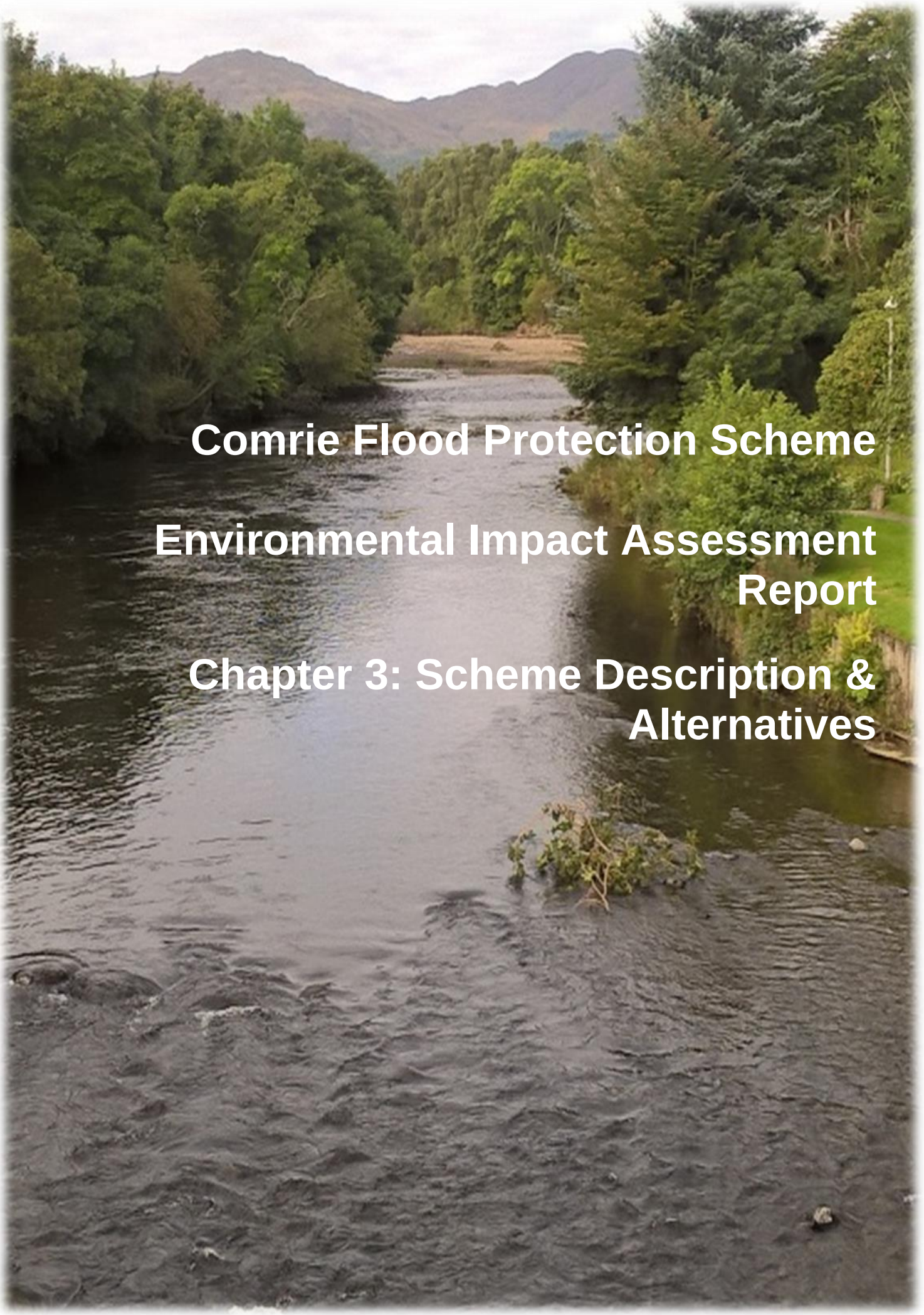

Comrie Flood Protection Scheme

Environmental Impact Assessment Report

Chapter 3: Scheme Description & Alternatives

Document Control

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3 Scheme Description & Alternatives

3.1 Introduction

3.1.1 This chapter provides a description and overview of the Comrie Flood Protection Scheme (the 'Scheme') which comprises flood defence walls, earthwork embankments, erosion protection measures, utility and service diversions and hard and soft landscaping summarised on **Figure 1.2**.

3.1.2 This chapter also sets out and describes the options and alternatives that have been considered in the selection of the preferred flood protection scheme and the project specific objectives that were set at the start of the design process.

3.2 Scheme Objectives

3.2.1 Perth & Kinross Council (the Council) are seeking to develop, promote and implement a flood protection scheme for Comrie which meets the following objectives:

- To reduce the economic damages to residential and non-residential properties in Comrie from the Water of Ruchill, the River Earn and the River Lednock and, where possible, to improve the Water Framework Directive (WFD) status of the bodies of water in the area.
- Develop an outline design and any identified surface water measures in sufficient detail to allow the flood scheme to be submitted to the statutory process under the Flood Risk Management (Scotland) Act 2009.

Sustainability

3.2.2 The Scheme objectives seek to manage flood risk in a sustainable environmental, social and economic manner. Sustainable development in line with Scottish Planning Policy has been a focus of the initial feasibility and design processes to date as well as ongoing stakeholder and community consultation. This process has ensured that measures to comply with sustainable related policy and guidance are prevalent through the design. The consultation has also ensured that the affected community have been able to inform the Scheme at critical stages in the design.

3.2.3 Climate change uplifts have been agreed with SEPA and the Council and have been considered throughout the outline design stage. An assessment of carbon and climate is presented in **Section 3.8** below.

3.2.4 Whilst catchment management and natural flood management have been scoped out of the Scheme, long term catchment management is an important factor. The Council are looking to find a steering group whose goal is to sustainably manage the catchment (including upstream areas on the Ruchill) mitigating some or all the effects of climate change.

3.2.5 Methodologies will be discussed and implemented with the appointed Contractor to minimise construction waste and maximise the re-use of materials on site.

3.3 Scheme Description

3.3.1 To meet the Scheme objectives, the Scheme comprises a combination of flood defence walls, earthwork embankments in locations where space is available, and, erosion protection measures. Following consultation with SEPA in relation to the current Scheme proposals, it was determined that the proposed flood protection scheme should be designed to accommodate a 1 in 200-year flood event, referred to as the 'design event'.

3.3.2 The outline design of the Scheme is summarised on **Figure 1.2**, with detailed plans of all operations provided in the Flood Order Scheme Drawings.

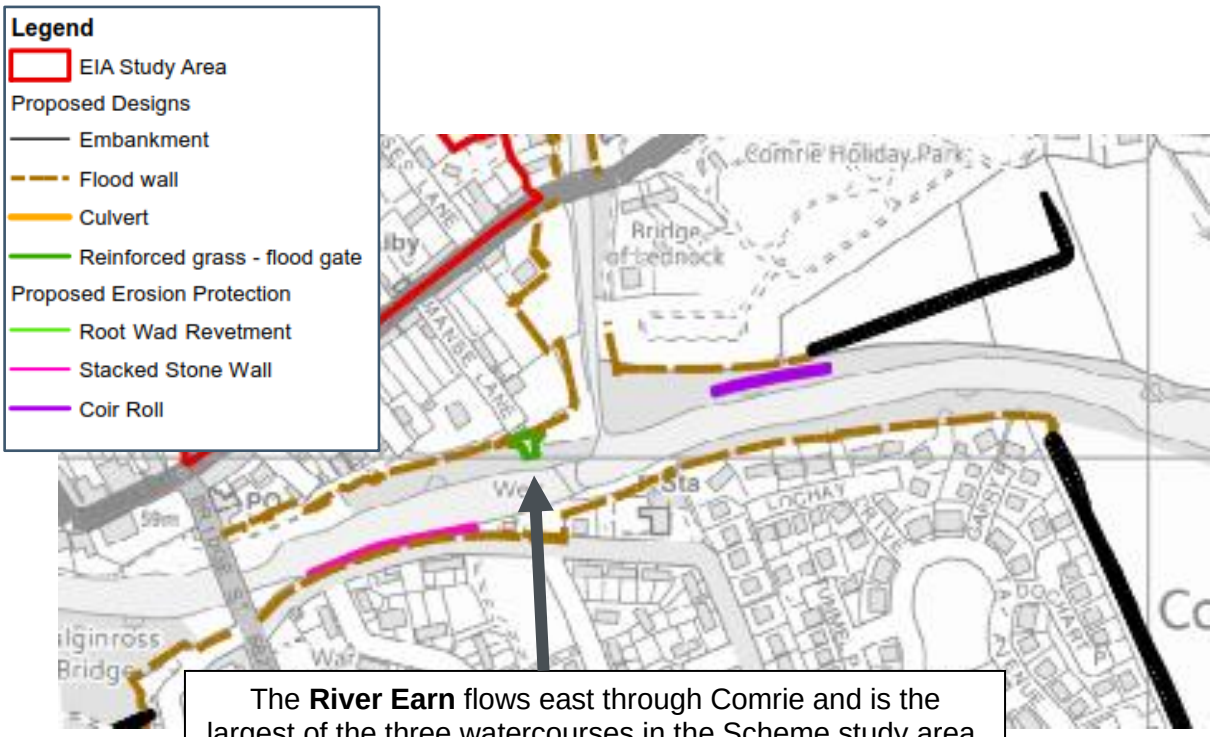
3.3.3 A description of the operations of the proposed flood protection measures are provided below. The Scheme descriptions provided are separated based on the three keys areas of the Scheme - the River Earn; the River Lednock; and the Water of Ruchill.

Scheme Facts

- The proposed Scheme will provide a minimum of 1:200-year standard of protection across the entire town. 189 properties will be brought out of flood risk at the 1:200-year event.
- The design of the defences (walls and embankments) has been carefully selected to ensure that in terms of visual impact and public access, any impact to the community is minimal.
- The natural environment, landscape and sites of historical, cultural or archaeological significance have been fully considered and accounted for during the outline design process.
- Felling of trees will be required to accommodate the construction of the defences. Total tree loss is expected to be in the region of 530 trees.
- Total compensatory tree planting is expected to cover an area of 7,649m^2. The proposals allow for more than 3 trees to be planted for every 1 tree felled.
- Construction and landscaping activities are expected to be phased over a period of 2 to 3 years.
- Concrete used in the construction of 'hard' defences will be either ready-mix or factory precast and will be brought to site via concrete wagons and standard HGVs.
- All material required for the earth embankments ('soft' defences) will be sourced from earthworks on site (where deemed suitable for re-use) or imported to site from local sources wherever possible via HGVs.
- All construction compounds will be secure and located sensibly i.e. close to the works but in locations that will minimise disruption to residents.
- The appointed Contractor and the Council will be responsible for public liaison and will communicate any road traffic changes / management and public access closures or diversions with appropriate warning.
- Construction working hours will typically be 0700 to 1900 hrs Monday to Friday and 0800 to 1300 hrs on a Saturday if required.

- Works are expected to commence with advance site clearance and ground preparation and installation of environmental protection measures including erosion protection, before beginning a phased construction programme and completing the works with hard and soft landscaping.

Detailed Scheme Description - River Earn



The **River Earn** flows east through Comrie and is the largest of the three watercourses in the Scheme study area.

3.3.4 The construction of new flood walls and earthwork embankments is along the left and right banks of the River Earn. Left and right banks are defined as those banks facing downstream. The new flood walls will typically be constructed as reinforced concrete flood walls with a combination of pedestrian access ramps (typically 1:12 gradient) and pedestrian access stairs. All pedestrian access features will include privacy fencing, handrails and where applicable lockable gates to private residential properties.

3.3.5 At the end of Manse Lane, a flood gate will be installed to provide vehicular maintenance access for the Council and Scottish Water. This gate will remain permanently closed and locked and will only open when vehicle access is required. This will ensure that the line of defence remains uncompromised and is not reliant on any third-parties for operation.

3.3.6 A new flood earth embankment will be constructed within the field to the rear of the houses located on Dochart Place, Tay Avenue, Tay Place and Earn Muir Road and in the area of Comrie Holiday Park.

3.3.7 Erosion protection measures are also being included with the Scheme. Erosion protection measures are proposed along the River Earn in two locations. On the right bank of the River Earn along Strowan Road where space is limited, the proposed solution comprises a stacked natural stone block wall, however this solution will be reviewed at detail design stage and may change to an alternative

rock roll approach. On the left bank of the River Earn near the Holiday Park, it is proposed to use a coir roll wall solution.

3.3.8 Traffic calming measures (blisters or build outs) are proposed along Strowan Road which will also be used for screen planting as part of the landscaping proposals. The traffic calming measures will provide protection to the wall by enforcing a reduction in traffic speed thereby reducing the risk of vehicle strike.

3.3.9 **Table 3.1** summarises the proposed flood defence operations for the River Earn section as shown on the Flood Order Scheme drawings.

Table 3.1: River Earn Scheme Defence Descriptions

Defence Operation Location and Drawing Reference	Operation Description
River Earn Left Bank (North side)	
EL01: River Earn left bank public space in front of Comrie Community Centre (as generally shown on the Flood Order Drawing marked 119398/400/303)	Regrading of existing footpaths to improve access, provision of public benches and soft landscaping.
EL02: River Earn left bank from Dalginross Bridge to Ancaster Lane (as generally shown on the Flood Order Drawings marked 119398/400/304 and 401)	Demolition of existing property walling and construction of a reinforced concrete flood wall with a suitable finish which will in part replace the property walling to be demolished. Construction of pedestrian access stairs at residential properties (Earnside & Plum Cottage, The Limes and East Riverside) including associated walls, railings and lockable gates. Construction of pedestrian access stairs at Commercial Lane including associated walls, railings and signage. Construction of ancillary works in the open space known as the 'Boulevard' such as soft landscaping, signage, connecting path and provision of two new memorial benches. Construction of ancillary street works such as the provision of two vehicle parking bays opposite Earnside Cottage. Construction of surface water drainage system on dry side of flood defence.

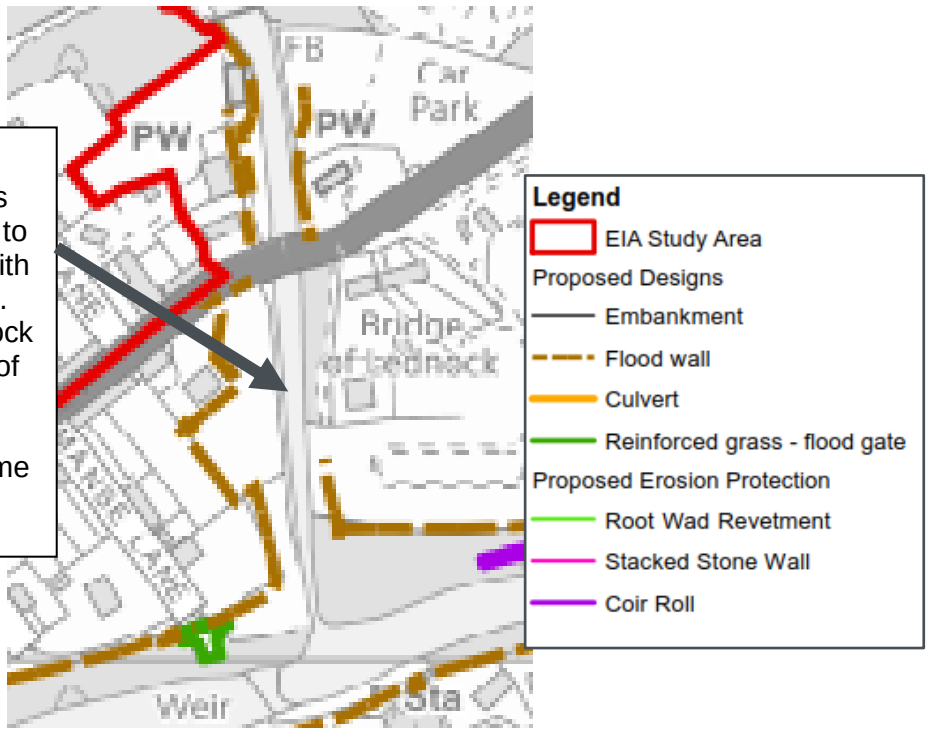
Defence Operation Location and Drawing Reference	Operation Description
EL03: River Earn left bank from Ancaster Lane to River Earn and River Lednock confluence (as generally shown on the Flood Order Drawings marked 119398/400/305 and 402)	Construction of a reinforced concrete flood wall with suitable finish. Construction of pedestrian access stairs for use of the residential property Mansfield, including cladding, associated walls, railings and lockable gate. Construction of reinforced grass maintenance standing area and turning head for use by authorised vehicles. Construction of ancillary works such as works to services and hard and soft landscaping. Construction of surface water drainage system on dry side of flood defence. Construction of a lockable flood gate at Manse Lane. The flood gate will remain in a closed position and locked.
EL04: River Earn left bank from River Lednock confluence along Comrie Holiday Park boundary (as generally shown on the Flood Order Drawings marked 119398/400/306, 307 and 403)	Construction of a reinforced concrete flood wall with suitable finish. Construction of ancillary works such as works to services, temporary and permanent relocation of static caravans and hard and soft landscaping. Construction of pedestrian access stairs at south west corner of Comrie Holiday Park including suitable concrete finish, associated walls, railings and signage. Construction of rock roll and seeded roll river bank including geotextile erosion protection and ancillary works such as soft landscaping. Construction of surface water drainage system on dry side of flood defence.
EL05: River Earn left bank from Comrie Holiday Park boundary to field boundary (as generally shown on the Flood Order Drawings marked 119398/400/307, 308 and 404)	Construction of an earthwork flood embankment, with geotextile erosion protection, including public access steps and pedestrian walkway along the crest of the flood embankment. Construction of ancillary works such as works to services, soft landscaping, protective fencing and gate Construction of surface water drainage system on dry side of flood defence. Compensatory tree planting between flood embankment and the River Earn to mitigate tree loss over the flood protection scheme.
ELGW: Gas works at the River Earn and River Lednock confluence (as generally shown on the Flood Order Drawings marked 119398/400/309, 402 and 407)	Carry out remediation works to facilitate safe access for the Operations. Remediations to include removal of made ground and historical gas works infrastructure and replacement with clean cover soils, and installation of geotextile membrane with cover added above.

Defence Operation Location and Drawing Reference	Operation Description
River Earn Right Bank (South side)	
ER01: River Earn right bank at Field of Refuge from car park to Dalginross Bridge (as generally shown on the Flood Order Drawings marked 119398/400/318 and 413)	Construction of a reinforced concrete flood wall with suitable finish including ancillary works such as soft landscaping. Construction of an access ramp complete with appropriate fencing, signage and lockable vehicle gate, and with the provision of a bridle gate. Construction of ancillary works such as works to services and hard and soft landscaping.
ER02: River Earn right bank from Dalginross Bridge to Legion Park (as generally shown on the Flood Order Drawings marked 119398/400/319, 320 and 414)	Construction of a reinforced concrete flood wall with suitable finish including ancillary works such as soft landscaping. Construction of ancillary works such as works to services and hard and soft landscaping. Construction of 3 No. traffic calming build outs (blisters) including associated signage, road markings, pedestrian deterrent pavement and soft landscaping. Construction of stacked natural stone block wall, including ancillary works such as ground anchors, geotextile matting and soft landscaping.

Defence Operation Location and Drawing Reference	Operation Description
ER03: River Earn right bank from Legion Park to Garry Place (as generally shown on the Flood Order Drawings marked 119398/400/321, 322, 323, 415, 416 and 417)	Construction of a reinforced concrete flood wall with suitable finish including ancillary works such as soft landscaping. Construction of ancillary works such as works to services and hard and soft landscaping including an unbound path and the formation of a maintenance access strip with new screen fencing for residents. Construction of access ramp opposite Legion Park. Operations to include associated walls, railings, screen fencing and signage Construction of access stairs at lane between Comrie Fire Station and No. 9 Lochay Drive, including associated walls, railings, screen fencing and signage. Construction of access stairs at lane between No. 12 and No. 13 Lochay Drive, including associated walls, railings, screen fencing and signage. Installation of a temporary gauge that will be operational in parallel with the existing SEPA gauge for a minimum of 6 months. Thereafter remove and reinstate existing gauge in a location agreed with SEPA. Construction of access stairs to the northeast of No. 4 Lochay Drive, including associated walls, railings, screen fencing and signage. Construction of new vehicle entrance and multi-use car park at Legion Park, including events space with seating and soft landscaping Construction of surface water drainage system on dry side of flood defence.
ER04: River Earn right bank from Garry Place to Tay Place (as generally shown on the Flood Order Drawings marked 119398/400/323, 324, 325, 326, 418 and 419)	Construction of an earthwork flood embankment with geotextile erosion protection. Construction of ancillary works such as works to services, soft landscaping, and protective stock fencing including access gate to the maintenance strip between the residential properties and flood embankment Construction of surface water drainage system on dry side of flood defence. Construction of new duct below the flood embankment to accommodate future high voltage cable and waste water pipe replacements. Location of new ducts given by marker posts at each end.

Detailed Scheme Description - River Lednock

The **River Lednock** flows through Comrie to its confluence with the River Earn. The River Lednock is the smallest of the three watercourses within the Scheme study area.



3.3.10 Defence structures proposed along the banks of the River Lednock comprise new flood walls. The flood walls will be constructed around the existing St. Margaret's Catholic Church and St Serfs Church ensuring minimal disturbance to the buildings wherever possible. The new flood walls will be reinforced concrete with natural stone cladding (type to be agreed and decided during detailed design) and coping. A vehicle access ramp at St Margaret's church driveway will also be included.

3.3.11 **Table 3.2** summarises the proposed defences for the River Lednock section as shown on the Flood Order Scheme drawings.

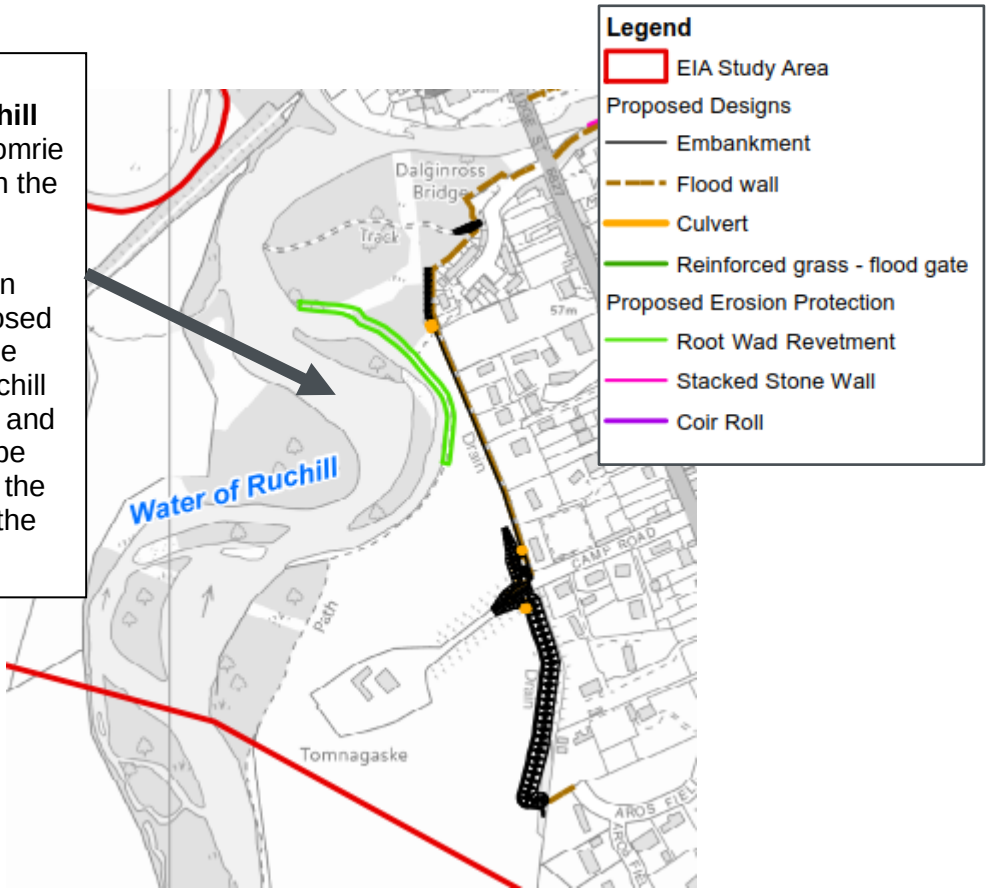
Table 3.2 River Lednock Scheme Descriptions

Defence Operation Location and Drawing Reference	Operation Description
Left Bank (East side)	
LL01: River Lednock left bank from St. Serf's Church meadow to A85 (as generally shown on the Flood Order Drawings marked 119398/400/310, 405 and 406)	Construction of a reinforced concrete flood wall with suitable finish to provide protection to St. Serf's Church. Construction of pedestrian access stairs at the Lednock bridge for maintenance access complete with lockable security gate and associated railings. Construction of ancillary works such as works to services and soft landscaping. Construction of surface water drainage system on dry side of flood defence.
LL02: River Lednock left bank at River Earn and River Lednock confluence (as generally shown on the Flood Order Drawings marked 119398/400/311 and 407)	Construction of a reinforced concrete flood wall with cladding, to provide protection to Comrie Holiday Park. Construction of ancillary works such as works to services, temporary and permanent relocation of static homes as necessary and hard and soft landscaping.
Right Bank (West side)	
LR01: River Lednock right bank from dismantled railway bridge abutment to A85 (as generally shown on the Flood Order Drawing marked 119398/400/310, 405 and 406)	The existing mass concrete retaining wall on the riverside of St Margaret's Church will be cut down and a new reinforced concrete flood wall will be constructed. Construction of ancillary works such as works to services and hard and soft landscaping. Construction of vehicle access ramp at St Margaret's church driveway, including associated walls, railings and signage. Construction of boundary wall to the west of St Margaret's church driveway. Construction of surface water drainage system on dry side of flood defence.
LR02: River Lednock right bank from A85 to River Earn and River Lednock confluence (as generally shown on the Flood Order Drawings marked 119398/400/311, 406 and 407)	Construction of a reinforced concrete flood wall with suitable finish. Construction of ancillary works such as works to services and hard and soft landscaping, including a a new terrace formed by the flood wall on the south and east elevations of Glenbuckie. Construction of pedestrian access ramp and stairs for private use including associated walls and railings. Construction of surface water drainage system on dry side of flood defence. Construction of ancillary works such as works to services on Drummond Street.

Detailed Scheme Description - Water of Ruchill

The **Water of Ruchill** meanders west of Comrie to its confluence with the River Earn.

Erosion protection measures are proposed on a section of the riverbank of the Ruchill with new flood walls and embankments to be constructed east of the riverbank close to the town.



3.3.12 Defence structures proposed along the east bankside of the Water of Ruchill comprise a new flood wall which will be constructed as a driven steel sheet pile wall with reinforced concrete textured stone facing and precast concrete coping. A new earthwork flood embankment will also be constructed at the Tomnagaske access road and to the south of Tomnagaske estate.

3.3.13 Construction of new defences render the existing flood wall redundant. However, the existing wall will be retained to minimise residential disturbance and the impact on existing vegetation. The existing drainage channel will be realigned with the new flood wall and embankment construction.

3.3.14 A private access ramp for Tomnagaske and a new shared access ramp to maintain pedestrian access and to enable private vehicle access to agricultural land northeast of Camp Road will also be provided.

3.3.15 Green bank protection measures are also proposed along the right bankside of the Water of Ruchill. Current bank protection on the right bank of the Water of Ruchill at the Field of Refuge is failing. A root wad revetment is proposed by way of remediation. Tree trunks with the root wads attached will be pushed into the bank with the roots exposed, this will be supported by stone and provide erosion protection.

3.3.16 An artificial otter holt will be provided in the root wad revetment to provide in stream habitat for otters in this area. Further information is provided in **Chapter 8: Ecology & Nature Conservation**.

3.3.17 **Table 3.3** summarises the proposed operations for the Water of Ruchill section as shown on the Flood Order Scheme drawings.

Table 3.3 Water of Ruchill Scheme Operation Descriptions

Defence Operation Location and Drawing Reference	Operation Description
WR01: Water of Ruchill right bank adjacent to Aros Field East (as generally shown on the Flood Order drawings marked 119398/400/312 and 408)	Construction of a reinforced concrete flood wall with suitable finish.
WR02: Water of Ruchill right bank from Aros Field East to Camp Road (as generally shown on the Flood Order Drawings marked 119398/400/312, 313, 314, 408, 409 and 410)	Demolish existing earthwork flood embankment and construct a new earthwork flood embankment, including ancillary works such as soft landscaping, fencing and drainage ditch, with geotextile erosion protection. Construction of a driven sheet pile flood wall incorporating an above ground reinforced concrete wall with suitable finish. Operations to include ancillary works such as soft landscaping. Construction of a culvert to maintain a continuous flow from the drainage ditch at the toe of the earth work flood embankment to the south of Camp Road with the drainage ditch at the foot of the flood wall to the North of Camp Road. Construction of a private access ramp for Tomnagaske, including ancillary works such as soft landscaping, with geotextile erosion protection. Construction of a shared access ramp to maintain pedestrian access and to enable private vehicle access to agricultural land northeast of Camp Road. Construction of ancillary works such as works to services, hard and soft landscaping, reinstatement of Tomnagaske entrance walls, fencing, signage and lockable gate to maintenance strip. Ancillary works to also include installation of lockable bollards, or similar, to prevent unauthorised vehicle access and parking Construction of surface water drainage ditch on dry side of flood defence. Construction of surface water drainage system at the entrance to Tomnagaske.
WR03: Water of Ruchill right bank from Camp Road to Field of Refuge (as generally shown on the Flood Order Drawings marked 119398/400/314, 315, 316, 410 and 411)	Construction of a driven sheet pile flood wall with suitable finish. Ancillary works to include soft landscaping and drainage ditch. Construction of access stairs at Field of Refuge for Council to access the maintenance strip on the dry side of the new flood wall including lockable gate and associated railings. Construction of root wad reinforced geotextile revetment including ancillary works such as ground anchors, bracing boulders and soft landscaping to finished ground level. Location to follow line of existing river bank as determined on site.

Defence Operation Location and Drawing Reference	Operation Description
WR04: Water of Ruchill right bank at Field of Refuge from Hillcrest dwellings to car park (as generally shown on the Flood Order drawings marked 119398/400/317 and 412)	Construction of a driven sheet pile flood wall with suitable finish including ancillary works such as works to services and soft landscaping. Construction of pedestrian access stairs at Field of Refuge, including localised demolition of existing wall, construction of walls associated with the access stairs, railings and signage, culvert at drainage ditch, and re-aligning of the existing footpath including associated walls, railings and signage, and culvert at drainage ditch. Construction of re-aligned drainage ditch.
Disused railway line to the south and east of Ross	
DR01: Disused railway line to the south and east of Ross (as generally shown on the Flood Order drawing marked 119398/400/327)	Compensatory tree planting on the line of the dismantled railway to the south and east of Ross to mitigate tree loss over the flood protection scheme

Secondary Flooding

3.3.18 An assessment of secondary flooding risk associated with the Scheme has been undertaken. The overall impact of the fluvial flood scheme on the secondary flooding issues is that across the town, only three properties will experience minor changes in pluvial (surface water) based flooding at a range of return periods.

3.3.19 Back of wall drainage and localised interventions specific to the three identified properties will be included as part of the Scheme to address detriment incurred. This is discussed further in **Chapter 7: Water Environment & Fluvial Geomorphology**.

3.4 Construction

3.4.1 Construction methods will be developed further during the detailed design stage and include further liaison with statutory consultees, landowners, key environmental stakeholders and the Council. To enable the assessment of potential impacts from construction, reasonable assumptions have been made with regards to likely methods, construction compound requirements and lay down areas.

3.4.2 The extent of the indicative construction working area (5m buffer either side of the defence structure) and construction compounds are shown on the appended Indicative Construction Plan (**Figure 3.1**).

Construction Environmental Management

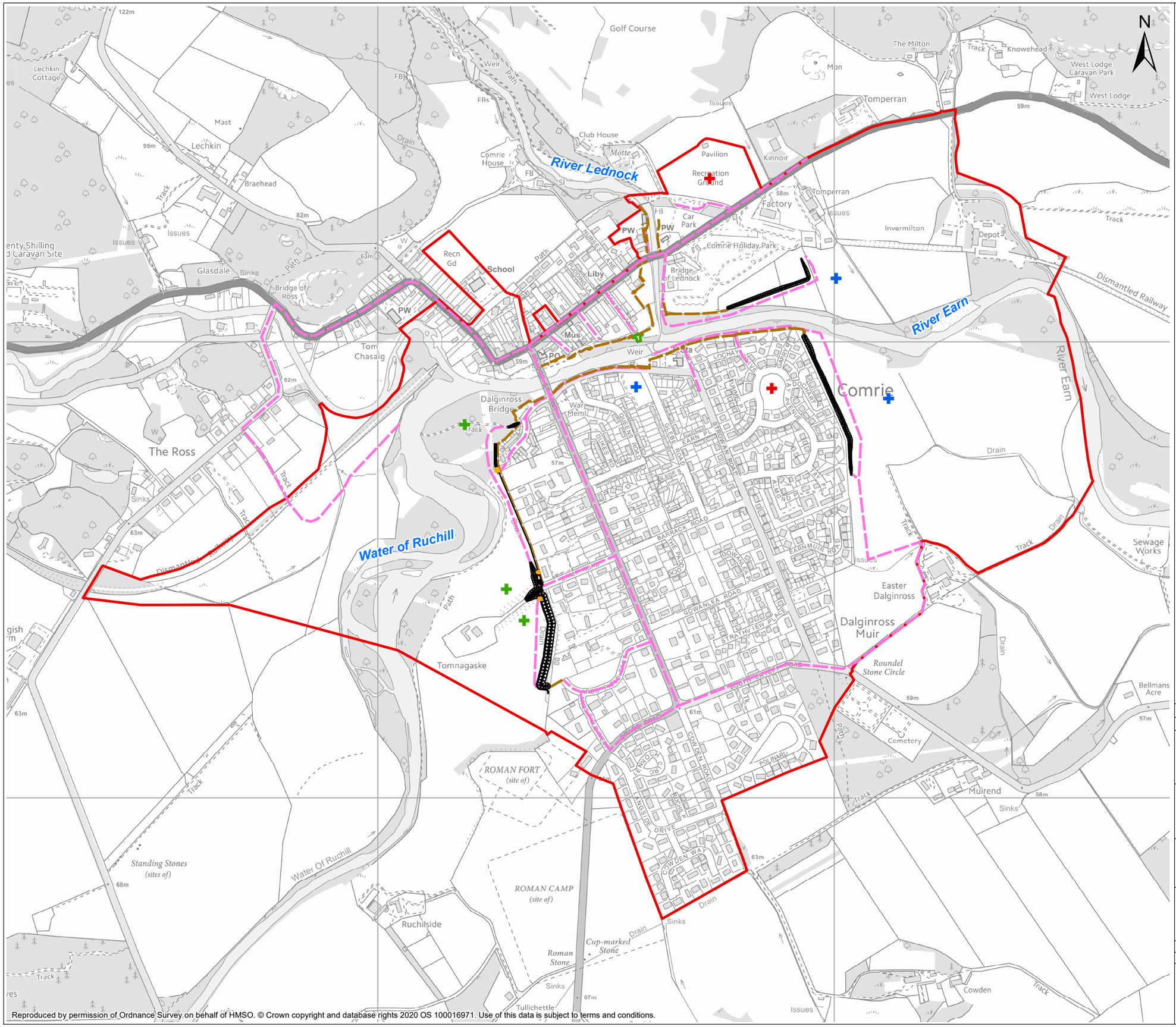
3.4.3 An outline Construction Environmental Management Plan (OCEMP) has been prepared for the Scheme and is provided in **Appendix 3.1**. This document provides mitigation measures which could be delivered during the construction period to reduce environmental impacts.

3.4.4 The OCEMP has been produced with reference to the detail included in this Environmental Impact Assessment Report (EIAR) and presented in the outline design and describes the likely effects of the construction of the Scheme on the environment

and community and suggests methods to avoid, minimise or mitigate any identified construction effects.

3.4.5 The OCEMP has been developed to provide the management framework needed for the planning and implementation of construction activities in accordance with environmental commitments identified in the EIAR and as per current legislation.

3.4.6 The OCEMP sets out the approach that should be used by the Contractor once appointed to update and prepare their own detailed CEMP at the detailed design stage. The detailed CEMP will be prepared by the Contractor prior to construction of the Scheme to further specify how site activities would be managed to ensure that risks to the environment are minimised and will be based on the confirmed Flood Order design.



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Legend

- EIA Study Area

Proposed Designs

- Embankment
- Flood wall
- Culvert
- Reinforced grass - flood gate

Potential Construction Site Compounds

- Main Compound
- Satellite Compound
- Discounted
- Access Route*

*Note: Access may be required in other areas / routes as part of the scheme construction. This map only highlights the routes likely to be frequently used.

0 200 400 Metres

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Rev.	Rev. Date	Drawing Suitability	Drawn	Appr'd
P01.1	05/02/2020	For Information	JB	RMcL

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Client

PERTH & KINROSS COUNCIL

Project

Comrie Flood Protection Scheme 2020

Drawing Title

Figure 3.1 - Indicative Construction Plan

Scale @ A3	1:8,000
Project No.	119702

Construction Method Statement

3.4.7 An outline Construction Method Statement (OCMS) has been prepared as a separate document to the EIAR (provided in **Appendix 3.2**). The OCMS provides an anticipated and general framework for how construction works could be undertaken including those construction activities within proximity of a watercourse (e.g. installation and use of cofferdams). All construction activities will be implemented and controlled to avoid any deterioration in river water quality.

3.4.8 The principal construction works are expected to comprise the construction of flood walls (sheet piled or reinforced concrete solutions), earthwork embankments and erosion protection measures.

3.4.9 The OCMS will be further developed by the appointed Contractor who will develop construction methods and specify management for different aspects of the Scheme, in accordance with the confirmed Flood Order design.

3.4.10 The OCMS will be submitted to the employer's representative for review and approval for compliance with any requirements set by the Council, regulators and other key stakeholders.

3.4.11 The design and implementation of temporary works to facilitate construction such as access route diversions, will also be included in the OCMS.

Construction Methodology

3.4.12 All anticipated working methodologies, construction areas, compounds and access arrangements will be reviewed and finalised in agreement with the Council and the appointed Contractor.

3.4.13 Construction is currently expected to commence in 2021 and will be phased over a period of 2 - 3 years.

3.4.14 Construction of the Scheme is expected to commence with site clearance and accommodation works before any construction of flood defence walls and earthwork embankments. Erosion protection measures and hard and soft landscaping will also be phased throughout the duration of the construction activities as summarised below.

Advance Works

3.4.15 Advance works are anticipated to comprise:

- Establishment of site compounds (main and satellite) and identification of key traffic access routes
- Site clearance including tree felling, vegetation clearance and invasive species removal / treatment
- Utility and service diversions
- Remediation earthworks at the former gas works site
- Installation of secondary flooding interventions
- Erosion protection measures
- Installation of ecological mitigation and enhancement features

Main Construction Works

3.4.16 The main construction activities are expected to comprise:

- Construction of flood defence walls
- Construction of flood defence earthwork embankments
- Construction of public and vehicular access stairs and ramps
- Landscaping including screen planting, re-instatement and compensatory tree planting
- Re-instatement of any traffic or public access diversions

Construction Site Access Routes & Traffic Management

3.4.17 It is anticipated that the main access route to the site would be the A85 (**Figure 3.2**). Access would also be required along Bridge Street, Strowan Road, Tay Avenue (providing access to Lochay Drive, Garry Place, Dochart Place and Tay Place), Field of Refuge, Camp Road and Commercial Lane, Ancaster Lane and Manse Lane.

3.4.18 Traffic management will be required during the construction phase and this may comprise temporary road diversions, temporary road restrictions and traffic signalling. An outline traffic management plan has been incorporated into the OCEMP which will be required to be developed further by the appointed Contractor and with the agreement of the Council.

3.4.19 Any closures or diversions to public rights of way, core paths or public footpaths will be included in the CEMP and developed further with the appointed Contractor as required.

3.4.20 Any closures or diversions will be communicated effectively by the Contractor and the Council in advance and progress reported throughout the construction works.

3.4.21 Requirements relating to noise levels from plant and machinery will also be documented within the CEMP and in consultation with key stakeholders.

Construction Site Compound(s)

3.4.22 Potential locations for site construction compounds have been identified within the Scheme suitable for use during construction activities as shown on the Indicative Construction Plan (appended **Figure 3.2**). These locations have been identified to allow the potential construction effects of the Scheme to be consistently assessed across the EIA. It has been assumed that there would be main construction compounds with several smaller satellite compounds set up as construction progresses and moves across the Scheme area.

3.4.23 The potential compound locations have been ascertained as suitable in terms of proximity to key construction areas, access for deliveries and as locations which are considered to pose minimal intrusion on the environment and community.

3.4.24 A potential construction compound in the area of the Sports Pavilion and Recreation Ground has been discounted due to the anticipated disturbance to the local community and environment. It is understood that this area is commonly used for sporting and community events such as but not limited to the Comrie Fortnight.

3.4.25 It is noted that some of the potential compound locations may be at risk of flooding. These locations could be used as potential satellite / temporary compounds. Any flood risk would be required to be appropriately mitigated against in accordance with the relevant Pollution Prevention Guidelines (PPGs) / Guidance for Pollution Prevention (GPPs).

3.4.26 All compounds and working areas will be temporarily fenced off for public safety and in accordance with health and safety requirements.

Waste Management

3.4.27 A site-based Waste Management Plan will be prepared by the Contractor. This will ensure that waste materials are appropriately managed on site. In accordance with the waste hierarchy, materials will be stockpiled and reused on-site wherever possible rather than taken off-site for disposal. If additional fill materials are required to be imported, local materials will be sourced where possible.

3.4.28 Methods to reduce the amount of waste generated on site will be adhered to with re-use and recycling the preferred methods as per the waste hierarchy and taking cognisance of circular economy initiatives.

Pollution Prevention Measures

3.4.29 Appropriate pollution prevention measures will be required given the proximity of construction activities on riverbank and proximity to waterbodies. The sensitive nature of the Scheme setting will also be taken into consideration.

3.4.30 Continual consultation with SEPA, SNH and Council departments to agree measures required to prevent pollution to watercourses and disruption will be undertaken throughout work activities.

Controlled Activities Regulation (CAR) Licensing

3.4.31 A Controlled Activities Regulation (CAR) Licence will be required from SEPA under the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) and the Water Environment (Miscellaneous) (Scotland) Regulations 2017.

3.4.32 A CAR (construction site) licence will also be required for the discharge of water runoff from a construction site to the water environment.

3.4.33 Further discussions will be held with SEPA to confirm the CAR licensing requirements as part of the detail design process to ensure that all authorisations are in place ahead of any construction works starting.

3.5 Operation & Maintenance

3.5.1 The Scheme has been designed to minimise operational and maintenance requirements. Once constructed, the Scheme will only require occasional interventions to operate and maintain the flood protection measures. The key aspects will be:

- Routine maintenance inspections of the walls and embankments to determine damage and any necessary repairs;
- maintenance of the floodgate;
- landscape maintenance of the embankments and landscaped areas;
- monitoring of the watercourses and bank protection measures to ensure that the bank erosion protection and vegetation is establishing effectively.

3.5.2 It is anticipated that any plant, materials and personnel required for the operation and maintenance works will be minimal and will only be on-site as required.

3.6 Scheme Alternatives

Early Studies

3.6.1 Several studies have been undertaken to investigate the flooding and potential flood alleviation options which could be implemented at Comrie.

3.6.2 The most relevant is the Comrie Flood Protection Scheme: Feasibility Report[1]. This report collates information from previous work and looks at all of the various options considered. It is the basis for the Scheme .The purpose of this report was to assess the potential flood protection solutions, including an assessment of the key constraints, costs of implementation and the benefits that could be realised together with a recommendation for a preferred option of flood walls and embankments.

Overarching Scheme Objectives

3.6.3 SEPA identified Comrie as a Potentially Vulnerable Area (PVA) which requires flood prevention works to help protect people, property (both residential and non-residential), agricultural land and the environment from flood events. The Tay Flood Risk Management Plan[2] seeks to outline objectives and actions for each PVA, setting out practically how flood risk will be managed at a local level.

3.6.4 The following objectives were identified for the Comrie PVA within the Tay Flood Risk Management Plan:

- Reduce economic damages to residential and non-residential properties in Comrie caused by flooding from the River Earn and River Lednock;
- Reduce the physical or disruption risk related to the transport network for roads;

[1] WSP September 2017.Comrie Flood Protection Scheme Feasibility Report.
[2] Perth & Kinross Council, June 2016. Local Flood Risk Management Plan - Tay Local Plan District

- Accept that significant flood risk in Dalginross is being managed appropriately. Maintain existing actions that reduce flood risk in Dalginross caused by flooding from the Water of Ruchill;
- Reduce overall flood risk; and
- Avoid an overall increase in flood risk.

Alternatives Considered

The Long-List

3.6.5 A long list of options for consideration was developed and appraised within the 2017 Comrie Flood Protection Scheme: Feasibility Report, the options considered both primary and secondary options as defined below:

- Primary Options are options which could provide a flood alleviation solution for the village.
- Secondary Options are options which in isolation could not provide a flood alleviation solution for the village but could provide some mitigation benefits to a primary option.

3.6.6 The key advantages and disadvantages of each long-list option were considered and are presented in **Appendix 3.3** for reference.

The Short-List

3.6.7 The shortlisting process was based on the modelling results for each of the long-list options considered, the advantages, disadvantages, hazards and opportunities. **Table 3.4** sets out the five options that were short-listed and the key reasons they were carried through for further assessment.

Table 3.4: Short-listed Options

Option	Reason for Shortlisting
P2 – Walls and Embankments	• Familiar forms of construction • Landscaping features through the village to reduce the visual impact of the defences. • Maintenance costs are expected to be a small percentage of the total capital costs. • Can achieve the 1 in 200 year Standard of Protection.
P4 – Upstream storage on the Water of Ruchill with walls and embankments	• Familiar forms of construction for the local defences. • Landscaping features through the village to reduce the visual impact of the defences. • Incorporating a storage area upstream of the village will reduces the works required through the village.

Option	Reason for Shortlisting
P5 – Upstream storage on the River Earn with walls and embankments	• Familiar forms of construction for the local defences. • Landscaping features through the village to reduce the visual impact of the defences. • Incorporating a storage area upstream of the village will reduce the works required through the village.
S8 – River Stabilisation Techniques	• Will help to reduce the increase of flood risk in some locations due to the protection of the river banks. • Can assist in habitat creation. • Will help to protect existing and future flood defence assets.

3.6.8 The short-listed options were then subject to further social, environmental and economic appraisal in order to determine a preferred option to be carried forward to outline design.

3.6.9 The preferred option selected for the Scheme based on the appraisal of the shortlisted options was option P2 - traditional walls and embankments. The Scheme proposals were developed to ensure that they met the objectives of the Local Flood Risk Management Plan for Comrie.

3.6.10 The preferred option was chosen primarily based on the benefit cost ratio for the scheme being above 1.0 (i.e. the benefits of the scheme are greater than the total scheme costs) with the other shortlisted options considered having benefit cost ratios of 1.0 or below 1.0. Without a benefit cost ratio for the scheme being above 1.0, justification for scheme funding from central government cannot be demonstrated and therefore the flood scheme would be considered financially unviable.

3.6.11 The Feasibility Report concluded that other benefits for selecting option P2 include the following:

- Familiar forms of construction – The techniques employed are commonly used in flood alleviation schemes.
- Reduced manual intervention – Manual intervention is required for some schemes to function properly. The preferred option however has limited requirements for manual intervention to enable the scheme to function and therefore is less likely to fail in a flood event.
- Environmental Impacts – Although there will be some environmental impacts, these impacts will be less than other shortlisted options.
- Scheme Maintenance – The on-going maintenance costs which would be associated with this option will be less than the other options.
- Type of Defences – Option P2 consists of only flood defences around the village perimeter which consist of walls and embankments.

3.6.12 Following the identification of a preferred option for the Scheme it was identified that the Scheme would need to be developed further during outline design to enable the scheme alignment to be confirmed as the defence type, defence heights, drainage and river engineering requirements to be confirmed.

3.7 Natural Flood Management

3.7.1 Natural Flood Management (NFM) techniques were considered as part of the initial feasibility studies commissioned by the Council and assessed as part of the long list of interventions.

3.7.2 A high-level examination was undertaken to assess the sensitivity of the upstream catchments of the Water of Ruchill, the River Earn and the River Lednock to potential NFM measures. This approach considered the impact of NFM on design flows and considered measures such as decreasing runoff potential, increasing the time to peak of the flood hydrograph and increasing local flood plain storage and conveyance capabilities.

3.7.3 The analysis included examination of the SEPA NFM maps and various hydrological characteristics of the catchment and model. It was found that NFM would only have a limited impact on peak river flows and design flood levels in the 'at risk' area of the catchment. This is partly due to existing land-uses (there is limited potential for improvement) and the impact of the upstream reservoirs. Runoff reduction in upland areas could be considered as part of a longer-term approach to increasing the resilience of the flood scheme, however as the initial analysis showed the NFM potential to be minimal, such measures were therefore discounted as a component of the Scheme.

3.7.4 NFM measures were not included as a suitable flood risk management action for Comrie within the Tay District Local Flood Risk Management Plan (prepared by Perth & Kinross Council in accordance with the Flood Risk Management (Scotland) Act 2009).

3.8 Design Review and Assessment

3.8.1 The Scheme design process has been completed principally to provide flood risk protection for the town.

3.8.2 To optimise this Scheme objective, the design team which has included the EIA technical specialists have worked together to assess alternative designs to minimise environmental impact wherever possible. This has ensured that matters such as public access, visual impact and the conservation setting have been accounted for in the outline design process.

3.8.3 Embedding solutions in the design to ensure that it is compliant in terms of flood risk protection, engineering requirements and environmental constraints is as detailed below.

Wall Design and Construction

3.8.4 Flood defence embankments (and walls) were aligned to suit the flood model which in turn was informed by Mouchel's original study. The decision to construct a flood wall or embankment has been sensitive to the setting to preserve visual character and screening and has accounted for the anticipated construction and foundation requirements.

3.8.5 The defence wall heights have been determined by the hydraulic modelling to meet the requirements for flood protection (including freeboard allowances). The Scheme has been modelled and verified and is considered acceptable for a 1 in 200-year

standard of protection.

3.8.6 Proposed flood defences seek to butt against existing structures where possible.

Visual Impact

3.8.7 The visual impact of the Scheme has accounted for the conservation status and picturesque riverside setting of Comrie. Wall finishes have been selected to reflect the setting of the Scheme and ensure that visual impact is minimised wherever possible. Consultation events throughout the project duration has provided useful feedback from the local community on this aspect of the design.

3.8.8 The potential for tree loss has been a focus of the design process with an aim of maximising tree retention wherever possible. An extensive tree survey was undertaken across the study area which estimated tree root zones which have been considered with respect to indicative foundation requirements and construction footprint by the design team.

3.8.9 To mitigate the identified tree loss, compensatory landscaping and planting schedules as detailed on **Sweco Landscape Proposal Drawings 119398-400-350 to 119398-400-360 (Appendix 5.5)** have also been included in the outline design presented. It is proposed to plant as a minimum three trees for each tree felled.

Public Access and Amenity

3.8.10 Public access has been maintained where possible with the provision of accessible up and over ramps and stairs. The location of these access points has been selected to ensure that public pedestrian access is maintained whilst ensuring that the access provided is safe. Provision of vehicular maintenance access to the riverside is only where required.

3.8.11 Lockable gates have been included to provide private access to residential properties along the riverside and a lockable floodgate (which will remain closed) is provided for vehicle maintenance access.

3.8.12 Consultation with the local community and the Councils access officers has informed the public access design and ensures that where possible the proposed design largely reflects the requirements of the local community.

Erosion Protection Measures

3.8.13 Bank protection measures have been incorporated into the Scheme design in areas where bank erosion is expected to increase as a result of the proposed flood defences and in areas of steep bankside.

3.8.14 The use of green bank protection as opposed to hard bank protection has been included where possible to limit any impact on the physical habitat condition for the waterbodies across the Scheme. The proposed solutions include the installation of stacked coir roll and root wad revetment.

3.8.15 On the steep bank of the River Earn, adjacent to Strowan Road, the solution proposed will provide a robust protection where construction is restricted due to the space available. The proposed solution here will be refined at detail design with the assistance of a specialist sub-contractor. It is possible that an alternative rock roll

solution may be adopted which would have a softer visual impact and is not anticipated to change or increase the impact assessments undertaken.

Carbon Reduction

3.8.16 During the outline design of the Scheme, value engineering has been a key focus and 'smart design' has been applied where possible reducing material requirements. During design assumptions have been made regarding the wall design, construction and its associated visual impact in the surrounding environment (taking account of the Comrie Conservation Area). These assumptions have fed into the Carbon Assessment.

3.8.17 A carbon assessment has been completed for the Scheme as it is currently proposed and the technical report for this is provided in **Appendix 3.4**. Current calculations indicate that during the construction period and with the material used, the scheme would generate 6200 tonnes of embodied Carbon.

3.8.18 During the detailed design stage of the works a review of the outline design will be undertaken with a view to reducing the embodied carbon of the Scheme. The review will consider:

- Using less materials (through for example: more efficient design, designing for less waste and changing the specification of specific elements of the design); and
- Using alternative materials (through for example: selecting materials with lower embodied carbon, selection reused or higher recycled content materials)

3.8.19 The contractor will be required to prepare a report during detailed design and also at completion of the project to provide information on the carbon associated with the final Scheme.

3.9 Major Accidents and Disasters

3.9.1 Major accidents and/or disasters can result in illness, injury or loss of life to a population, either directly, or indirectly. In accordance with the 2017 EIA Regulations, this has to be considered during the EIA stage of a development and must focus on the vulnerability of a development to major accidents and/or natural disasters.

3.9.2 The Scheme has been designed in line with current best practice and it is expected that the detailed design stage and construction will also follow best international current practice and, as such, reduce the vulnerability of the proposed Scheme to risks of major accidents and/or natural disasters.

3.9.3 The Scheme is also being built to protect the town of Comrie from major flooding incidents. By its very nature it is increasing the resilience of the local area to the most likely major weather event. In addition, by reducing the number of flooding events in the area, the Scheme is also freeing up emergency services (fire, police and ambulance), allowing them to deal with other incidents that may occur and providing increased capacity for the local and regional area.

3.9.4 In the regional area, there is also the North of Scotland Regional Resilience Partnership (NSRRP)[3]. This partnership sets policy on emergency planning, response and recovery and brings together organisations to plan and deliver services for people of Perth and Kinross. With this policy in place, potential effects from major accidents and disasters are being planned for in a holistic manner.

3.9.5 Current EIA practice already considers an assessment on some potential accidents and disaster scenarios such as significant road traffic accidents, acts of terrorism, fire/explosions, seepage of pollutants into the Rivers, extreme weather and collapse/damage to structures. These assessments are detailed within **Chapter 10: Socio-economics, Public Access and Amenity.**

3.9.6 A number of potential accidents and/or disasters were considered with regards the proposed Scheme, but none are predicted to be material and no indirect significant effects on population and human health due to major accidents and/or disasters is predicted so a standalone assessment has not been included.

3.10 Environmental Enhancement and Innovation

3.10.1 Environmental enhancements and innovative ideas have been included in the outline design where possible (**Figure 3.3**). These are summarised below along with added ideas for further consideration during detailed design.

Ecological

- Provision of artificial bat roosting habitat on the railway bridge at the confluence of the Water of Ruchill and River Earn.
- Provision of an artificial otter holt in the area of erosion protection measures (root wad revetment) to be constructed on the bankside of the Water of Ruchill.
- Compensatory tree planting along the existing railway line which will provide an ecological enhancement as well as improving the visual aspect in this area – other areas could be considered as well.
- Fruit tree planting around the local primary school playing fields could be provided as an initiative with the Council and the local Primary School. Increasing the number of orchards is a priority of the Tayside Local Biodiversity Action Plan.
- Native species (wildflower and ornamental shrub and herbaceous planting) have been proposed throughout the Scheme which will provide both a biodiversity and a landscape added value.

[3] https://www.pkc.gov.uk/media/22921/13-12-11-Item-14-13-584-/pdf/13.12.11_-_Item_14_(13-584).pdf?m=635217527424370000

Visual

- Use of local stone and appropriate style of cladding to be used on the flood defence walls within the Comrie Conservation area and in keeping with the existing styles observed.
- Suitable visual screen planting (trees, shrubs, flowers) across the Scheme including within the proposed traffic calming measures (blisters or build outs) on Strowan Road and within the landscaped amenity greenspace areas.

Geomorphological

- Use of green and grey bank protection measures where possible to minimise environmental detriment and bankside erosion.

Community

- Introduction of a new surfaced path within the green space to the east of the Dalginross Bridge (left bank of the River Earn).
- Regrading the existing footpath to make it DDA compliant.
- Restoration of a former pathway along the bankside of the Water of Ruchill following bank protection interventions.
- Landscaping design across public amenity and riverside areas within the Scheme footprint.
- Provision of a bridle gate leading to the Water of Ruchill.
- Provision of pedestrian public use up and over access stairs and ramps within the flood wall design to maintain prior access to the riverside.
- Improved access and parking at Legion Park for the relocation of the Comrie Fortnight celebrations.
- Discussions to be held with the local community (including Comrie in Colour and Comrie Fortnight) to discuss options for planting, street lighting and seating options within public amenity and riverside areas.
- Establishing a local steering group to sustainably manage the catchment including upstream areas on the Ruchill.

Environmental Enhancement Comments

- Ecological
- 1 — Provision of artificial bat roosting habitat on the railway bridge
- 2 — Artificial otter holt to be constructed on the bankside of the Water of Ruchil
- 3 — Compensatory tree planting along the existing railway line
- 4 — Invasive species management
- Geomorphological
- 5 — Use of green bank protection measures
- 6 — Use of grey bank protection measures
- Community
- 7 — Introduction of a new surfaced path within the green space to the east of the Dalginross Bridge
- 8 — Horse friendly vehicle access gate
- 9 — Access ramps
- 10 — Maintaining accessibility to paths and greenspace
- 11 — Additional landscape planting and seating
- 12 — Improvements to Legion Park for the future provision of events
- 13 — Potential fruit tree planting around the local primary school playing fields

Legend

- EIA Study Area

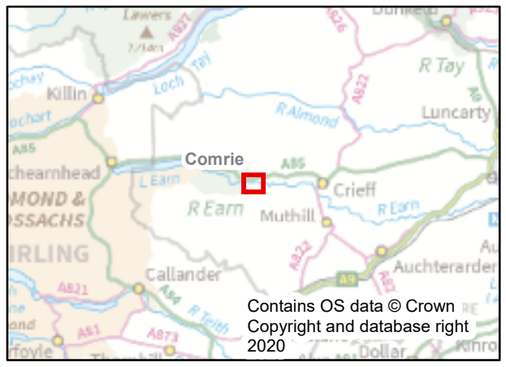
Proposed Designs

- Embankment
- Flood wall
- Culvert
- Reinforced grass - flood gate

Proposed Erosion Protection

- Root Wad Revetment
- Stacked Stone Wall
- Coir Roll

0 200 400 Metres



Scheme Wide

- Native wildflower planting has been proposed throughout the Scheme.
- Use of local stone and appropriate style of cladding to be used on the flood defence walls.
- Suitable screen planting (mix of native and non native trees, shrubs and plants).
- Potential for community involvement for local environmental enhancement works / opportunities.

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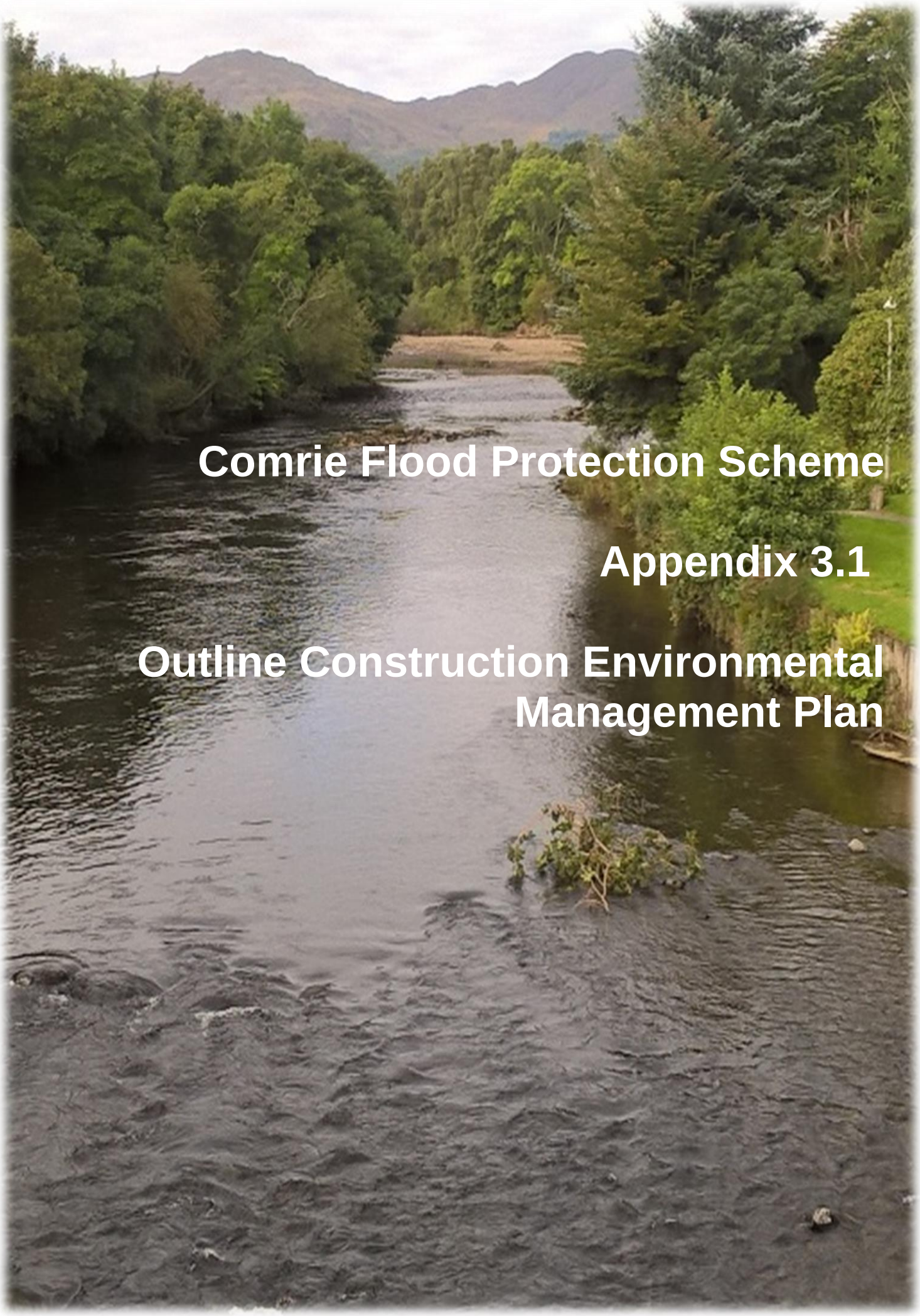

Comrie Flood Protection Scheme

Appendix 3.1

Outline Construction Environmental Management Plan

Document Control

Document title	Appendix 3.1 Outline Construction Environmental Management Plan
Originator	Gail Currie
Checker	
Approver	Rebecca McLean
Authoriser	Rebecca McLean
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CONTENTS

1 Introduction

1.1 Background

1.1.1 This outline Construction Environmental Management Plan (OCEMP) supports the Environmental Impact Assessment (EIA) and the Flood Order for the Comrie Flood Protection Scheme ('the Scheme') to demonstrate how mitigation measures to reduce environmental impacts during the construction period could be delivered.

1.1.2 The outline CEMP sets out the approach that should be used by the appointed Contractor to update the outline CEMP and to prepare their own CEMP at the detailed design stage.

1.1.3 This approach, where the Contractor is responsible for preparing the CEMP, aims to ensure that all potential environmental impacts identified in the preliminary assessment and at the detailed design stage are fully addressed by the appointed Contractor and suitable mitigation measures implemented.

1.2 Supporting Documents

1.2.1 The basis for the mitigation measures and the main aspects of the outline CEMP have emerged from the supporting technical documents produced to accompany the Scheme EIA and Flood Order:

- Environmental Impact Assessment Report (EIAR)
- Flood Order Technical Report

1.3 Environmental Impacts

1.3.1 The key environmental impacts that will require further consideration are:

- Construction threats / risk to the local ecology
- Construction threats / risk to water quality and water pollution
- Construction threats / risk to general nuisance including potential dust and noise
- Construction threats / risk to soils, ground and presence of contaminated material
- Construction threats / risk to previously unrecorded archaeological remains

1.4 Outline CEMP Review and Updating

1.4.1 The outline CEMP will be used to inform the production of the Contractor's CEMP which will be a working and live document to be updated throughout the duration of the construction phase.

1.4.2 The CEMP shall be reviewed and modified as necessary during the construction phase and when any new activities are to be undertaken. The review shall be undertaken by the Environmental Manager / Construction Manager for the Scheme, in consultation with the project team and any other contractors or sub-contractors on site.

1.4.3 The Contractor will maintain a record of any reviews and updates and also a record of any complaints or incidents.

1.5 Environmentally Significant Changes

1.5.1 If any environmentally significant changes are encountered during construction, then the CEMP should be changed to reflect the new information.

1.6 Pollution Prevention Guidance (PPGs) and Guidance for Pollution Prevention (GPPs)

1.6.1 Pollution Prevention Guidelines (PPGs) and the replacement guidance series Guidance for Pollution Prevention (GPPs) have been developed to provide advice on legal responsibilities and best practice during construction.

1.7 Consents and Licences

1.7.1 Likely consents and licences required to be obtained by the appointed Contractor have been identified where possible within the EIAR. The consents and licences shall be reviewed by the Environmental Manager to ensure that the programme is being achieved and new consents are identified as early as possible. These include but are not limited to:

- Listed building consent;
- Controlled Activities Regulations (CAR) authorisations
  - for river engineering works and
  - a construction site licence to manage water runoff from the site during construction; and
- European Protected Species (EPS) licence and species protection plan

2 Environmental Management

2.1 Introduction

2.1.1 Specific environmental management procedures including Method Statements and environmental risk management strategies will be in place throughout the construction phase. Addressing environmental issues at an early stage in project planning is vital for successful minimisation of environmental impact. Environmental impact minimisation will be actively pursued as part of the Scheme.

2.1.2 The objectives of the environmental management procedures will be to avoid or minimise any potential impacts, comply with each environmental commitment and follow best practice.

2.2 Roles and Responsibilities

2.2.1 A clear management structure for construction and development of the Scheme will be included in the detailed CEMP. This will detail all staff responsible for any element of environmental work or mitigation measures. The organisational chart / register will define the responsibilities and accountability of specific Project team members.

2.2.2 An example of the register and typical roles that may be required is provided in **Table 2.1**.

Table 2.1: Typical Roles and Responsibilities

Role	Responsibilities
Construction / Project Manager	Overall responsibility for construction works and environmental management on site Ensure appropriate resources are available to the Project team so environmental commitments can be met Ensure the CEMP and all associated policies and procedures are implemented during the works
Environmental Manager	Main contact for all environmental issues on site. Co-ordinate all Environmental Specialists to ensure environmental commitments are complied with Ensure Project remains compliant with the CEMP, including compliance with environmental legislation, best practice, consents, commitments and objectives set Update and review the CEMP throughout the works Ensure the Project team have sufficient environmental training and co-ordinate delivery of additional training / inductions / tool-box talks where required Liaison with regulatory bodies and the local community where required
Site Agent	Produce Method Statements for specific work activities in relation to environmental aspects and impacts Undertake and direct works in accordance with Method Statements and environmental risk assessments in order to comply with environmental commitments, best practice and legislation
Environmental Specialists	Individual specialists may be responsible for the inputs into the environmental assessment and final detailed designs

Role	Responsibilities
	Provide support to the construction Project team in the form of pre-construction surveys, applications for licenses / consents, watching briefs and other specific issues Oversee mitigation throughout the Project

2.3 Meetings

2.3.1 In accordance with best practice, the Contractor should hold regular Site Progress Meetings during the works.

2.3.2 Issues relating to environmental design, mitigation and implementation in general, as well as implementation of the CEMP, should be an agenda item at these Progress Meetings.

2.4 Sub-Contractors and the Supply Chain

2.4.1 The Contractor should demonstrate how they aim to ensure that all sub-contractors are aware of and buy into project environmental management. They should show how the selection, control and review of performance of sub-contractors are to be managed.

2.4.2 The Contractor should also ensure that all sub-contractors understand the external communications strategy and maintain effective methods of communication.

2.5 Training

2.5.1 The Contractor shall identify (and record attendance at) any training they propose to carry out related to environmental issues including making staff aware of issues relating to matters such as flooding, ecology, amenity and pollution control.

2.5.2 Training may include site inductions; toolbox talks; and specific technical training.

2.6 Environmental Records

2.6.1 The Contractor should demonstrate what records are to be kept as part of the environmental management process.

2.6.2 The information should also identify where the documents are to be kept and who will be responsible for maintaining them. The documentation should include (but not be limited too): training; monitoring; project reviews; minutes of meetings; Method Statements; procedures; consents / licences etc.

2.7 Auditing

2.7.1 The Council may undertake or organise periodic audits of Contractor's performance against the CEMP and other site management practice.

3 Construction and Environmental Management Plan

3.1 Introduction

3.1.1 The EIA and outline design process has identified potential environmental impacts to residents and users of the Scheme area during planned construction and earthworks.

3.1.2 The main environmental issues at risk from the construction works are grouped as:

- Ecology
- Water pollution
- General nuisance including noise and dust
- Ground contamination
- Previously unrecorded archaeological remains

3.1.3 These environmental issues and associated construction threats, with mitigation recommendations and site actions are presented in **Tables 3.1 - 3.5.**

3.2 Ecological Construction Threats

Table 3.1 Ecological Construction Threats

Item	Construction Activity	Threat / Risk	Receptor	Mitigation	Recommended Action
1	Establish site and working areas / compound	Potential disturbance	Protected species	Any areas to be cleared, should be checked by a suitably qualified ecologist (SQE). Ahead of the works an Ecological Clerk of Works (ECoW) may give a tool box talk to onsite contractors in order to relate applicable legislation, what signs to look for, and what to do should protected species be encountered on site. The extent of ground clearance and other construction practices and restoration works should be minimised where possible to avoid unnecessary disturbance to habitats.	Pre-construction surveys and SQE to supervise any site clearance.
2	Prior to construction - vegetation / tree clearing	Loss of habitat	Habitat & trees	Any vegetation clearance should be preferably done outside the breeding bird season (March to August inclusive). If this is not possible, areas to be cleared, should be checked by a suitably qualified ecologist (SQE).	Pre-construction survey and SQE to supervise any site clearance.
2i		Loss of habitat	Protected species (e.g. bats)	Any areas to be cleared, should be checked by a suitably qualified ecologist (SQE). Works should be avoided where possible during the bat maternity roosting period of May to August inclusive.	Pre-construction survey and SQE to supervise any site clearance.
3	All construction activities, particularly noise	Potential disturbance	Nesting wild birds	Regular site checking for nesting birds, together with implementation of active measures to deter birds from breeding / nesting in construction areas. As a precaution, develop safe working procedures to protect nesting wild birds if discovered within working area, together with implementation of species specific buffer zones from active nests to avoid disturbance and harm to sensitive species.	Regular inspection concurrent with the bird breeding season. SQE to supervise any site clearance.
3i	All construction activities, particularly noise	Potential disturbance	Protected species (e.g. bats)	Regular site checking for protected species, together with implementation of active measures to deter them from nesting in construction areas.	

Item	Construction Activity	Threat / Risk	Receptor	Mitigation	Recommended Action
				As a precaution, develop safe working procedures to protect species if discovered within working area, together with implementation of species specific buffer zones from active nests to avoid disturbance and harm to sensitive species.	
4	Ground disturbance works	Injury	Badgers	As a precaution, any excavations or trenches should be covered at night to prevent foraging badgers falling into uncovered trenches.	Excavations and / or trenches to be covered at night.
4i		Disturbance at night	Bats and Otters	As a precaution, no night working or lighting of woodland edges at night to avoid disrupting potential foraging activity.	No night working or lighting of woodland edges at night.
5	Construction and earthworks near riverbanks and in-river engineering	Potential disturbance to protected species	Aquatic species	Construction methods will aim to avoid disturbance of the river and river bed habitat. Construction works will be undertaken outwith seasonal restrictions (e.g. outwith fish spawning, hatching and / or migration periods (November to May)) Walls and embankments will be placed back from the river's edge and no sheet piles will be used within the river. Appropriate mitigation and working practice will be implemented to ensure no silting of the water occurs during the construction and earthworks programme.	Ahead of works, work areas to be regularly inspected concurrent with seasonal restrictions. Adopt best practice to ensure safe working in proximity to water courses and in river engineering. Access to the river for construction works to be reviewed.
5i		Presence of Invasive Non-Native Species	Japanese Knotweed & Himalayan Balsam	All Contractors to be made aware of the localities where Japanese knotweed and Himalayan balsam have been identified. Methodologies for the treatment of and safe working in areas with invasive non-native species to be provided and biosecurity measures to prevent the inadvertent spread.	Biosecurity measures to be adhered to preventing the inadvertent spread.

3.3 Water Pollution Construction Threats

Table 3.2 Water Pollution Construction Threats

Item	Construction Activity	Threat / Risk	Receptor	Mitigation	Recommended Action
1	Establish site and working areas / compound	Poor surface water management and control	Surface water and Groundwater	Provide and maintain robust surfacing to compound area(s) to prevent pooling of surface water. Ensure appropriate surface water management and containment, particularly around the compound perimeter.	Regular inspection of the condition of the site compound(s). COSHH controls
1i		Leaks and spills from refuelling of plant and equipment	Surface water and Groundwater	Locate refuelling bays within an isolated area, appropriately bunded and contained to prevent surface water runoff and surface water penetration to the underlying soils and groundwater.	Regular inspection of refuelling bay. COSHH controls
1ii		Leaks and spills from storage of plant, equipment and materials	Surface water and Groundwater	Ensure all plant, equipment and materials are appropriately contained and isolated from the weather and surface water. Plant should be parked on hardstanding where possible, with the surface regularly maintained throughout the construction period. Areas of hardstanding should be constructed to prevent standing water and suitably bunded and contained to prevent uncontrolled surface water runoff and / or surface water penetration to the underlying foundation soils and groundwater.	Regular inspection. COSHH controls
1iii		Leaks and spills from waste management	Surface water and Groundwater	Ensure all liquid wastes are stored on site but are removed from site for appropriate and safe disposal elsewhere. Ensure solid wastes are appropriately segregated and contained within robust weather proof containers to avoid windblown littering of the work area.	Regular inspection. No wastes of any kind (solid or liquid) to be discharged to the drainage system. COSHH controls

Item	Construction Activity	Threat / Risk	Receptor	Mitigation	Recommended Action
				Ensure liquid wastes are not discharged directly onto the ground but contained for offsite disposal. Solid wastes should be collated, segregated and appropriately contained to prevent the generation of litter. Foul water (sewerage) generated from the site compound / welfare units will be contained on site for safe and controlled discharge elsewhere or appropriately piped to the foul sewer network at the site.	
2	Construction and earthworks activities	Leaks and spills from poor condition of plant and machinery	Surface water and Groundwater	All plant and equipment shall be in a good and safe working condition and appropriately maintained.	Regular inspection
2i		Accidental discharge of pollutants	Surface water and Groundwater	During construction, the possibility of accidental discharge of pollutants such as spills or leaks of fuel, oil and lubricants from construction plant, equipment and materials can occur. Whilst the impact will likely be localised, appropriate accidental pollution control and mitigation and spillage response plans will be developed and reviewed throughout the construction works.	Ensure appropriate and suitably robust pollution prevention and control mitigation measures are in place and integrated into the CEMP prior to commencement of the works. Measures should be developed in accordance with current UK best practice. COSHH controls
2ii		Flooding	Residents in Comrie and Dalginross	During construction, the possibility of breaching existing flood defences and flooding events during the construction works is possible.	Flood warning system to be in place and construction sequence plan to be followed to minimise risk of flooding during the construction activities. Potential breeches in the existing defences shall be

Item	Construction Activity	Threat / Risk	Receptor	Mitigation	Recommended Action
					minimised. For example, access along camp road to the 'wet side' of the defences will be left safe during weekends and holidays such that the town remains defended during these times. Construction shall be phased such that the defences in eastern Dalginross are functional prior to completion of the defences in west Dalginross.
2iii			Site operatives	Flood warning for the Ruchill is challenging because it is a flashy catchment. Good communication with SEPA is required to keep operatives safe.	Consultation with SEPA is required, such that SEPA are aware of times when site operatives will be working in close proximity to the river and in de-watered areas in the river. Threshold levels of dewater areas will be shared with SEPA so that they may respond appropriately to hydrometric observations.
2iv			SEPA gauge access	SEPA require 24/7 access to the gauge. SEPA personnel will be welcome on site at any time, all accommodations will be made to ensure that they are able to maintain the gauge. Any damage to the gauge or cabling will be reported to SEPA immediately.	Ensure that SEPA have all pertinent contact numbers for normal hours and outside normal hours. Ensure that Site inductions are offered to SEPA prior to them needing immediate access. Ensure that the construction time table is shared with SEPA and ensure that they

Item	Construction Activity	Threat / Risk	Receptor	Mitigation	Recommended Action
					receive regular bulletins regarding gauge access.
3	Construction and earthworks near riverbanks and in-river engineering	Silting of watercourse / river channel	River Earn, River Lednock and Water of Ruchill	Construction methods will aim to avoid disturbance of the river and where possible, walls and embankments will be placed back from the river edge. Appropriate mitigation and working practice will be implemented to ensure no silting of the water occurs during the construction and earthworks programme. In-river construction such as temporary cofferdams will be appropriately managed and mitigated.	Adopt best practice to ensure safe working in proximity to water courses. In river engineering work to be reviewed. Formation of cofferdams.
4	Staff and Personnel training	Staff and personnel unaware or ignorant of environmental risk and associated potentially severe implications of a neglect of responsibility	Surface water and Groundwater	Provide regular training for staff, together with environmental awareness sessions and regular environmental notifications through message boards and site wide posters. New starter inductions to include environmental awareness and responsibility and environmental care. Contractor staff to include environmental regulation and awareness within tool box talks and site inductions.	Promote and maintain learning and development culture to include environmental awareness and environmental responsibility. Provide opportunity for staff and contractor feedback and involvement to benefit environmental improvement.

3.4 General Nuisance Construction Threats

Table 3.3 General Nuisance Construction Threats

Item	Construction Activity	Threat / Risk	Receptor	Mitigation	Recommended Action
1	General Works	Risk of noise nuisance	Local residents	The contractor shall assess noise throughout the construction works to ensure noise levels remain within acceptable levels and without potential to cause nuisance, particularly to adjacent dwellings and communities. Unavoidably noisy works will be managed on site by the Contractor during least sensitive periods. The Contractor will give prior notice to adjacent residents and communities of likelihood of nuisance, giving a description of the works and likely time periods of operation and duration of potential nuisance levels of noise.	Contractor to assess noise generated from site activities and implement appropriate noise reduction measures, as necessary. Contractor to respond to complaints and action appropriate mitigation to reduce nuisance noise levels.
1i		Risk of dust nuisance	Local residents	The Contractor shall assess dust nuisance throughout the construction works to ensure operational controls are in place. Such controls may include damping down materials; reseeding areas after earthworks; and during dry conditions the use of a water bowser.	Contactor to regularly inspect and monitor (visual) during earthworks. Contractor to respond to complaints and action appropriate mitigation to reduce nuisance dust levels
1ii		Risk of light nuisance	Local residents & ecological receptors	Lighting will be provided at the minimum luminosity necessary, in order to minimise light pollution. Lights will be planned, positioned and directed so as to minimise light spill onto adjacent buildings, activities and habitats.	External lighting will be controlled to ensure lighting is minimised outside consented working hours.
1iii		Disturbance to amenity and local events	Community	The Contractor shall take account of local community events and plan the construction work programme accordingly to minimise any disruption to the local community.	Contractor to take account of local events and plan accordingly. Contractor to liaise with the local community council or events team in advance

Item	Construction Activity	Threat / Risk	Receptor	Mitigation	Recommended Action
				Appointment of a community liaison officer by the Council and appointed Contractor.	Stakeholder Communication Plan.
2	Transportation	General nuisance	Local residents	Road Deliveries to the site should be programmed to coincide with least sensitive periods and outwith periods of peak traffic movements. Construction vehicles travelling from the site will be clean and devoid of mud and dust prior to leaving the site.	The delivery of large and exceptional loads should be restricted to outwith sensitive periods. Where necessary, the Contractor shall provide appropriate diversion routes for local traffic and additional road safety measures to protect other roads users and pedestrians etc. Implementation of a Traffic Management Plan.
2i		Road Safety	Local residents	Where necessary, the Contractor shall employ appropriate traffic management measures and / or signage to ensure and maintain a high standard of road and pedestrian safety.	The Contractor shall engage with the Council and other relevant agencies to ensure road safety is maintained. Implementation of a Traffic Management Plan.
3	Public Access	General nuisance	Local residents	Forward planning for potential public right of way or footpath closures to maintain public access with clearly signposted diversions and advance notice to local residents about the proposals. Appointment of a community liaison officer by the Council and appointed Contractor.	The Contractor shall engage with the Council and other relevant agencies to ensure public access is maintained. Stakeholder Communication Plan

3.5 Soil & Ground Contamination Construction Threats

Table 3.4 Soil & Ground Contamination Construction Threats

Item	Construction Activity	Threat / Risk	Receptor	Mitigation	Recommended Action
1	Establish site and working areas / compound	Poor surface water management	Soils / Ground contamination	Provide and maintain robust surfacing to compound area to prevent pooling of surface water. Ensure appropriate surface water management and containment, particularly around the compound perimeter to prevent possible leaching into the underlying groundwater and / or spread of mobile contaminants into adjacent areas.	Regular inspection of the condition of the site compound, particularly condition of working surface.
1i		Refuelling of plant and equipment	Soils / Ground contamination	Locate refuelling within an isolated area, appropriately bunded and contained to prevent surface water runoff and surface water penetration to the underlying soils and groundwater.	Regular inspection of refuelling area.
1ii		Storage of plant, equipment and materials	Soils / Ground contamination	Ensure all plant, equipment and materials are appropriately contained and isolated from the weather and surface water. Potentially corrosive materials should be stored within robust, waterproof containers. Plant should be parked on hardstanding, with the surface regularly maintained throughout the construction. Areas of hardstanding should be constructed to prevent standing water and suitably bunded and contained to prevent leaching of potential contaminants into the underlying foundation soils and groundwater.	Regular inspection.
1iii		Waste Management	Soils / Ground contamination	Ensure all wastes are not stored on site but are removed from site for appropriate and safe disposal elsewhere. Ensure solid wastes are appropriately segregated and contained and disposed of following best practice to a suitably licensed disposal facility. Ensure liquid wastes are not discharged directly onto the ground but contained for offsite disposal.	Regular inspection. No wastes of any kind (solid or liquid) to be discharged into the drainage system.

Item	Construction Activity	Threat / Risk	Receptor	Mitigation	Recommended Action
				Foul water (sewerage) generated from the site compound / welfare units will be contained on site for safe and controlled discharge elsewhere or appropriately piped to the foul sewer network. Should unexpected contamination be identified during construction (e.g. hydrocarbon impacted soils or asbestos), works should be halted until a suitably qualified professional is consulted to assess the situation and provide advice.	
2	Construction and earthwork activities	Condition of plant and machinery	Soils / Ground contamination	All plant and equipment shall be in good and safe working condition and appropriately maintained.	Regular inspection.
2i		Cleanliness of plant and machinery	Soils / Ground contamination	All plant and equipment brought to site will be cleaned to a high standard “as new” to prevent transfer of contamination.	Inspection of plant and equipment prior to and following mobilisation to the site. In addition, all plant and equipment replacements and additions will be suitably inspected following mobilisation to the site. All plant, equipment and materials to be supplied cleaned to “as new” standard.
2ii		Accidental discharge of pollutants	Soils / Ground contamination	During construction, the possibility of accidental discharge of pollutants, such as spills or leaks of fuel, oil and lubricants from construction plant, equipment and materials can occur. Whilst the impact will likely be localised, appropriate accidental pollution control and mitigation, and spillage response plans will be developed and reviewed throughout the construction works.	Ensure appropriate and suitably robust pollution prevention and control mitigation measures are in place and integrated into the CEMP prior to commencement of the works.

Item	Construction Activity	Threat / Risk	Receptor	Mitigation	Recommended Action
					Measures should be developed in accordance with current UK best practice.
3	Staff and Personnel training	Staff and personnel unaware or ignorant of environmental risk and associated potentially severe implications of a neglect of responsibility	Soils / Ground contamination	Provide emergency spill kits on site and training for use. Provide regular training for staff, together with environmental awareness sessions and regular environmental notifications through message boards and site wide posters. New starter inductions to include environmental awareness and responsibility and environmental care. Contractor staff to include environmental regulation and awareness within tool box talks and site inductions	Promote and maintain learning and development culture to include environmental awareness and environmental responsibility. Provide opportunity for staff and Contractor feedback and involvement to benefit environmental improvement. Ensure commitment to environmental concerns and environmental improvement.

3.6 Archaeological Construction Threats

Table 3.5 Archaeological Construction Threats

Item	Construction Activity	Threat / Risk	Receptor	Mitigation	Recommended Action
1	Establish site and working areas / compound	Loss / damage to previously unrecorded archaeological remains	Unrecorded archaeological remains	Prior to construction Perth & Kinross Heritage Trust will be contacted to confirm programme of archaeological works. This is initially likely to be trial trenching in areas of archaeological potential. The results of the trial trenching will inform the requirement for further archaeological works in advance of construction.	Contact Perth & Kinross Heritage Trust to agree an appropriate programme of archaeological works
2	Construction and earthworks activities	Loss / damage to previously unrecorded archaeological remains	Unrecorded archaeological remains	Prior to construction Perth & Kinross Heritage Trust will be contacted to confirm programme of archaeological works. This is initially likely to be trial trenching in areas of archaeological potential. The results of the trial trenching will inform the requirement for further archaeological works in advance of construction.	Contact Perth & Kinross Heritage Trust to agree an appropriate programme of archaeological works
3	Construction activities	Damage to a Category C Listed Building	Dalginross Bridge (LB75)	Prior to any works being carried out on these assets it will be necessary to apply for and obtain Listed Building Consent from Perth & Kinross Council. Appropriate mitigation will be agreed in consultation with Perth & Kinross Council Conservation Officers.	Apply for Listed Building Consent
3i		Loss / damage to a Category C Listed Building	The garden wall of Earnside (LB5347).	Prior to any works being carried out on these assets it will be necessary to apply for and obtain Listed Building Consent from Perth & Kinross Council. Appropriate mitigation will be agreed in consultation with Perth & Kinross Council Conservation Officers.	Apply for Listed Building Consent

4 Site Based Waste Management Plan

4.1 Overview

4.1.1 The use of Site based Waste Management Plans (WMP) is recognised best practice and is likely to be implemented during construction and development works.

4.1.2 A Site based WMP will be prepared and included as part of the CEMP in accordance with best practice guidance from (but not limited to) the Waste and Resources Action Programme (WRAP), Contaminated Land: Application in Real Environments (CL:AIRE) and Construction Industry Research and Information Association (CIRIA).

4.1.3 The WMP will seek to achieve the efficient use of resources, minimise waste production and encourage re-use and recycling materials.

4.1.4 The detailed design process will design out waste using proven design principles and construction methods that prevent and minimise the use of resources.

4.1.5 Construction will be planned to identify and implement ways to prevent, reduce, reuse and recycle waste, with a preference given to prevention, reusing and recycling of waste within the project.

4.1.6 The following hierarchy will be used, in order of preference, for management of all excavated materials and construction waste.

- Prevent potential waste generation
- Minimise / reduce potential waste generation
- Reuse and /or recycle materials within the site
- Find a beneficial use for the materials on another site
- Segregation with transport off site for recycling
- Segregation with transport off site for disposal

4.2 Purpose

4.2.1 WMPs encourage the effective and efficient management of materials and operate as a guide for construction staff. The WMP will ensure that waste is considered at each stage of the construction and development and that all waste streams are dealt with appropriately and as sustainably as possible.

4.2.2 The WMP will include consideration of:

- reduction, re-use and recycling of all materials and soils (both on and off site)
- location of all environmentally sensitive receptors
- storage of all waste materials on site
- all relevant legislations, regulations and best practice guidance in relation to waste
- waste carriers and local disposal and recycling facilities

5 Outline Traffic Management Plan

5.1.1 During construction activities, there will be disruption to traffic routes used within the Scheme footprint and wider area. This is expected to temporarily affect both vehicular and pedestrian access routes.

5.1.2 Where possible, disruption to the local community will be avoided and measures put in place to mitigate the potential effects.

5.1.3 Routing of construction vehicles will be pre-determined with restricted speed limits and allocated entry and exit points. Any traffic diversions will be agreed in advance with the Councils Roads department and Outdoor Access Officers. Advance notification will be provided to the local community in accordance with the Councils methodology.

5.1.4 Where possible, construction traffic movement will be phased so that deliveries to site are received outwith peak times and with consideration of school hours. If appropriate, banksmen would supervise moving plant machinery and dedicated turning areas / layby areas will be utilised where appropriate.

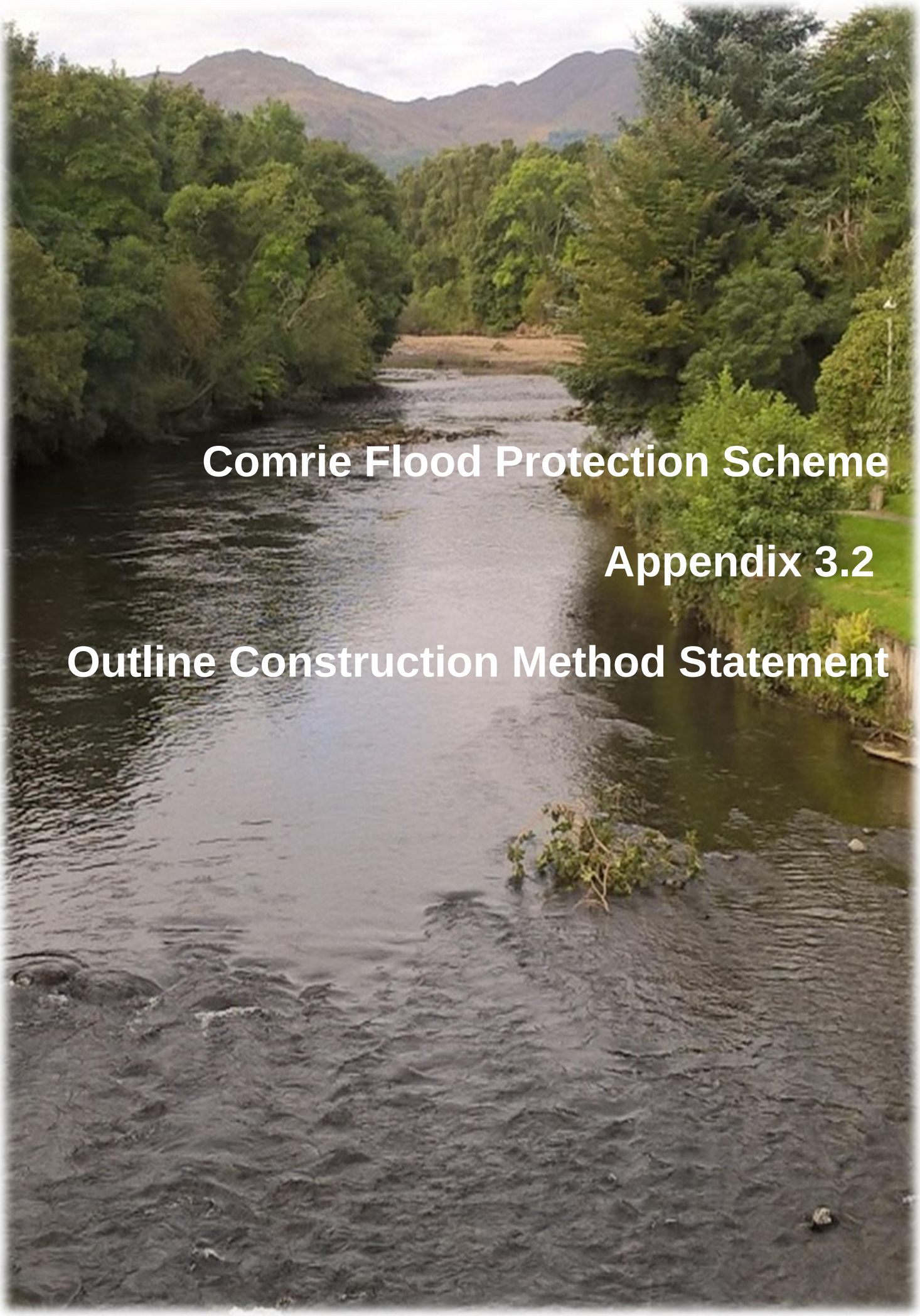
5.1.5 Anticipated vehicle movements and how the routing plan will be communicated to contractor staff, delivery drivers and any visitors will be identified by the appointed Contractor within the detailed CEMP and detailed Traffic Management Plan.

5.1.6 The Traffic Management Plan will also ensure that emergency vehicles and fire station employee vehicles are not prevented entry or exit to the fire station. Provisions for emergency vehicle movements during construction works along Strowan Road will have to be incorporated into the construction methodology.

6 Summary

6.1.1 The general basis of an outline CEMP is provided herein which will require to be developed further, prior to the commencement of the Scheme.

6.1.2 The outline CEMP identifies potential construction threats and risks to the local environment and includes recommendations for mitigation to avoid the potential to cause harm during construction of the Scheme.



Comrie Flood Protection Scheme

Appendix 3.2

Outline Construction Method Statement

Document Control

Document title	Appendix 3.2 Outline Construction Environmental Method Statement
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Checker	
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CONTENTS

1 Introduction

1.1.1 This Outline Construction Method Statement (OCMS) supports the Environmental Impact Assessment (EIA) and the Flood Order for the Comrie Flood Protection Scheme ('the Scheme') and presents the anticipated construction methodology that could be delivered for the Scheme. The document has been drafted as a guide with an emphasis on construction activities and those within proximity to a watercourse.

1.1.2 The OCMS sets out an indicative approach that could be used by the appointed Contractor to undertake the construction work responsibly with respect to the environmental setting and provides a general framework of how construction could be implemented and controlled to avoid any deterioration in river water quality.

1.1.3 It will be the role of the appointed Contractor, to review and amend the CMS as required.

2 Site Preparation Works

2.1 Introduction

2.1.1 It is anticipated that the following site preparation works will be carried out in advance of the main construction activities, however this will be reviewed and amended as necessary by the appointed Contractor.

2.2 Vegetation Clearance

General

2.2.1 The site will need to be cleared of vegetation (e.g. groundcover shrubs and trees) to accommodate the main construction works. This will be required within the construction footprint of the flood defence structures; in areas used to provide access to construction works; and for the establishment of construction compounds.

2.2.2 Any vegetation clearance should be undertaken such that silt run-off from bare earth to the watercourses is avoided.

2.2.3 Any vegetation clearance will be undertaken considering identified environmental restrictions (e.g. ecological and/or seasonal constraints).

2.2.4 Any topsoil stripped as part of the clearance works will be stockpiled and if deemed acceptable for re-use, used within the construction works on site.

Tree Felling

2.2.5 Tree felling to accommodate the construction works and the advance utility and service diversions will be required.

2.2.6 Where possible, suitable trees should be uprooted such that they can be reused in the root wad revetment.

2.2.7 It is anticipated that in the order of 530 trees will have to be felled across the Scheme working area.

2.2.8 Any tree felling works will be undertaken considering identified environmental restrictions (e.g. Tree Preservation Orders and ecological seasonal constraints i.e. breeding bird season).

Invasive Non-Native Species (INNS)

2.2.9 Japanese knotweed and Himalayan balsam have been mapped across the Scheme extents and within areas of the construction footprint. These invasive plant species are required to be treated in advance of the construction works.

2.2.10 Management of these invasive plant species commenced during the 2019 growing season across the anticipated construction footprint. Treatment was undertaken by a specialist company and comprised herbicide spraying.

2.2.11 Further herbicide treatment will be scheduled during the 2020 spring growing season.

2.2.12 Biosecurity measures will need to be implemented throughout the duration of the construction works, to prevent the inadvertent spread of invasive plant species.

2.2.13 An Invasive Non Native Species (INNS) Management Plan has been prepared by Sweco ecologists (**EIAR Appendix 8.9**).

2.3 Utility and Service Diversions

2.3.1 Buried and overhead services are located within the proposed construction footprint and diversions to buried services will be required. These diversions are shown on the Flood Order Drawings.

2.3.2 Utility service providers have been consulted during the outline design process to ensure that specific requirements for each potential diversion have been considered and addressed where possible. Utility and service diversions will be refined as part of the detail design and tender process.

2.4 Secondary Flooding

2.4.1 Secondary flooding measures may be constructed as part of the enabling works. These measures have been agreed in principle with affected homeowners, the Council, Scottish Water and SEPA.

2.4.2 Installation of secondary flood and targeted property mitigation measures can be undertaken as part of the advance works to ensure flood protection is provided to affected properties before construction of the Scheme begins.

2.5 Construction Compounds and Site Access

2.5.1 Construction compounds will be located throughout the Scheme construction area. Main compound and smaller satellite compounds are anticipated. The main compound and access routes will be agreed and set up in advance of the construction works.

2.5.2 The potential compound locations and access routes identified for the Scheme thus far (**EIAR Figure 3.2 Indicative Construction Plan**) have been provided in order that a consistent approach to assessing the impact of construction from the Scheme is undertaken within the EIA. This approach is considered to provide a best-case scenario; however, it is acknowledged that this is subject to review by the appointed Contractor and may differ at the time of construction.

2.5.3 The potential compound locations have been ascertained as suitable in terms of proximity to key construction areas, access for deliveries and as locations which are considered to pose minimal intrusion on the environment and local community.

2.5.4 A main compound will house the Contractors site office, storage of plant and equipment and site welfare facilities. Any generators used will comply with

standard regulatory requirements.

2.5.5 It is anticipated that the main construction access route into the main site would be via the A85. Access would also be required along Bridge Street, Strowan Road, Tay Avenue (providing access to Lochay Drive, Garry Place, Dochart Place and Tay Place), Field of Refuge, Camp Road and Commercial Lane, Ancaster Lane and Manse Lane and possibly Nurses Lane for the old railway track to get behind St. Margaret's Church, the car park and track behind St. Serf's Church, and Aros Field East.

2.6 Archaeological Evaluation

2.6.1 Pre-construction archaeological evaluation may be required prior to the establishment of construction compounds and greenfield areas where embankment construction is proposed. Advance discussions with the Council and Perth and Kinross Heritage Trust (PKHT) will be undertaken to agree an appropriate programme of works as required.

2.7 Construction Plant

2.7.1 Typical construction plant is expected to be used on site including, tracked excavators dumper trucks, telehandlers, site dumpers and sheet piling rig. HGV's for delivery of materials and removal of materials are also expected to be commonly used throughout the construction period.

2.7.2 The appointed Contractor will adhere to regulatory requirements in terms of storage of plant and machinery and maintenance and service requirements.

2.8 Traffic Management

2.8.1 Traffic management will be required during the construction phase and this may comprise temporary road diversions, traffic routing, road restrictions and traffic signalling. An outline traffic management plan has been incorporated into the OCEMP which will be required to be developed further by the appointed Contractor and with the agreement of the Council.

2.8.2 Temporary diversions and closures to public roads and footpaths will be required throughout the duration of the construction works. Disruption to the local community will be minimised wherever possible and be a key consideration during traffic management planning.

2.8.3 Advance notification of any closure or diversion would be implemented in consultation and agreement with the Councils Access Officers.

3 Main Construction Works

3.1 General

3.1.1 An anticipated construction methodology has been derived at this stage based on the outline design presented for the Flood Order.

3.1.2 It is acknowledged that this is subject to review during detailed design and by the appointed Contractor.

3.2 Construction Sequencing

3.2.1 Construction is expected to be undertaken over a period of 3 years.

3.2.2 Construction works will be phased accordingly based on the proposed sequence of construction, environmental and ecological seasonal restrictions and impacts/ disruption to the local community.

3.2.3 Construction in Dalginross should be undertaken in a clockwise direction starting in the south-west of the Scheme (Aros Field Road area) in order to minimise flood risk during construction before the Scheme is completed.

3.2.4 A sequence where the north defences are constructed first (or at least in parallel with the south) could prove beneficial in reducing flood water in the town.

3.3 Flood Defence Walls

3.3.1 As part of the Scheme, new flood walls will be constructed along the riverbanks of the River Earn, River Lednock and set back from the Water of Ruchill. Where possible, the majority of the direct flood defences will be placed back from the river edge to simplify the construction process and avoid in-river engineering work.

3.3.2 Flood risk during construction should be minimised through the use of temporary defences. The line of defence will not be left in a compromised manner during weekends and holidays.

3.3.3 Flood walls are expected to be constructed as sheet pile walls and / or reinforced concrete cantilever walls (see **Figure 1**). The walls will be constructed with reinforced concrete or steel sheet piling to resist forces subject to them during extreme flow events.

3.3.4 Flood walls will be finished with either a smooth or textured concrete finish or be clad using stone (e.g. local whinstone or ashlar red sandstone). The proposed wall finishes will be agreed at detail design but will take account of the existing setting, conservation status of the town and seek to minimise visual impact.

3.3.5 Coping will comprise natural stone rubble, precast concrete or reconstituted stone and comprise a combination of round and steeple finishing.

3.3.6 Concrete used in the construction of ‘hard’ defences will be either readymix

or factory precast and will be brought to site via concrete wagons and standard HGVs.

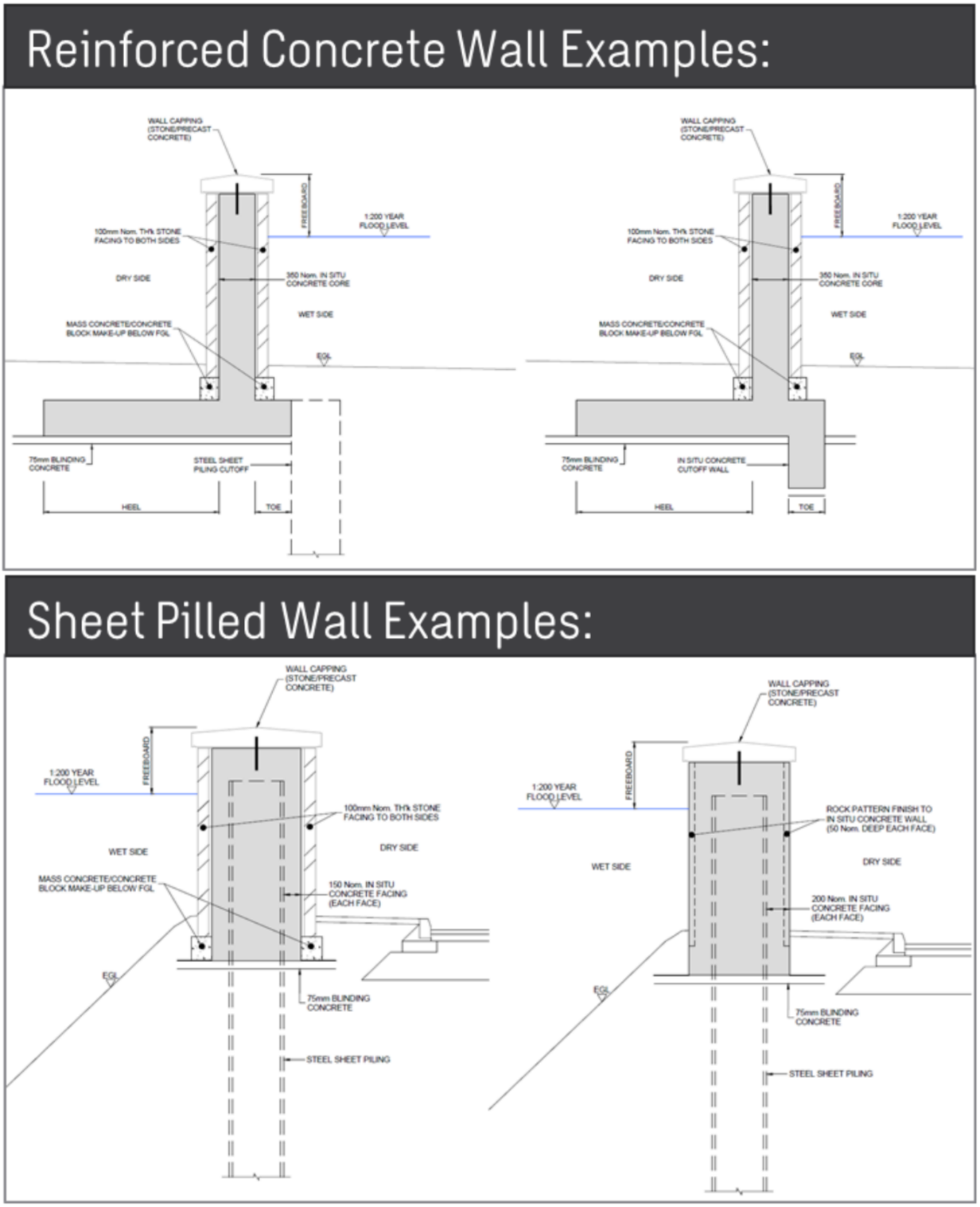


Figure 1: Typical Flood Wall Schematic

3.4 Flood Defence Embankments

3.4.1 Flood embankments will be constructed where possible with material sourced from earthworks on site (where deemed suitable for re-use). The embankments will be covered in topsoil and seeded to blend in with the surrounding landscape.

3.4.2 The width of the embankment will be dependent on the height of the embankment, but a large area of land will be required to accommodate the embankment and construction.

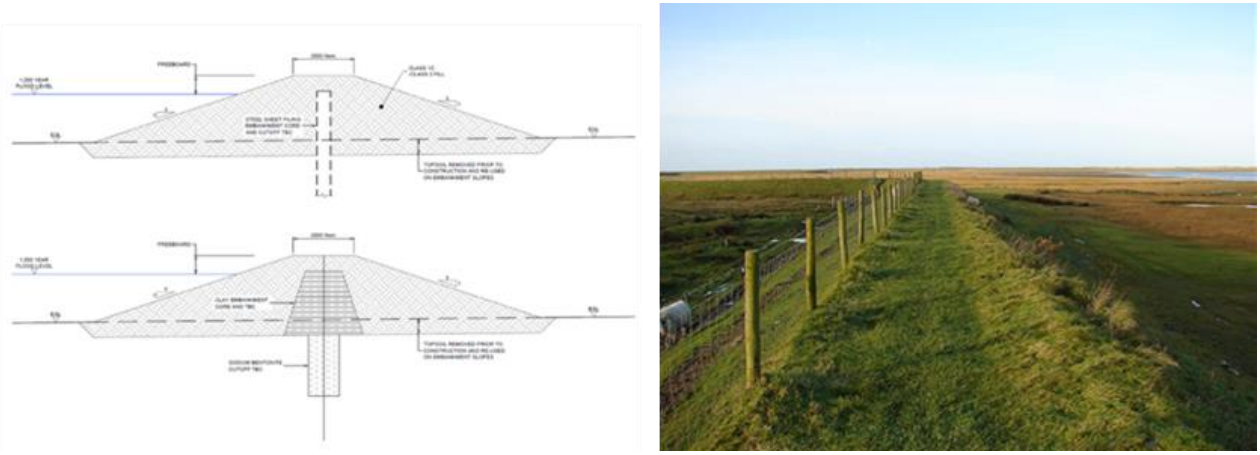


Figure 2: Typical Flood Defence Embankment

3.5 Stairs, Ramps and Floodgate

3.5.1 The inclusion of pedestrian and vehicular access stairs and ramps within the flood defence walls and embankments will be constructed concurrently with that defence.

3.5.2 Access ramps will typically be constructed at 1:12 gradient.

3.5.3 All access stairs will be built with appropriate safety handrails.

3.5.4 Gates which can be locked will be provided where private access is required (residential access and maintenance requirements).

3.5.5 A floodgate at the end of Manse Lane will be incorporated for vehicle access with reinforced grass turning Tee.

3.6 Erosion Protection Measures

3.6.1 Rootwad revetments will be constructed on the outer bend of the Water of Ruchill close to Dalginross. The engagement of a specialist sub-consultant for the construction design and installation of these revetments will be required, as they are a specialist solution.

3.6.2 Significant tree loss is forecast during construction. All efforts should be made to retain trees, or re-use felled trees as material for rootwad revetment installation. The existing rip-rap must be removed prior to rootwad revetment

installation. Every effort should be made to re-use these materials in further construction.

3.6.3 As the planting establishes, the contractor will repair any storm damage to the revetments up to a period of a year after installation.

3.6.4 Hydro-seeded rock roll revetments with pinned geotextile bank protection is to be installed downstream of Dalginross Bridge. A specialist subcontractor should be engaged to correctly pin the geotextile to the bank to ensure that the planting can take root successfully.

3.6.5 Coir roll matting will be installed on the left bank of the River Earn, upstream and downstream of the River Lednock confluence. A specialist subcontractor should be engaged to correctly install the coir rolls on the bank to ensure that the planting can take root successfully.

3.6.6 The specialist contractor employed for the installation of erosion protection must supply a RAMS document for safe working, including comprehensive procedures working in the river channel. The subcontractor and main contractor must maintain close communication with SEPA with regards to flood risk when construction within the channel is taking place. The subcontractor will minimise the release of silt when working in the river by establishing a dry working area, and if required, temporary silt traps and associated treatment.

3.6.7 Consultation with SEPA with regards to a CAR licence for working within the channel and pollution prevention control measures should be undertaken for each of these constructions outlined above. Consideration of the salmonids and spawning habitat should be taken to avoid habitat degradation and damage. Construction should be staged in consultation with SEPA and the Fisheries Trust. Biosecurity measures will be in place to manage any encounters with INNS.

3.7 Traffic Calming Measures

3.7.1 Traffic calming measures are proposed along Strowan Road. These will be constructed at 40m centre spacings on the left-hand side of the road which ensures that the fire station emergency vehicles have right of way to exit from Strowan Road to Bridge Street.

3.7.2 The introduction of the traffic calming measures will provide protection to the flood wall by minimising the risk of vehicle strike.

3.7.3 Tactile paving cobbles will be placed within the footpath surfacing around the traffic build outs to discourage pedestrian use.

3.7.4 Tree and shrubs will be planted within the traffic calming measures proposed on Strowan Road for visual enhancement.

3.8 Re-instatement and Landscaping

3.8.1 Tree protection measures (i.e. careful construction methods and hand digging to verify tree root zones) will be required during the construction works to protect the trees identified on site as to be retained where possible.

3.8.2 Erection of hoarding around operational areas of the site to screen the construction works and compound areas will be undertaken where possible.

3.8.3 Re-instatement of the site area will be undertaken upon completion of the main construction works. Any land (with the exception of the land being used for flood embankments) will be re-instated to its condition immediately before the construction works began and in agreement with the affected landowner.

3.8.4 Some landscaping works will be undertaken as construction work progresses (i.e. seeding of embankments) however, most of the landscaping work is expected to be undertaken and completed following the main construction works.

3.8.5 Replacement native tree planting including specimens ranging in height and including feathered forms are proposed throughout the Scheme extents. The majority of the proposed tree planting would be transplants, however, larger extra heavy and semi-mature trees are proposed where space is available and instant impact is required.

3.8.6 Enhancements are also proposed near Dalginross Bridge which is the most visually sensitive area of the Scheme. This will include tree, shrub and ornamental planting and provision of seating areas.

3.9 Earthworks

3.9.1 Material (soils) will be excavated for foundation requirements. Material will be stored and stockpiled where possible and if deemed acceptable, re-used within the main construction works.

3.9.2 Additional fill will be imported as required and where possible, sourced locally.

3.10 In River Construction

3.10.1 It is expected that some of the proposed flood defence walls and erosion protection measures may require some in-river construction in the River Earn and possibly the Water of Ruchill.

3.10.2 Construction along the riverbank is expected to be undertaken using temporary cofferdam structures, however this will be for the appointed Contractor to confirm.

3.10.3 SEPA will also be consulted on this process to ensure that the river is sufficiently protected during construction works.

Cofferdams

3.10.4 A cofferdam is a temporary dam structure which is used for construction within water. It provides a dry working area for the construction to be undertaken.

4 Environmental Considerations

4.1 Flood Warning

4.1.1 A flood warning system will be agreed in consultation with the appointed Contractor, the Council and SEPA ahead of the construction works. The Contractor should as a minimum, monitor the local weather forecast. SEPA flood warnings in the local area will be reviewed on a daily basis by the Environmental Manager (or equivalent).

4.1.2 Appropriate action will be taken in the event of predicted heavy rainfall to protect unsecured materials/plant and items located in site compounds to prevent their movement or release. Plant and materials will be stored in safe areas out with the floodplain where practicable

4.2 Surface Water Protection

4.2.1 Pollution Prevention Guidelines (PPGs) and the replacement guidance series Guidance for Pollution Prevention (GPPs) have been developed to provide advice on legal responsibilities and best practice during construction. The guidance series will be adhered to as part of the construction works particularly those relating to pollution control and sediment release.

4.2.2 Continual consultation with SEPA and SNH to agree measures required to prevent pollution to watercourses will be undertaken.

4.3 Ecological Measures

4.3.1 An Environmental/ Ecological Clerk of Works (ECoW) should be employed on site for all ecological aspects of the construction activities. The ECoW will provide advice in the event of any unforeseen protected species issues that arise during construction and oversee the implementation of mitigation measures to be adopted.

4.3.2 Pre-construction surveys will be required to ensure that construction activity avoids unlawful disturbance of protected species. Pre-construction surveys are aimed towards informing any additional mitigation measures that may be required and provide evidence for licence applications that may be required.

4.4 CAR Licensing

4.4.1 A Controlled Activities Regulation (CAR) Licence will be required from SEPA under the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) and the Water Environment (Miscellaneous) (Scotland) Regulations 2017.

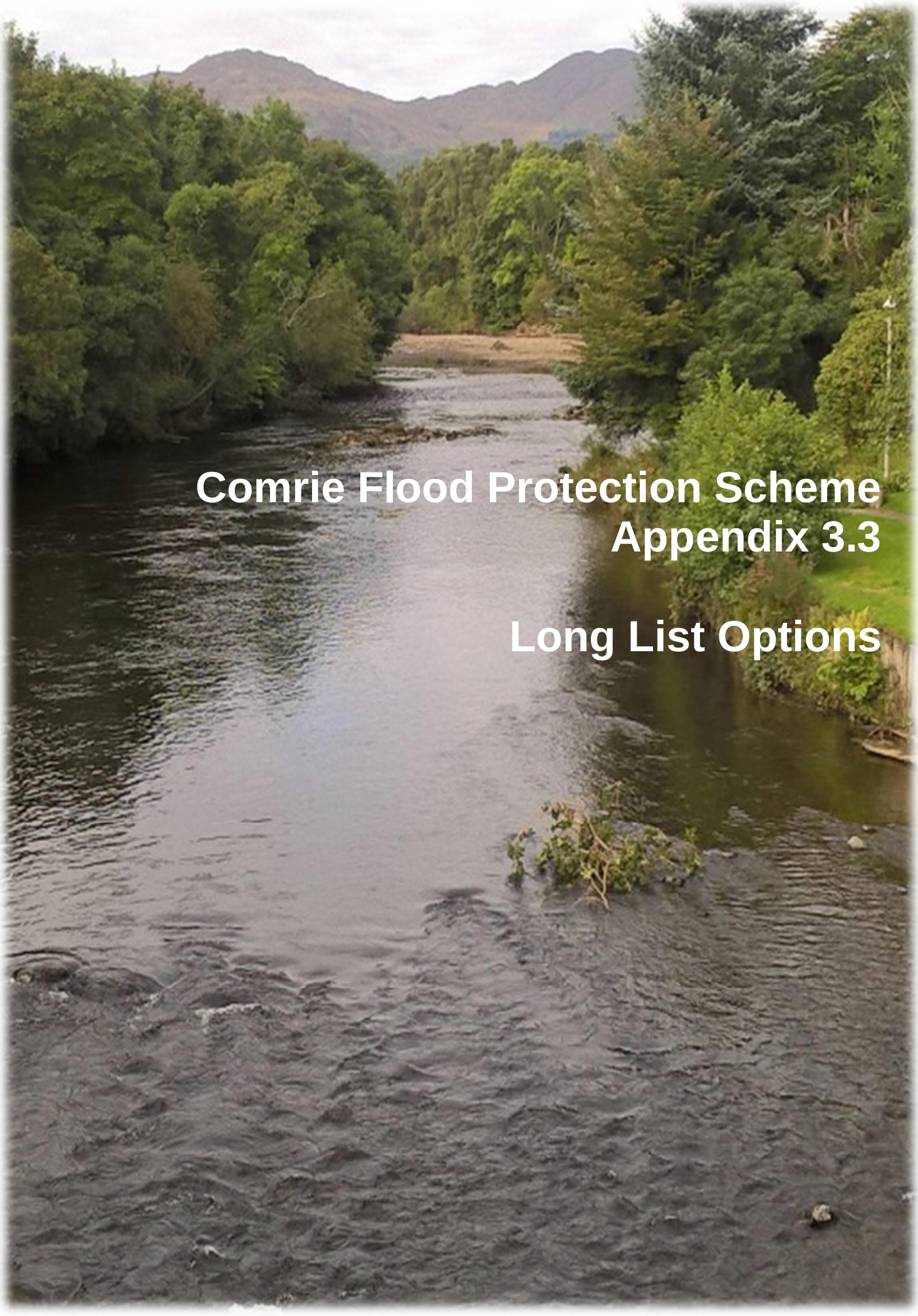
4.4.2 The construction works will also require a CAR (construction site) licence for the discharge of water runoff from a construction site to the water environment.

4.5 Planning Controls

4.5.1 Deemed planning consent will be sought for the Scheme as part of the Flood Order process. The appointed Contractor will have a copy of the consent for reference and ensure that the construction works are carried out in compliance with the consent.

4.5.2 Listed Building Consent will also be required in advance of the construction works where the proposed new flood walls will abut the existing listed Dalginross Bridge and any other affected listed buildings in the Scheme area. Consultation with the Councils Conservation Officer has confirmed this process will be required as part of the advance construction works.

4.5.3 Listed building consent is required for any internal or external alteration, extension or demolition of a listed building which would affect its character as a building or structure of architectural or historic interest.



Comrie Flood Protection Scheme
Appendix 3.3

Long List Options

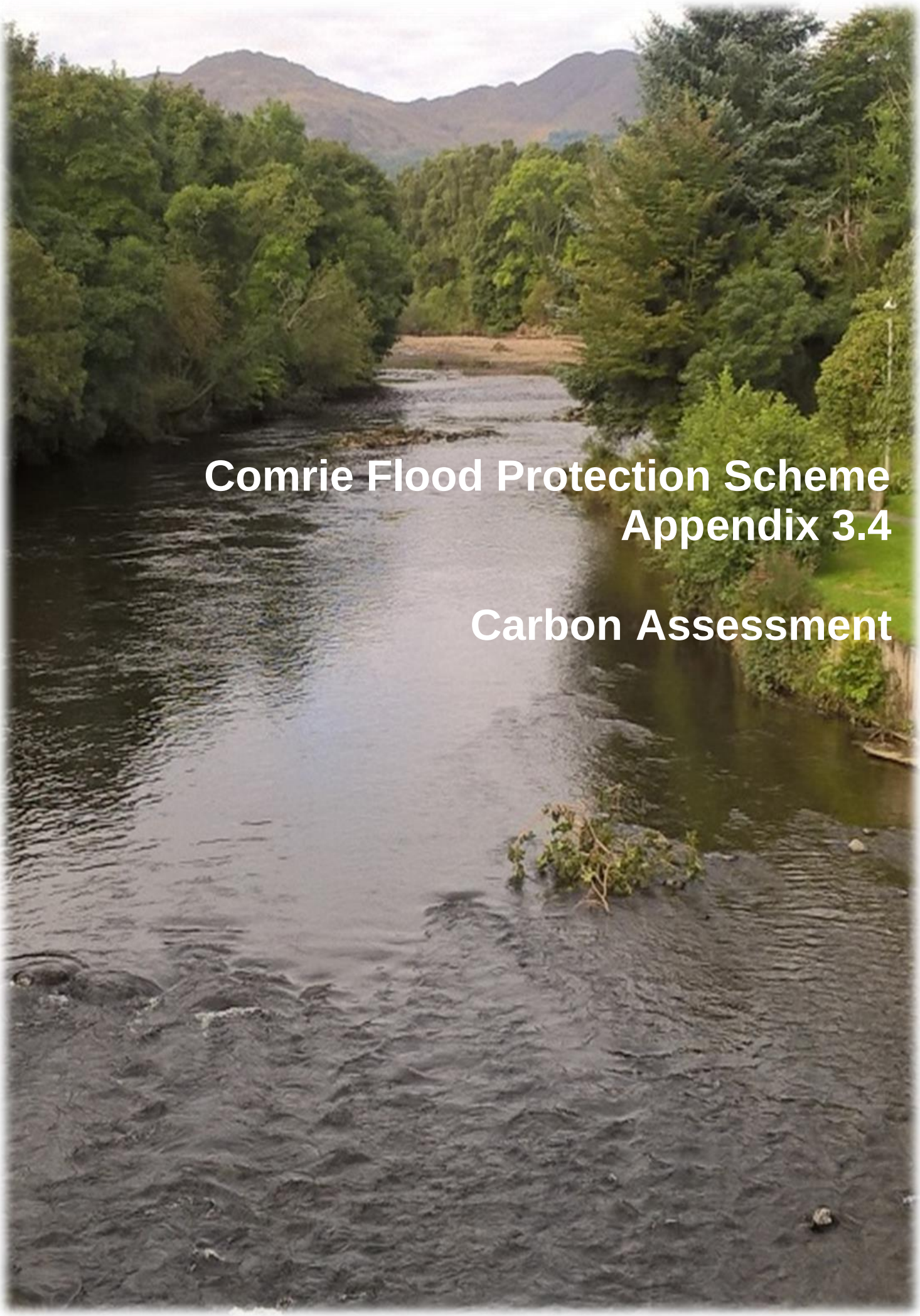
Table 3.3.1 sets out the long-list of options that were considered and the key advantages and disadvantages of the options as set out in the **2017 Comrie Flood Protection Scheme: Feasibility Report.**

Table 3.3.1: Long-List Advantages and Disadvantages

Option	Description	Advantages	Disadvantages
Primary Option 1	Dredging of the River Earn, Water of Ruchill by an average of 5 metres for a distance of 2.45 kilometres. This will require re-profiling of the upstream reaches to compensate for the drop-in bed level in the main channel.	• Would eliminate the need for any defences through the village for the 1 in 200-year event.	• Very significant adverse environmental impacts would result if this option was implemented. • Regular dredging would be required in order to maintain the required depth of the channel, maybe as frequently as annually. • Structures, such as bridges, along the watercourses would be adversely affected due to channel instability / under mining. • Could cause impacts to the tourism to the village due to significant changes in the watercourse aesthetics. • Restriction on the disposal of river material and the likely volumes would increase the cost of the option. • The council would have an annual expense to maintain the river capacity.
Primary Option 2	Construction of walls and/or embankments to constrain water to the channel, from the hydrological and hydraulic modelling, these could typically be up to 1.5 metres in height but up to 2.5 metres in some localised sections. Existing defences along the Water of Ruchill are likely to need upgrading.	• Familiar forms of construction. • Relatively simple design. • Possible to have a positive visual impact in some locations. • Re-assurance to the residents of a visible defence which is always present. • Some residents may benefit from re-landscaping works undertaken in close consultation with them. • Maintenance costs are lower than the other options.	• Height of defences may have to be limited due to visual impacts. • Defences may restrict access / views to the river. • Extent of defences in the village could be significant. • Some defences may be required within residential property boundaries. • Defences may not be able to be further developed to accommodate the potential impacts of climate change post construction. • Access will have to be modified for residents in some locations. • Some disruption to the local economy during construction. • The noise and disruption caused during construction is likely to be significant to the local community.
Primary Option 3	New large earth embankments on the River Earn (20 metres high) and the Water of Ruchill (30 metres high) to store flood water upstream of Comrie.	• Would eliminate the need for any defences through the village for the 1 in 200-year event. • Enhanced biodiversity through habitat/wetland creation.	• Environmental and local flood implications for creating these storage areas. • Would require compliance with Reservoirs the Act depending upon volume of stored water and maintenance of them throughout their life • Cost is likely to be higher than other options. • Agreement with multiple stakeholders would be required for implementation. • To accommodate the storage areas, drowning of mature forests and agricultural land would occur.
Primary Option 4	New large earth embankment on the Water of Ruchill (28 metres high) to store flood water upstream of Comrie and defences through the village.	• Reduces the required heights of defences through the village • along the Water of Ruchill for the 1 in 200-year event (reduction of 0.0 – 1.50 metres). Therefore, visual impact reduced for some residents. • It may be possible to have a positive visual impact due to the • scheme in some locations. • Enhanced biodiversity through habitat/wetland creation.	• Environmental and local flood implications for creating these storage areas. • Would require compliance with Reservoirs the Act depending upon volume of stored water and maintenance of the storage area throughout its life. • Some defences may be required within residential property boundaries. • Cost is likely to be higher than other options • Agreement with multiple stakeholders would be required for implementation. • Possible negative visual impact to the village and residents in some locations. • Negative visual impact to the surrounding area due to new dam structure upstream on the Water of Ruchill. • Access will have to be modified for residents in some locations. • Some disruption to the local economy during construction. • Complex construction and disruption across multiple sites. • The noise and disruption caused during construction is likely to be significant to the local community.
Primary Option 5	New large earth embankment on the River Earn (18.4 metres high) to store flood water upstream of Comrie and defences through the village	• Reduces the required heights of defences through the village for the 1 in 200-year event (reduction of 0.0 – 1.80 metres). • It may be possible to have a positive visual impact due to the scheme in some locations. • Enhanced biodiversity through habitat/wetland creation.	• Environmental and local flood implications for creating these storage areas. • Would require compliance with the Reservoirs Act depending upon volume of stored water and maintenance of them throughout its life. • Some defences may be required within residential property boundaries. • Cost is likely to be higher than other options. • Agreement with multiple stakeholders would be required for implementation. • Possible negative visual impact to the village and residents in some locations. • Negative visual impact to the surrounding area due to new dam structure upstream on the River Earn. • Access will have to be modified for residents in some locations. • Some disruption to the local economy during construction. • Complex construction and disruption across multiple sites. • The noise and disruption caused during construction is likely to be significant to the local community.

Option	Description	Advantages	Disadvantages
Primary Option 6	New large earth embankment on the River Lednock (16.4 metres high) to store flood water upstream of Comrie and defences through the village.	• Small reduction in the required heights of defences through the village for the 1 in 200-year event (0.0 – 0.36 metres). • Enhanced biodiversity through habitat/wetland creation.	• Reduction in water level through the village tends to be small – (typically 0.15 metres) so overall small benefits for quite a high cost. • Environmental and local flood implications for creating these storage areas. • Would require compliance with the Reservoirs Act depending upon volume of stored water and maintenance of them throughout their life • Some defences may be required within residential property boundaries. • Agreement with multiple stakeholders would be required for implementation. • Possible negative visual impact to the village and residents in some locations. • Negative visual impact to the surrounding area due to new dam structure upstream on the River Lednock. • Access will have to be modified for residents in some locations. • Some disruption to the local economy during construction. • Complex construction and disruption across multiple sites. • The noise and disruption caused during construction is likely to be significant to the local community.
Secondary Option 1	Removal of weir on the River Earn downstream of Dalginross Bridge will help to reduce the flood level upstream of the weir and could help to reduce flooding.	• Will improve conveyance of water through the village. • Reduction in levels between the Dalginross Bridge and the weir for the 1 in 200-year event is typically 200mm. • Expense for this option is likely to be less than other secondary options considered	• Only small improvements in conveyance • Channel re-grading is required 250 metres upstream and 200 metres downstream of the weir. • This option requires river stabilisation works. • Dredging would be required to re-grade the river bed which would be environmentally damaging. • Ecological surveys would be required and third-party consultation e.g. SNH (Scottish National Heritage), SEPA etc.
Secondary Option 2	Maximizing flood storage in the floodplain adjacent to the Water of Ruchill. This would involve reducing the level of an area of 0.58km2 by 0.75 metres.	• Reduction in levels for the 1 in 200-year event is typically 250mm.	• Only small improvements in conveyance. • Will involve landowner agreement which may be problematic. • Compensation for use of land to flood more regularly will be payable.
Secondary Option 3	Dredging of the River Earn, Water of Ruchill by an average of 1 metre for a distance of approximately 2.2 kilometres.	• Will have some reduction in the 1 in 200-year water levels, typically 200mm.	• Only small improvements in conveyance • Significant adverse environmental impacts would result if this option was implemented. • Regular dredging would be required in order to maintain the required depth of the channel. • The initial and on-going cost for this option is likely to be high.
Secondary Option 4	Raising of the Dalginross Bridge above the 1 in 200-year level	• Will improve conveyance of water through village. • Reduction in flood levels upstream of the Dalginross Bridge is typically 110mm for the 1 in 200-year event.	• Only small improvements in conveyance. • Implementing this option will cause a lot of disruption to traffic in the village. • Based on an initial assessment, it is unlikely this option would be cost effective or practical to implement.
Secondary Option 5	Using NFM techniques to reduce the runoff from catchments upstream of Comrie e.g. tree planting, woody dams on small tributaries, better farming practice to reduce runoff.	• May be more be cost effective than traditional options. • Measures will be environmentally enhancing to the area • Reduction in peak flow once measures have been properly established is estimated to be up to 6%.	• There is little data of the direct benefits of this option, but best hydrological estimates run through the hydraulic model suggest that NFM would only reduce levels by 50mm through the village. • It will take considerable time for some of these measures to be properly established and it would be difficult to quantity the flood management benefits of this option. • Requires the consent and co-operation of all land owners concerned. • Difficult to maintain / enforce
Secondary Option 6	Using the upstream Lednock Dam as a flood storage area during times of high flows in the Lednock to alleviate flood risk to Comrie.	• Use of the existing infrastructure to obtain flood alleviation benefits for the village. • This option would be cost effective.	• There would only be relatively small hydraulic benefits to using this dam as a flood storage area. • To use the dam as a flood storage area, there would be conflicting interests with the Scottish hydro electric company SSE (Scottish and Southern Energy) who use the dam to generate hydro-electric power. • Requires human intervention at the correct time in order for this option to be effective.
Secondary Option 7	Using the upstream River Earn Reservoir as a flood storage area during times of high flows in the Earn to alleviate flood risk to Comrie.	• No new storage areas would have to be built. The existing Loch could be used to obtain flood alleviation benefits for the village. • Utilising this storage area could help to reduce the required defence heights within the village.	• Requires a new control structure to be built at the outfall of Loch Earn. • Requires human intervention at the correct time in order for this option to be effective. • It is unlikely that Loch Earn would have storage available to act as a flood storage area. • Controlling flows on the Loch could have environmental impacts e.g. fish migration along the River Earn. • Based on an initial assessment, it is unlikely this option would be cost effective or practical to implement.
Secondary Option 8	Using River Stabilisation Techniques to prevent further erosion to the Water of Ruchill river banks.	• Would help to stabilise the existing channel. This will reduce the risk of channel migration and under mining of existing or future flood defences. • Would reduce the erosion of banks which can cause an increase in flood risk to some locations where bank levels have been reduced due to erosion.	• Will increase the roughness of the channel in some locations and could cause small increases in flood levels locally.

Option	Description	Advantages	Disadvantages
Secondary Option 9	Using a diversion channel to divert high flows from the Water of Ruchill to the River Earn.	• Would alleviate some flow from the Water of Ruchill in high flow events	• Expensive to construct • Would require consent from a number of land owners and also land compensation would be needed • Provided negligible hydraulic benefits even from a large diversion channel. • Based on an initial assessment, it is unlikely this option would be cost effective or practical to implement.



Comrie Flood Protection Scheme
Appendix 3.4

Carbon Assessment

Document Control

Document Title	Appendix 3.4 Carbon Assessment
Originator	Kirsten Leggatt
Checker	
Approver	Lewis Barlow
Authoriser	Lewis Barlow
Status	Final

Revision History

Version	Date	Description	Author	Approver
0001	05.02.20	Initial Draft	Kirsten Leggatt	Lewis Barlow
0002	05.02.20	Final Issue	Kirsten Leggatt	Lewis Barlow

CONTENTS

1 Carbon Assessment

1.1 Introduction

1.1.1 The Scottish Government, through the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019, has set a legally binding target of net-zero greenhouse gas emissions by 2045, with interim reduction targets of 70% by 2030 and 90% by 2040 based on 1990 levels. Scottish Local Authorities have yet to set their respective carbon reduction targets, although this process is underway.

1.1.2 European Union (EU) Directive 2014/52/EU, implemented in May 2017 in Scotland, requires that climate change is addressed within the Environmental Impact Assessment (EIA) process. This involves minimising the potential effects of a development on the climate (i.e. Carbon Impact Assessment) as well as assessing the effects of projected climate change on identified receptors (i.e. Climate Change Resilience Assessment).

1.1.3 This appendix focuses on the estimation of carbon emissions from the construction of the Comrie Flood Protection Scheme. Please refer to **Section 3.8** in the Scheme Description which sets out the design decisions to ensure resilience to climate change.

Terminology

1.1.4 All greenhouse gas (GHG) emissions have been reported as a common unit of carbon dioxide equivalent (CO_2e). The term carbon dioxide equivalent (CO_2e) refers to the equivalent global warming potential of carbon dioxide (CO_2). For the purposes of this report, the term carbon will be used as shorthand to refer to all relevant GHG emissions.

1.2 Methodology

1.2.1 A Bill of Quantities (BoQ) has been created by the Design Team based on Flood Order Drawings for the Comrie Flood Protection Scheme. This forms the basis for the items used in the carbon assessment. Where possible, embodied carbon has been estimated for each item within the BoQ.

1.2.2 The assessment includes the embodied carbon of materials, emissions associated with construction activities and transport of materials from manufacturing plant to site.

1.2.3 CESMM4 Carbon and Price Book 2013 (CESMM4) has been used for estimating the embodied carbon for materials and construction activities for each item within the BoQ. CESMM4 provides a database of

approximate costs and embodied carbon for common construction processes. The CESMM4 methodology involves selecting items within the database which match each item within the BoQ. It is considered that the embodied carbon values from CESMM4 are sufficiently accurate.

1.2.4 Embodied carbon of the transport of line items is calculated in tonnes per kilometre (tCO2e/(tonne.km)). It has been assumed that all materials have been transported to site by Heavy Goods Vehicles (HGV) and the corresponding factor has been used from the UK Government 2019 Conversion Factors1.

1.2.5 Material weights have been estimated based on the quantities within the BoQ. The distance is the total distance the materials are transported from manufacturing origin to site. It is assumed that items have been sourced either locally (50km); regionally (100km); or nationally (300km). For a given item, the source of the material has been decided based on estimates provided by the design teams.

Uncertainties

1.2.6 Where possible, the embodied carbon has been estimated for each item within the BoQ. In some instances, no embodied carbon value exists, therefore the associated embodied carbon has been omitted from the estimation. The total carbon estimated for the project is therefore likely to underrepresent actual carbon emissions. However, this underestimate is not considered to be material (i.e. <5% of total emissions).

1.3 Results

1.3.1 The total embodied carbon for the Comrie Flood Protection Scheme Outline Design is estimated to be 6,321 tCO_2e.

1.3.2 The carbon values for each wall in the design are presented in **Table 1** and shown graphically in **Figure 1.**

Table 1: Total Embodied Carbon Estimate based on Outline Design by Flood Wall

Flood Wall Reference	Material & Construction (tCO_2e)	Transport (tCO_2e)	Project Total (tCO_2e)
EL01	9.6	1.5	11.1
EL02 & EL03	726.7	242.9	969.5
EL04	91.2	59.2	150.4

[1] https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2019

Flood Wall Reference	Material & Construction (tCO_2e)	Transport (tCO_2e)	Project Total (tCO_2e)
EL05	35.3	137.8	173.1
ER01	91.7	36.4	128.1
ER02	129.4	77.6	207.0
ER03	403.7	262.5	666.2
ER04	64.8	341.2	406.0
LL01 & LR01	366.8	105.8	472.6
LL02 & LR02	247.0	43.1	290.0
WR01	84.4	53.3	137.7
WR02	329.8	1,245.3	1,575.1
WR03	716.3	160.0	876.3
WR04	110.2	57.9	168.1
Project Total	**3,406.9**	**2,824.5**	**6,231.3**

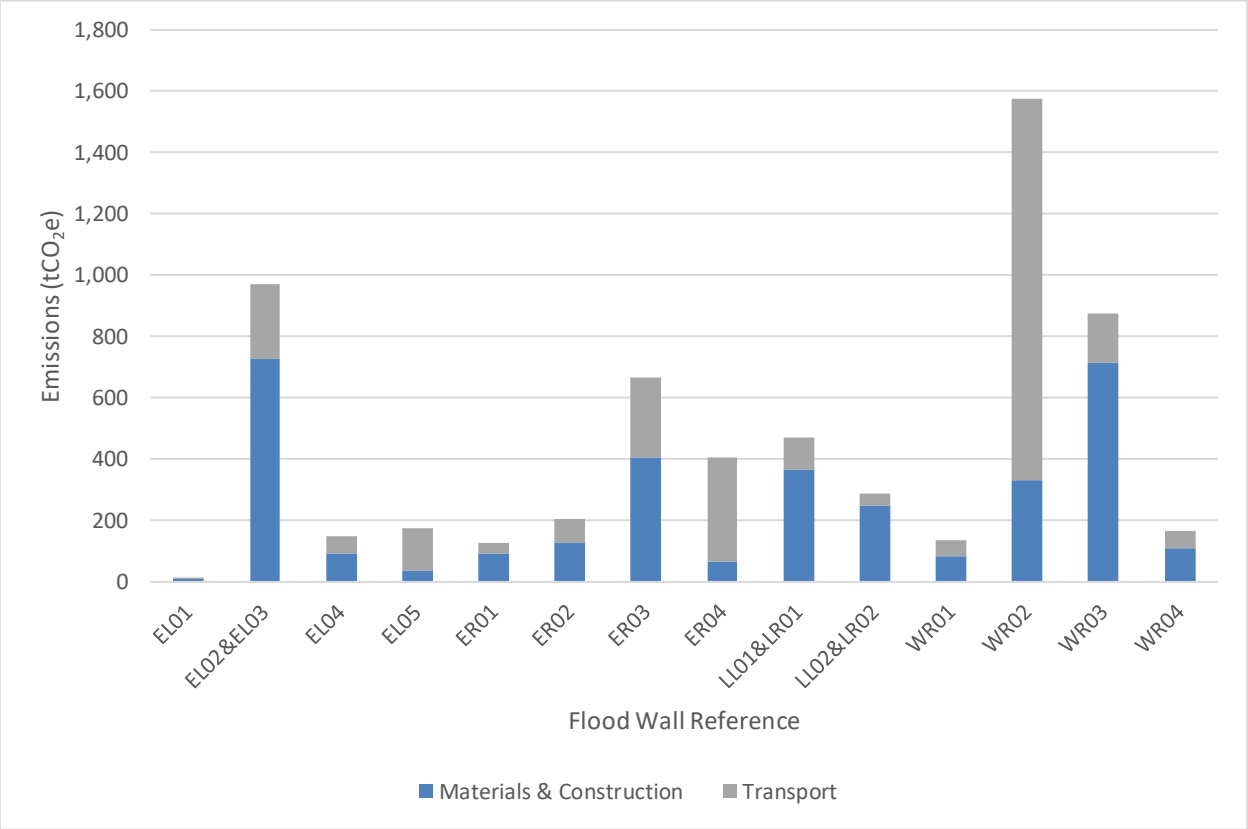


Figure 1: Total Embodied Carbon Estimate based on Outline Design by Flood Wall

1.3.3 **Table 2** shows the total embodied carbon estimate per Class, based on CESMM4 classes. Class A to C (A- General Items; B- Ground Investigation; and C- Geotechnical and other Specialist Processes) are omitted from this assessment as they are included as lump sum costs at this stage of Outline Design. **Figure 2** shows this graphically.

Table 2: Total Embodied Carbon Estmiate based on Outline Design by Class

Class	Material & Construction (tCO_2e)	Transport (tCO_2e)	Project Total (tCO_2e)
Class D: Demolition & Site Clearance	104.4	0.0	104.4
Class E: Excavation	408.0	2,245.8	2,653.8
Class F: In Situ Concrete	1,062.5	193.9	1,256.4
Class G: Concrete Ancillaries	561.7	39.5	601.2
Class H: Precast Concrete	49.7	3.3	53.0
Class P: Piling	1,077.8	204.6	1,282.4

Class Q: Piling Ancillaries	7.6	119.5	127.2
Class U: Brickwork, Blockwork and Masonry	108.5	17.4	125.9
Class W: Waterproofing	0.4	0.2	0.6
Class X: Miscellaneous Work	26.2	0.2	26.5
Project Total	**3,406.9**	**2,824.5**	**6,231.3**

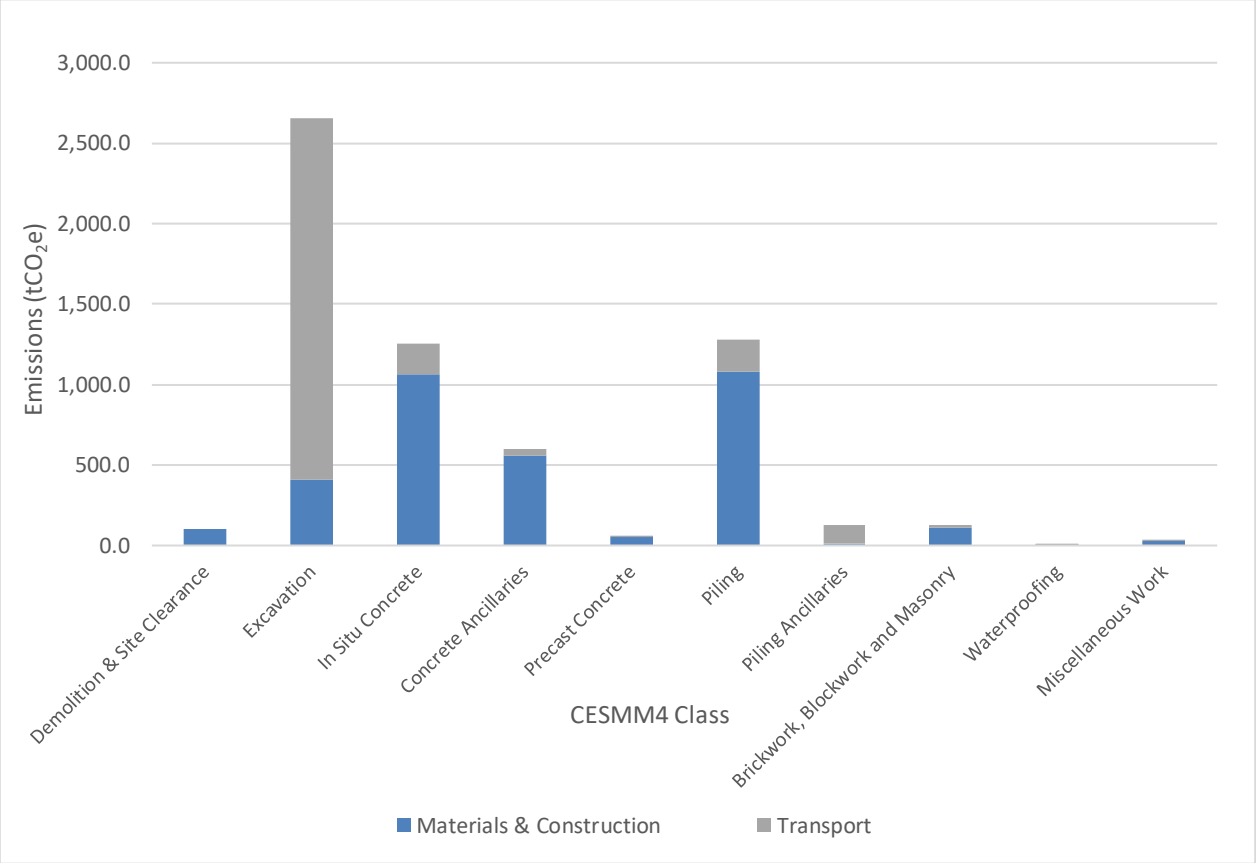


Figure 2: Total Embodied Carbon Estimate based on Outline Design by Class

1.4 Summary

1.4.1 Total carbon emissions associated with the Comrie Food Protection Scheme have been estimated to be 6,231 tCO_2e.

1.4.2 Ongoing carbon reduction will be most effective by focussing on carbon emission hotspots, including:

- Excavation by increasing the use of site won materials as far as possible as opposed to importing materials;

- In Situ Concrete by reducing the volume of concrete required through innovative design and considering the use of lower strengths of concrete mixes as far as possible; and,
- Piling by reducing the use of virgin materials for use as interlocking steel piles.

1.4.3 Whilst this is only a first estimate of carbon emissions from the scheme, there are still likely to be opportunities for further reduction through detailed design. It is recommended that the information here should be used as a baseline for further reductions.

1.4.4 Further reductions could be encouraged through the incorporation of carbon targets within the procurement process as a metric for the contractor during the construction stage.