye Laws and Regulations.
- To avoid impacting on bird nesting sites, the vegetation removal within the defined working area will not be carried out during the peak bird nesting season of March to August (inclusive) prior to the onset of works.
- To avoid impacts on otters, derogations may be required to carry out works in the vicinity of breeding holts. The timing of the works will be agreed with the NPWS.
- Christmas non-working time is from the beginning of the second week of December to the end of the second week of January to avoid impacts on residents/businesses in the vicinity.

The co-ordination of people and materials on site will be one of the key activities throughout the construction phase. In order to ensure that construction workers do not create undue disruption, there will be a requirement that the Contractor provide adequate site supervision to co-ordinate, monitor and implement site regulations.

Normal construction working hours will be observed. These are 08.00 - 19.00Monday to Friday; 09.00 - 16.00 on Saturday. It may be necessary to work outside these hours, including at weekends and at night, at certain stages. Working outside normal hours may be necessitated through consideration of safety or weather and sub-contractor availability. Heavy or noisy construction activities will be avoided outside normal hours and the amount of work outside normal hours will be strictly controlled. Approval from Cork County Council will be obtained for works outside normal hours.

It is envisaged that the average number of construction personnel on site will be circa 30 personnel but this will vary depending on the construction activities required, seasonal constraints and will likely peak during the summer months when up to 50 construction personnel is envisaged.

4.6 In-stream works

- All concrete works will be carried out in dry conditions with no in-stream pouring of concrete. It may be necessary therefore to effectively sheet-pile or cofferdam sections of the river and pump out the river water during the construction of the proposed works. If required, fish populations which become isolated, will be salvaged via electrofishing under licence from the Department of Communications, Climate Action and Environment and in consultation with Inland Fisheries Ireland.
- It is expected that most of the equipment used will be standard construction plant for a project of this nature, e.g. mechanical excavators, dump trucks, dewatering pumps, ready mix concrete lorries, pile drivers, rock breakers etc. All machinery should be maintained in good condition to prevent leakage of hydrocarbons. Fuelling and lubrication of equipment must not be carried out within 30m of any watercourse.
- All contractors, sub-contractors and in particular machinery operators will be made aware of the provisions for protecting water quality as outlined in the method statements.
- Where possible excavated material should not be stockpiled long-term within 10m of a watercourse. Where this measure is not implementable, then specific silt control measures should be planned as part of the detailed method statement for site works in each specific area. Precautions will be taken to minimise the run off of soil into watercourses.
- All culverts and walls will be designed to minimise impacts on fish and macroinvertebrate populations. Where possible, gravel substrates and as natural a flow pattern as possible under low water/ low tide conditions will be provided in channels affected by site works. The structure and flow pattern with culverts on minor streams will be designed to allow fish to move through them. The slope of culverts will follow the existing gradient and trash screens are not currently envisaged as part of the Scheme.
- Input from a qualified fisheries/aquatic ecologist with experience in the design of in-stream structures is required into the design of culverts and the post works flow patterns and channel structure. The specialist in conjunction with the supervising ecologist will be required to visit the watercourses prior to the commencement of site works to assess the existing channel structure, fish holding features, substrate composition, flow patterns etc. Where feasible such structures will be incorporated into the channels following completion of work.

4.7 Environmental Construction Management

4.7.1 General

Every effort will be made to ensure that any detrimental environmental effects will be avoided, prevented or reduced during the construction phase of this project.

A construction environmental management plan (CEMP) will be prepared prior to construction commencing. The CEMP will comprise all of the construction mitigation measures, which are set out in this EIS, and any additional measures which are required by the statutory consent conditions. Implementation of the CEMP will ensure disruption and nuisance are kept to a minimum. The plan will have regard to the guidance contained in the handbook published by Construction Industry Research and Information Association (CIRIA) in the UK, *Environmental Good Practice on Site Guide*, 4th Edition (CIRIA 2015).

The Employer's Representative will have a construction management team on the project site for the duration of the construction phase. The team will supervise the construction of the scheme including monitoring the contractors' performance to ensure that the proposed construction phase mitigation measures are implemented and that construction impacts and nuisance are minimised. The construction management team will liaise with residents and the general community during the construction phase to ensure that any disturbance is kept to a minimum and to ensure that all anticipated nuisances are minimised and that the construction activity will have the lowest possible impacts on the residents and other properties.

It is also proposed that a Community Liaison Officer will be appointed who will coordinate communications and liaise with the local community during the construction phase.

4.7.2 Soil, Surface Water and Groundwater

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 Industry Research and Information Association (CIRIA) in the UK has issued a guidance note on the control and management of water pollution from construction sites, *Control of Water Pollution from Construction Sites, guidance for consultants and contractors* (Masters-Williams et al 2001). Additional guidance is provided in the CIRIA technical guidance on Control of Water Pollution from Linear Construction Projects (Murnane et al 2006).

The guides are written for project promoters, design engineers and site and construction managers. They address the main causes of pollution of soil, groundwater and surface waters from construction sites and describes the protection measures required to prevent pollution of groundwater and surface waters and the emergency response procedures to be put in place so that any pollution, which occurs, can be remedied.

The guides address developments on green field and potentially contaminated brownfield sites. The construction management of the site will take account of the recommendations of the CIRIA guidance to minimise as far as possible the risk of soil, groundwater and surface water contamination.

Site activities considered in the guidance include the following:

- Excavation;
- Earthmoving;
- concreting operations;
- spreading of topsoil;
- road surfacing;
- site drainage, and the control and discharge of surface water runoff from the site;
- oil and fuel delivery and storage; and
- plant maintenance.

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;
- Where feasible, soil excavation will be completed during dry periods and undertaken with excavators and dump trucks. Topsoil and subsoil will not be mixed together;
- Ensure that all areas where liquids are stored or cleaning is carried out are in a designated impermeable area that is isolated from the surrounding area, e.g. by a roll-over bund, raised kerb, ramps or stepped access;
- Use collection systems to prevent any contaminated drainage entering surface water drains, watercourses or groundwater, or draining onto the land;
- Wheel wash at site entrance to clean vehicles prior to exiting onto public road network;
- Minimise the use of cleaning chemicals;
- Use trigger-operated spray guns, with automatic water-supply cut-off;

- Use settlement lagoons or suitable absorbent material such as flocculent to remove suspended solids such as mud and silt; and
- Ensure that all staff are trained and follow vehicle cleaning procedures. Post details of the procedures in the work area for easy reference.

The implementation of the above measures will ensure that the risk of pollution of groundwater, soils and surface waters, resulting from the construction activities will be minimised.

Furthermore, appropriate mitigation measures will be implemented prior to the construction phase to ensure that water quality of the Glashaboy River and its tributaries are not adversely affected through pollution incidents and silt mobilisation. This mitigation will include:

- Appropriate sediment control measures will be employed.
- Any chemical, fuel and oil stores will be located on an impervious base within a secured bund with a storage capacity 110% of the stored volume.
- Biodegradable oils and fuels will be used where possible.
- Drip trays will be placed underneath any standing machinery to prevent pollution by oil/fuel leaks. Where practicable, refuelling of vehicles and machinery will be carried out on an impermeable surface in one designated area well away from any watercourse or drainage (at least 10m).
- Emergency spill kits will be available on site and staff trained in their use.
- Operators will check their vehicles on a daily basis before starting work to confirm the absence of leakages. Any leakages will be reported immediately.
- Daily checks will be carried out and records kept on a weekly basis and any items that have been repaired/replaced/rejected noted and recorded. Any items of plant machinery found to be defective will be removed from site immediately or positioned in a place of safety until such time that it can be removed. All items of plant will be checked prior to use before each shift for signs of wear/damage.
- All washing out of grout pumps will be carried out in designated areas away from the river, such as in the lined compound area. At no point will grout pumps be washed out at the worksite.
- Any structures installed within the channel, to allow working in dry conditions must be designed by a competent person, be constructed of appropriate materials and take account of site conditions (i.e. depth of water, available space, bed substrate, flow velocities, flow patterns, duration of works, and accessibility and potential ingress of water).
- During all works the weather forecast will be monitored and a contingency plan developed to prevent damage or pollution during extreme weather and high flow events.
- Containment measures and emergency procedures to deal with accidental spillages of fuel and lubricants from site machinery will be outlined in the Construction Management Plan which will be developed by the contractor in advance of construction works taking place on site.

- The potential pollution of surface water will be mitigated through the development of containment measures and emergency procedures to deal with accidental spillages in the Construction Management Plan. Fuel will be stored within containment bunds within the site to prevent release of contaminants into the ground. Where it is necessary to refuel machinery on site this will be done in a carefully managed manner at a minimum distance of 25 m away from watercourses. An emergency plan to deal with accidental spillages will be drafted and kept on site during the construction period. The pollution control methods will be outlined within the Construction Management Plan.
- To minimise any impact on the underlying subsurface strata from material spillages all oils, solvents and paints used during construction will be stored within temporary bunded areas. The design (volume and construction) of all bunds will conform to standard bunding specifications. The retention capacity of bunded areas will be as follows: 110% of the capacity of the largest tank or drum to be stored within the bunded area: and 25% of the total volume of substance which could be stored within the bunded area. Spill kits / absorbent pads and boom should be used in the event of a spillage.
- Spill kits will be retained on site, in particular at refuelling areas and other high risk areas, to ensure that any spillages or leakages are dealt with immediately. All dispensing of fuels and hazardous materials will occur over areas of concrete hardstanding or other impermeable surface with drainage directed to an oil / water interceptor or a suitably constructed bund. No refuelling will be permitted in or near soil or rock cuttings.
- All associated waste residuals will also be stored within temporary bunded storage areas prior to removal by an appropriate waste disposal contractor for off-site treatment/recycling/disposal. Any other building waste will be disposed of to on-site skips for removal by a licensed waste disposal contractor. An emergency plan to deal with accidental spillage will be drafted and kept on site during the construction period.

4.7.3 Emissions to Air

As construction activities are likely to generate some dust emissions, particularly during the site clearance and excavation phase, a dust minimisation plan will be prepared and implemented by the contractor during the construction phase of the project.

The following measures will be implemented as part of the dust minimisation plan:

- Limiting vehicle speeds on the construction site;
- During very dry periods, spraying surfaces with water will control dust emissions from heavily trafficked locations;
- All vehicles exiting the site will make use of wheel wash facilities prior to entering onto public roads, to ensure mud and other wastes are not tracked onto public roads. Public roads outside the site will be regularly inspected for cleanliness, and cleaned as necessary. Wheel-washing facilities will be located away from sensitive receptors;

- Topsoil and other dusty material being moved onsite will be transported in covered trucks, where the likelihood of emitting dust is high, and during dry weather conditions the area of removal will be sprayed with water from a mobile tanker on a regular basis to control dust emissions;
- Exhaust emissions from vehicles operating within the site, including trucks, excavators, diesel generators or other plant equipment, will be minimised through regular servicing; and
- Dust monitoring will be carried out at the site boundary throughout the construction phase.

4.7.4 Site Tidiness

The following are some of the measures that will be taken to ensure that the site and surroundings are maintained to a high standard of cleanliness:

- Daily site inspections will be undertaken to monitor site tidiness;
- A regular programme of site tidying will be established to ensure a safe and orderly site;
- Scaffolding will have debris netting attached to prevent materials and equipment being scattered by the wind;
- Food waste will be strictly controlled on all parts of the site.
- Mud spillages on roads and footpaths outside the site will be cleaned regularly and will not be allowed to accumulate;
- Wheel-wash facilities will be provided for vehicles exiting the site; and
- 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 normal manner.

4.7.5 Noise Emissions and Vibration

Construction noise will be kept to a minimum in accordance with BS 5228 (2009). The contract documents will specify that the contractor, undertaking the construction of the works, will be obliged to take specific noise abatement measures and will comply with the best practice outlined in British Standard BS 5228 – 1: 2009 +A1 2014: *Code of Practice for Noise and Vibration Control on Construction and Open Sites – Noise* and the NRA (now TII) guidelines *Good Practice Guideline for the Treatment of Noise during the planning of National Road Schemes* (NRA 2014). The following measures will also be employed:

- Selection of plant machinery with low inherent potential for generation of noise and/or vibration. All construction plant and equipment to be used at the site will be modern equipment and will comply with the relevant legislation and regulations
- Regular maintenance of plant will be carried out in order to minimise noise produced by on-site operations. The regular and effective maintenance of plant can play an important role in reducing noise emissions. In particular, attention will be paid to the lubrication of bearings and the integrity of silencers.

Silencers and engine covers will be maintained in good and effective working order.

- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the Contract.
- Any compressors used on-site will be of the "sound reduced" models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machines, which are used intermittently, will be shut down or throttled back to a minimum during those periods when they are not in use.
- Any plant, such as generators or pumps, which are required to work outside of normal working hours, will be surrounded by an acoustic enclosure.
- Training of drivers to ensure smooth machinery operation/driving, and to minimise unnecessary noise generation.
- A maximum speed limit of 40 km / hr will be imposed for HGV's and drivers will be instructed to maintain as far as possible the distances between vehicles.

In terms of minimising vibration levels, the Contractor will be required to select and utilise methods of working and items of plant so that the maximum measured ground vibrations do not exceed a peak particle velocity (PPV) of 8.5mm per second at any occupied property, with a lower PPV limit of 5mm per second applying to properties in poor condition or other sensitive receptors.

The Contractor will be required to monitor ground vibrations at selected locations to the approval of the Employer's Representative during the progress of the works. Each vibrograph shall be certified as being in proper working order and shall unless otherwise approved, record vibrations in three directions simultaneously with print-out showing the amplitude and frequency of the vibrations.

Vibration measurements shall be taken at the base of buildings, on the side facing the source of vibration. Where feasible, the measurement should be taken on a hard surface on the ground outside the building.

A pre-condition survey will also be undertaken of all properties potentially affected by the works (likely within a 10m radius of works areas). Crack monitoring will be installed on such affected properties and monitored throughout the works.

Where sheet piling is required, low vibration rigs will be used.

4.7.6 Invasive Species

• The invasive alien species Himalayan balsam and Japanese knotweed were recorded within the proposed works areas and wider study area and these species could potentially be dispersed downstream by incorrect work practices. It is noted that the locations identified are indicative of the current distribution of the species within the works area but should not be considered definitive.

- Works may require access to areas outside the immediate works area (i.e. stockpiling material, storage of machinery etc.) and these areas could support this species. It is recommended therefore that any area potentially affected by site works is checked for the presence of invasive species by the supervising ecologist prior to the commencement of site works.
- The Contractor shall also take every precaution to prevent the spread of invasive species (Japanese Knotweed in particular) encountered during the works by ensuring that all plant and equipment that comes in contact with these species (and soil deemed contaminated with species) are regularly cleaned or disposed of in the appropriate manner. The contractor shall be obliged to comply with The European Communities (Birds and Natural Habitats) Regulations 2011 which contain important new provisions to address the problem of invasive species. Whilst Himalayan balsam can be treated in a relatively straight forward manner with herbicides, treatment of Japanese Knotweed may involve burial, bunding, herbicides or a combination of methods. Relevant guidance documents include:
 - The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads (2008), Kelly, J., Maguire, C.M. and Cosgrove, P.J.;
 - (2008) Best Practice Management Guidelines Japanese knotweed
 Fallopia japonica prepared for NIEA and NPWS as part of Invasive; and
 - Managing Japanese knotweed on development sites The Knotweed Code of Practice (2006) UK Environmental Agency.

The treatment of knotweed infested soil and associated biosecurity measures to prevent the spread of knotweed is described in **Appendix 4.1**.

4.7.7 Construction Waste Management

Waste generated during the construction phase will be carefully managed according to the accepted waste hierarchy which gives precedence to prevention, minimisation, reuse and recycling over disposal with energy recovery and finally disposal to landfill.

This hierarchy will be implemented by identifying opportunities to firstly prevent waste from being produced, and secondly minimise the amount of waste produced. Where prevention and minimisation will not be feasible, ways to reuse or recycle waste will be sought, preferably on-site to avoid the impacts arising from transportation. If this is not feasible, opportunities to reuse or recycle the waste off-site will be investigated. If this is not feasible, then waste will be sent to an energy recovery facility, and only where there is no alternative, will waste be disposed of to landfill. To achieve this, existing waste management programmes and networks will be used such as the National Waste Prevention Programme, which is implemented by the Environmental Protection Agency.

All waste removed from the site will be collected only by contractors with valid waste collection permits, under the Waste Management (Collection Permit) Regulations.

All facilities to which waste will be taken will have appropriate waste licences or permits, under the Waste Management Act 1996, as amended, and the regulations thereunder, allowing them to accept the type of waste that is to be sent there. Hazardous waste generation will be minimised, and such waste will be recovered where feasible, and only disposed of if recovery is not feasible. Hazardous waste will be managed in accordance with the relevant legislation.

4.7.7.1 Waste Arising

In general, construction waste materials may include general construction debris, scrap timber and steel, machinery oils and chemical cleaning solutions. The practice of excessive purchase of materials and equipment to allow for anticipated wastage will be avoided.

It is anticipated that the majority of the excavated material, which is expected to be uncontaminated soil will be suitable for reuse onsite. In the unlikely event of any evidence of soil contamination being found during work on site, the appropriate remediation measures will be employed. The treatment of knotweed infested soil and associated biosecurity measures to prevent the spread of knotweed is described in **Appendix 4.1**.

Any work of this nature would be carried out in consultation with, and with the approval of the Environmental Department of Cork County Council, IFI, EPA and NPWS as necessary. The material would be transported to a permitted site via the national and regional road network.

Timber from trees, felled as part of the site preparation, will be sold to the timber industry.

4.7.7.2 Waste Management Plan

The contractor will be required to develop, implement and maintain a Waste Management Plan during the construction works. A senior manager will be responsible for the waste management plan. The manager will be competent in waste management, and will receive training, where necessary, such as the CIF Site Waste Management and Environmental Awareness course.

The key principles underlying the plan will be to minimise waste generation and to segregate waste at source. The measures to achieve these aims include:

- Ordering of appropriate quantities of materials, with a just-in-time philosophy;
- Immediate and careful storage of materials delivered to the site;
- Storing materials which are vulnerable to damage by rain under cover and raised above the ground;
- Careful handling of materials, using appropriate equipment, to avoid undue damage; and

• Designation of separate storage areas for different types of waste, in order to maximise the reuse and recycling potential of the waste.

The Waste Management Plan will outline how residual waste will be handled as follows:

- The identification of disposal sites;
- The identification of quantities to be excavated and disposed of and classification of this material;
- The identification of measures to prevent nuisance, etc.;
- The identification of the amounts intended to be stored temporarily on site and the location of such storage;
- The contractor's approach to waste management; and
- The names, roles, responsibilities, and authority of the key personnel involved in the waste management.

The Waste Management Plan will include documented procedures for dealing with waste management including liaison with third parties, statutory undertakers and other companies.

The Waste Management Plan will meet the requirements of the guidelines prepared by the National Construction and Demolition Waste Council (NCDWC), Best Practice Guidelines on the Preparation of Waste Management Plans for Construction & Demolition Projects, NCDWC 2006.

The following will also be considered as part of the Waste Management Plan:

- The identification of the amounts of materials intended to be stored temporarily on site and the location of such storage;
- Procedures for controlling sub contracts i.e. for checking waste procedures of subcontractors and ensuring sub-contractors fulfil design teams and contractors obligations in respect of waste management;
- Designation of separate storage areas for different types of waste materials in order to maximise their re-use and recycling potential;
- Procedure for record keeping for waste retained on site;
- Procedure for record keeping for hazardous waste, for example, C1 forms and trans-frontier shipment documents; and
- Details of authorised waste hauliers with appropriate and up-to-date Waste Collection Permits. Details of permitted or licensed recovery and/or disposal facilities where waste materials will be sent, including copies of permits and licenses.

4.7.7.3 Waste Minimisation

The main contractor will be required to minimise waste and to segregate waste at source. The possible measures used to achieve these aims will include:

- Ordering of appropriate quantities of materials, with a just-in-time philosophy.
- Immediate and careful storage of materials delivered to the site.
- Storing under cover and raised above ground materials, which are vulnerable to damage by rain.
- Careful handling of materials, using appropriate equipment, to avoid undue damage.
- Designating separate storage areas for different types of waste in order to maximise the re-use and recycling potential of the waste.

Anticipated wastes arising can be summarised as follows:

- Sanitary waste from toilet and washing facilities. These will be routed to the existing sanitary waste infrastructure and treated on site prior to discharge; and
- Construction Waste e.g. packaging, pallets, and metal waste will be disposed off-site at suitably permitted waste facilities.

4.8 Materials Source and Transportation

In so far as is feasible, all construction materials will be sourced from local suppliers if these are available within the Cork area. The selection and specification of construction materials will be informed by local availability of these materials. Within the necessary constraints of performance, durability and cost, construction materials will be sourced from local suppliers and manufacturers, where possible. The coordination and logistics of construction traffic will be captured within the construction traffic management plan which will be agreed with CCC and An Garda Siochána.

4.9 Construction Safety

As required by the Safety, Health and Welfare at Work (Construction) Regulations 2013, a Health and Safety Plan will be prepared which will address health and safety issues from the design stages through to the completion of the construction and maintenance phases. This plan will be reviewed as the scheme progresses. The contents of the Health and Safety Plan will comply with the requirements of the Regulations.

The Regulations require the developer of a project to appoint a "Project Supervisor Design Process" and "Project Supervisor Construction Stage". Cork County Council has appointed Arup as Project Supervisor Design Process in accordance with the current legislation.

The Project Supervisor Design Process will assemble the Safety File as the project progresses. The Safety File will be incorporated into the overall technical record system at the end of the project.

Safety on site will be of paramount importance. During the selection of the contractors and subcontractors, their safety records will be investigated. Only contractors with high safety standards will be selected.

Prior to working on site, each individual will receive a full safety induction and will be provided with all of the safety equipment relevant to the tasks the individual will be required to perform during employment on site.

Safety briefings will be held regularly and prior to any onerous or special task. 'Toolbox talks' will be held to ensure all workers are fully aware of the tasks to be undertaken and the parameters required to ensure the task will be successfully and safely completed.

All visitors will be required to wear appropriate personal protective equipment prior to going on to the site and will undergo a safety briefing by a member of the site safety team.

Regular site safety audits will be carried out throughout the construction and the complied with at all times.

At any time that a potentially unsafe practice is observed, the site safety manager will have the right as well as the responsibility to halt the work in question, until a safe system of working is again put in place.

4.10 Construction Site Decommissioning

On completion of construction, all construction facilities and equipment such as plant, materials, signage, contractors' offices and laydown areas, etc. will be removed from site. Temporary entrances will be removed, boundary walls, fences reinstated and all roads reinstated as necessary. Construction site fencing will be removed and landscaping/replanting will be completed.

Appendix 4.1

Outline Japanese Knotweed Management Plan

Appendix 4.1 Outline Japanese Knotweed Management Plan

Cork County Council and Office of Public Works

Glashaboy River (Glanmire and Sallybrook) Drainage Scheme

Outline Japanese Knotweed Management Strategy

Appendix 4.1

Issue 1 | 24 October 2016

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 234334-00

Ove Arup & Partners Ireland Ltd

ARUP

Document Verification

ARUP

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Appendix A

Invasive Species Drawings GR_201 to GR_219

1 Introduction

Invasive plant species have been identified and documented within proposed works areas that are included in the Glashaboy River (Glanmire and Sallybrook) Drainage Scheme.

While other invasive plant species have also been identified in the area, such as Himalayan Balsam (*Impatiens glandulifera*) and White Heliotrope (*Petasites fragrans*), Japanese knotweed is of primary concern for the structural integrity of these proposed flood works and for the designated sites downstream, therefore the focus of this report is on the prevention of the spread of knotweed. However, the same principles will apply to other invasive species.

This report outlines the strategy that will be adopted during the construction and operation of the drainage scheme in order to prevent the spread of the knotweed species. This report will outline the steps that will be taken during construction and operation of the scheme.

The main objective of the Japanese knotweed management strategy for the scheme will be to:

- Prevent the spread of Japanese knotweed during the construction phase.
- Manage the growth of Japanese knotweed adjacent to flood defences so as to protect the integrity of the structures from the impacts of Japanese Knotweed.
- Prevent the spread of Japanese knotweed during channel maintenance works in the future.

2 Methodology

This report applies the most relevant and current guidance in relation to the treatment and management of invasive plant species in construction projects. The following literature was referred to in preparation of this report.

- NRA Guidelines on The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads (2008)
- Managing Japanese knotweed on development sites The Knotweed Code of Practice produced by the Environmental Agency (2013)
- Best Practice Management Guidelines Japanese knotweed *Fallopia japonica*, Invasive Species Ireland (2015)

3 Legislation

The control of invasive species in Ireland comes under the Wildlife (Amendment) Act 2000 where it states that 'Any person who— [...] plants or otherwise causes 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, ['refers only to exotic species thereof'][...] otherwise than under and in accordance with a licence granted in that behalf by the Minister shall be guilty of an offence.'

Under the European legislation, the Birds and Natural Habitats Regulations 2011 (SI 477 of 2011), Section 49(2) prohibit the introduction and dispersal of species listed in the Third Schedule (including Japanese knotweed) whereby "any person who plants, disperses, allows or causes to disperse, spreads or otherwise causes to grow [....] shall be guilty of an offence."

4 Invasive Species in the Study Area

The most recent invasive species survey carried out on the Study Area in September 2016 by Dixon Brosnan. While other invasive plant species were also identified, such as Himalayan Balsam (*Impatiens glandulifera*) and White Heliotrope (*Petasites fragrans*), Japanese knotweed is of primary concern for the structural integrity of these proposed flood works, therefore the focus of this report is on the prevention of the spread of knotweed.

Japanese knotweed is present in many areas within the Glashaboy catchment however for the purposes of this scheme, a Japanese Knotweed Management Plan will only be put in place within the footprint of the construction works.

The key times during the scheme when a japanese knotweed management plan will be put in place will be during the construction phase and during the operation phase which includes the protection of flood defence structures and preventing the spread of knotweed during channel maintenance activities by the OPW.

The drawings appended to the end of this report show the locations of invasive species, including Japanese Knotweed within the works area in September 2016. Refer to Drawings GR_201 to GR_219 in **Appendix A**.

5 Japanese Knotweed Management Plan During Construction Phase

The contractor will be required develop a Japanese Knotweed Management Plan prior to construction activities commencing. This purpose of this plan will be to:

- Identify the extent of the infestation on the site
- Ensure further growth and spread of the plant on the site does not occur,
- Ensure the plant is not spread to other sites either adjacent to the infested site or through transportation of contaminated soil to another site
- Identify the best method for managing and controlling Japanese knotweed on the site with regard to the proposed site works and construction methods
- Communicate the plan to all site operatives to ensure success of the plan
- Document and record the treatment and management methods carried out on site for future reference (future site owners, site users, avoid litigation etc.)

The plan shall be completed by a suitably qualified ecologist, made as simple as possible and should contain the following:

- Site background including proposed works
- Extent of the Japanese knotweed infestation
- Specific control plan to be put in place
- Site hygiene protocols
- Responsible individuals
- Follow up requirements
- Any other relevant information (in Appendix)

Where flood relief structures are proposed at sites that contain Knotweed, root barrier membranes will be installed to protect the structures from the plant. The design of these membranes will form part of the detailed design stage.

Site hygiene protocols, like those listed in **Section 5**, will need to be implemented on all works sites.

5.1 Management Options

There are a number of management options that may be taken to control and prevent the spread of Japanese knotweed. In consultation with a qualified ecologist, the contractor will decide upon a suitable methodology. The proposed management plan will need to be agreed with the National Parks and Wildlife Service (NPWS), Inland Fisheries Ireland (IFI) and Cork County Council prior to the works being carried out. It should be noted that:

- Where any infested material (soil containing Japanese Knotweed) is to be taken off site, a license to transport the material will need to be sought from NPWS.
- A permitted landfill will need to be sourced to deposit excavated material which can accept such material. The landfill site operator will need to be informed of what the material contains.
- Where herbicide treatment will be used, consideration must be made as to where the herbicide will be located, the proximity to watercourses and other vegetation.
- For all management plans, site hygiene protocols will need to be implemented. These protocols should include sites which are infested with Knotweed and those where Knotweed is not growing to prevent contaminated material being brought to site. Site hygiene protocols are outlines in **Section 5.2** below.

Figure 1 provides an example of a simple flow chart that may be used in the process of forming a management plan.

5.2 Site Hygiene

Maintaining site hygiene at all times in a Japanese knotweed affected area is essential to prevent further spread. It is also necessary on sites where Japanese Knotweed is not present but where there is risk of contaminated material being brought to site, for example, site machinery being used on multiple site, construction staff travelling between infested and not infested sites. Preventative measures must be taken. Construction equipment, vehicles and footwear may provide a vector for the spread of Knotweed.

The following site hygiene measures should be taken for each site where applicable:

- Understand the possible extent of the rhizome (root) system underground up to 7m horizontally and 3 meters vertically.
- Where possible avoid the infested area and fence it off or clearly mark off the rhizome extent.
- Avoid if possible using machinery with tracks in infested areas.
- Clearly identify and mark out areas where contaminated soil is to be stockpiled on site and cannot be within 50m of any watercourse or within a flood zone.
- Create designated entry and exit points for operators on foot and for small mobile equipment. A delineated access track to be maintained free of Japanese knotweed should be established through the site to minimise the spread of Japanese knotweed by permitted vehicles accessing the site.
- Installation of a dedicated footwear & vehicular wheel wash down facility into a contained area within the site.
- Vehicles leaving the site should be inspected for any plant material and washed down into a contained area.

- Vehicles used in the transport of contaminated material will need to be visually checked and washed down into a contained area before being used for any other work, either on the same site or at a different site.
- Material gathered in dedicated wash down contained areas will need to be appropriately treated along with other contaminated soil on site.
- For any material entering the site, the supplier must provide an assurance that it is free of Japanese Knotweed.
- Ensure all site users are aware of measures to be taken and alert them to the presence of the Japanese knotweed Site Management plan.
- Erection of adequate site hygiene signage in relation to the management of non-native invasive material.

6 Japanese Knotweed Management – Operation Phase

6.1.1 **Protecting Flood Defence Structures**

As part of the operation phase there will need to be on-going treatment of knotweed at sites where it could potentially compromise the structural integrity of the flood defence structures. A management plan for the operational phase will need to be approved with the relevant bodies i.e. NPWS, IFI and Cork County Council.

Site hygiene protocols will need to be implemented.

6.1.2 Channel Maintenance Works

During channel maintenance works, a management plan will need to be put in place to prevent the spread of Japanese Knotweed downstream during those works.

Site hygiene protocols will need to be implemented.

As discussed above, the management plan for the operational phase will need to be approved by the NPWS, IFI and Cork County Council.

Flowchart for treating Japanese knotweed



Figure 1. Flowchart for treating Japanese knotweed (Environment Agency, 2013).

7 Conclusion

The presence of Japanese Knotweed requires the scheme to have a Japanese Knotweed Management Plan. The Plan shall be written by a suitably qualified ecologist. Given the nature of the species and the rate of growth, each proposed works site will need to be re-surveyed prior to works. Site hygiene will be particularly important on sites where Knotweed is present but also 'clean' sites. Incoming vehicles, equipment and including footwear worn by contractors will need to be cleaned and inspected before coming on site to prevent the further spread of the plant.

Where possible material will remain on site and be reused. Any material that must be removed off site to landfill or other suitable facility will require a licence from the National Parks and Wildlife.

The Management Plan must be clearly communicated to all site staff and must be adhered to if it is to be implemented successfully.

8 **References**

Best Practice Management Guidelines Japanese knotweed *Fallopia japonica*, Invasive Species Ireland (2015)

Managing Japanese knotweed on development sites - The Knotweed Code of Practice produced by the Environmental Agency (2013)

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

Appendix A

Invasive Species Drawings GR_201 to GR_219

A1



GLASHABOY RIVER, CORK (Glanmire/Sallybrook) - Invasive Species Survey September 2016

Glashaboy River (Glanmire/Sallybrook) Tree Survey



DRG. NO. GR_201 Invasive Species - Plan Layout



Glashaboy River (Glanmire/Sallybrook) Tree Survey



DRG. NO. GR_202 Invasive Species - Plan Layout

Glashaboy River (Glanmire/Sallybrook) Tree Survey



DRG. NO. GR_203 Invasive Species- Plan Layout





NOT TO SCALE

DRG. NO. GR_204 Invasive Species - Plan Layout

Glashaboy River (Glanmire/Sallybrook) Tree Survey



DRG. NO. GR_205 Tree Survey - Plan Layout



Glashaboy River (Glanmire/Sallybrook) Tree Survey



DRG. NO. GR_206 Invasive Species - Plan Layout



NOT TO SCALE

DRG. NO. GR_207 Invasive Species - Plan Layout





NOT TO SCALE

DRG. NO. GR_208 Invasive Species - Plan Layout



NOT TO SCALE

DRG. NO. GR_209 Invasive Species - Plan Layout



Glashaboy River (Glanmire/Sallybrook) Tree Survey



DRG. NO. GR_210 Invasive Species - Plan Layout

Glashaboy River (Glanmire/Sallybrook) Tree Survey



DRG. NO. GR_211 Invasive Species - Plan Layout

Glashaboy River (Glanmire/Sallybrook) Tree Survey



DRG. NO. GR_212 Invasive Species - Plan Layout





DRG. NO. GR_213 Invasive Species - Plan Layout



NOT TO SCALE

DRG. NO. GR_214 Invasive Species - Plan Layout



Glashaboy River (Glanmire/Sallybrook) Tree Survey



DRG. NO. GR_215 Invasive Species - Plan Layout

Glashaboy River (Glanmire/Sallybrook) Tree Survey



DRG. NO. GR_216 Invasive Species - Plan Layout

Glashaboy River (Glanmire/Sallybrook) Tree Survey



DRG. NO. GR_217 Invasive Species - Plan Layout



DRG. NO. GR_218 Invasive Species - Plan Layout



Glashaboy River (Glanmire/Sallybrook) Tree Survey





DRG. NO. GR_219 Invasive Species - Plan Layout



C Habitat maps of the proposed scheme





