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Smithton & Culloden Protection Scheme: Design Justification Report

Final Report v4.0

April 2016

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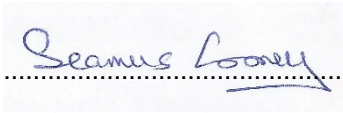
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Revision History

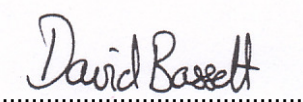
Revision Ref / Date Issued	Amendments	Issued to
Final v3.0 / April 2016		Alan Fraser
Final v3.0 / April 2016	Minor corrections	Alan Fraser
Final v4.0 April 2016	Minor corrections	Alan Fraser

Contract

This report describes work commissioned by Alan Fraser, on behalf of The Highland Council, by a letter dated 14 March 2013. The Highland Council's representative for the contract was Alan Fraser. A multi-disciplinary team led by Rene Dobson of JBA Consulting carried out this work.

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Purpose

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Acknowledgements

JBA wishes to thank The Highland Council and all who participated in the consultation process for their contribution to this document.

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Abbreviations

1D	One Dimensional (modelling)
2D	Two Dimensional (modelling)
AP	Annual Probability
CAR	Controlled Activity Regulations (2010)
CEH	Centre for Ecology and Hydrology
DMRB	Design Manual for Roads and Bridges
FPS	Flood Protection Scheme
FRA.....	Flood Risk Assessment
mAOD	metres Above Ordnance Datum
NGR.....	National Grid Reference
PDI.....	Planning, Development and Infrastructure (Committee)
SEPA	Scottish Environment Protection Agency

Definitions

Term	Definition
Appraisal	The process of defining objectives, examining options and weighing up costs, benefits, risks and uncertainties before a decision is made.
Appraisal period	The period over which costs and benefits are assessed. This period is defined by guidance from HM Treasury and is normally 100 years for capital assessments.
Annual Exceedance Probability	The probability that any event will be exceeded in one year where the annual event has an exceedance probability of 100%
Maintenance	Work that sustains the desired condition and intended performance of an asset. In some circumstances maintenance may accept a gradual decline in standard. For existing assets that have no residual life, maintenance may not result in an acceptable Standard of Service and only refurbishment or replacement will reinstate an acceptable Standard of Service.
Residual life	Residual life is the time until assets need replacing. Residual life can be extended or reduced by altering maintenance practices. The point at which the asset requires replacement may be estimated by a condition grade or performance measures that reflect an unacceptable Standard of Service.
Return period	The average length of time separating flood events of a similar magnitude.

1 Introduction

1.1 General Background

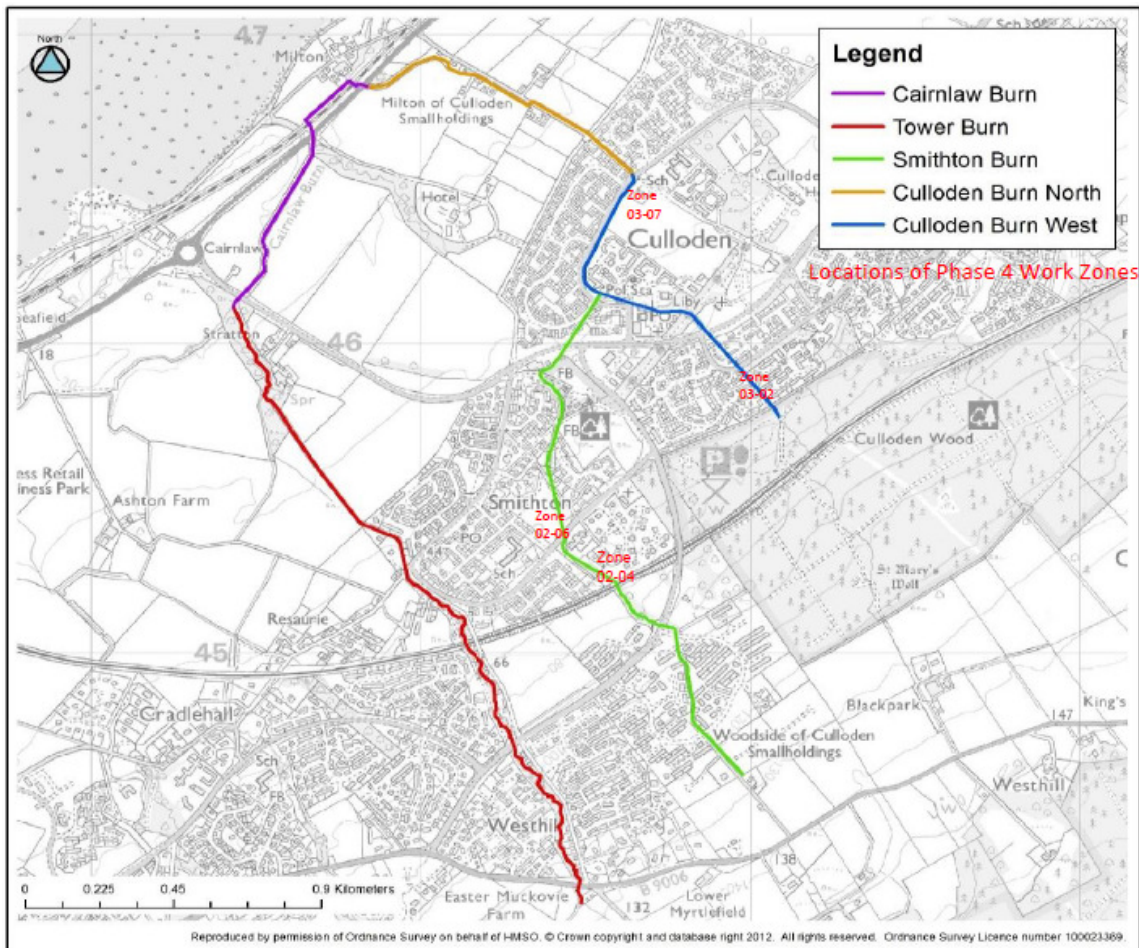
Smithton and Culloden has developed rapidly as a suburb of Inverness. There are records of the area flooding for over a century with two significant events in 2002 and 2011. Most of the floods occur during summer events and are associated with intense rainfall that makes the small watercourses rise rapidly and leave the watercourse at constrictions such as bridges, culverts and screens.

The most recent floods occurred as a result of intense local rainfall in July and August 2011, and again in October 2014. The area has also been identified as being at risk in SEPA's National Flood Risk Appraisal. Post flood analysis commissioned by the Highland Council (THC) identified various approaches which could be taken to reduce flood risk and this work was extended to identify potential solutions which were then compared on economic, environmental and technical basis to derive a preferred solution. The preferred solution was developed in conjunction with stakeholders and in consultation with residents and is now being promoted as the Smithton and Culloden Flood Protection Scheme (FPS). The purpose of this report is to support the promotion of the FPS.

1.2 Study Area

Smithton and Culloden are part of a conurbation located to the east of Inverness and the study area is centred on NGR 271750,846000. The project covers the catchment of the Culloden Burn which includes, among other watercourses, Culloden Burn West and the Smithton Burn on which this scheme is centred. The area of interest is shown, in context, in Figure 1-1 below.

Figure 1-1 Burns showing Phase 4 Works locations



1.3 Legislative framework

The Flood Risk Management (Scotland) Act 2009 provides The Highland Council with general powers to manage flood risk in its area and to carry out flood protection work. The Smithton and Culloden Flood Protection Scheme is being promoted by the Highland Council under Part 4 of the Act.

1.4 Aims and objectives

The aim of this report is to describe the development of the scheme origins and to provide a description of the extent and scale of the Flood Protection Scheme and its impacts on both residents and the environment. This report should be read in conjunction with the FPS drawings and Smithton and Culloden Flood Protection Scheme document.

This report is used to:

- Support the notification and confirmation of the Flood Protection Scheme as per Flood Risk Management (Scotland) Act 2009, Schedule 2,
- Support the promotion of the Smithton and Culloden Flood Protection Scheme to Scottish Ministers in the event of Ministerial call-in as per Flood Risk Management (Scotland) Act 2009, Schedule 2.

2 Flooding Issues

2.1 Flooding Background

The burns to the east of Inverness have a history of flooding that has been well documented including:-

- 27 August 1829 - *"considerable flood damage in Inverness; crops flattened, numerous bridges lost, mills and homes damaged..."*
- 24 July 1846 - *"The storms were widespread in Scotland. Around Inverness the rain poured down in torrents, flooding a good deal of the country."*
- 25 September 1890 - *Rainfall observer at Loch Sheil, West Inverness, noted "Rain 3.57 in. causing an exceptionally great flood."*
- 15 August 1893 - *"Thunderstorm in Strathnairn: The somewhat remarkable thunderstorm of Tuesday afternoon, which was startling but not destructive in the immediate neighborhood of Inverness."*
- 24-26 September 1915 - *rainfall "totals exceeding 3.5 inches were measured, at Inverness (3.64 in), Nairn (3.78 in)..."*

More recent flooding events recorded by THC on the Smithton Burn and Culloden Burn West include the following:

- 28 November 1999 - *Flooding to properties on Murray Terrace (Smithton Burn).*
- 8 September 2002 - *Severe flooding to a number of locations in September and October resulting in overland flows and flooding to roads, houses, gardens and commercial properties (Smithton Burn and Culloden Burn West). 55mm of rain fell during the night of the 7/8 September.*
- 3 July 2004 - *Short term torrential rainfall resulting in burn overtopping and garden flooding on Redburn Avenue (Culloden Burn West).*
- 4 July 2007 - *"Gullies surcharging on lower section of Tower Road. Water flowing down road to junction with Barnchurch Road"*

2.2 Current management approach

After the flooding in July and August 2011 The Highland Council implemented a more rigid and thorough routine inspection regime. A priority based inspection process has been derived by The Highland Council Flood Risk Management Team based on monthly, 3 monthly, 6 monthly and annual inspection requirements.

2.3 Flood impacts

Flooding from the August 2011 flood resulted in approximately 50 properties being directly affected by flood water in the Smithton and Culloden area as well as roads and additional properties in the surrounding area.

As a result of this a post flood analysis report was commissioned, including the identification of sustainable solutions for detailed consideration to reduce flood risk within the study area.

2.4 Consequences of Doing Nothing

Since the flooding in 2002 there has been significant development within the catchment, some of which have culverted the watercourse, or developed properties within areas now understood to be floodplain. In the recent past The Highland Council has progressed a number of improvements to reduce large debris and sediment within the burns to reduce the risk of blockage at in-channel structures and resulting flooding. To achieve a formal standard of protection, larger scale works are required which need to be progressed as a Flood Protection Scheme. Doing nothing will continue to leave a number of people and properties at risk of flooding from the 10% Annual

Probability (AP) (10 year flood) event. Maintenance will reduce the risk of blockage at sensitive locations.

In addition climate change is likely to gradually increase the vulnerability to flood events.

3 Summary of Flood Risk Assessment (FRA)

3.1 Existing Flood Risk

Currently properties in Smithton and Culloden are at flood risk. Fluvial flooding is the overriding flood risk. The area has flooded several times in the last 20 years from the Smithton Burn and Culloden Burn. The most recent being October 2014 and August 2011 where approximately 50 properties were affected. Blockage of screens and culverts of limited capacity were identified as a major factors contributing to the flooding.

The culverts which have limited capacity are:

- Murray Terrace Culvert.
- Culvert beneath Murray Road.
- Property boundary fences and access bridges crossing burn on Murray Place.
- Redburn Avenue.
- Culloden Centre Walkway.
- Keppoch Road Culvert.

A lack of channel capacity is also a further issue. The channel between the outlet of Smithton Burn and Keppoch Road is approximately equal to the 2% AP (50 year) flow.

The locations where the channel capacity is too small to cater for the 0.5% AP (200 year flood) event and results in out of bank flow are:

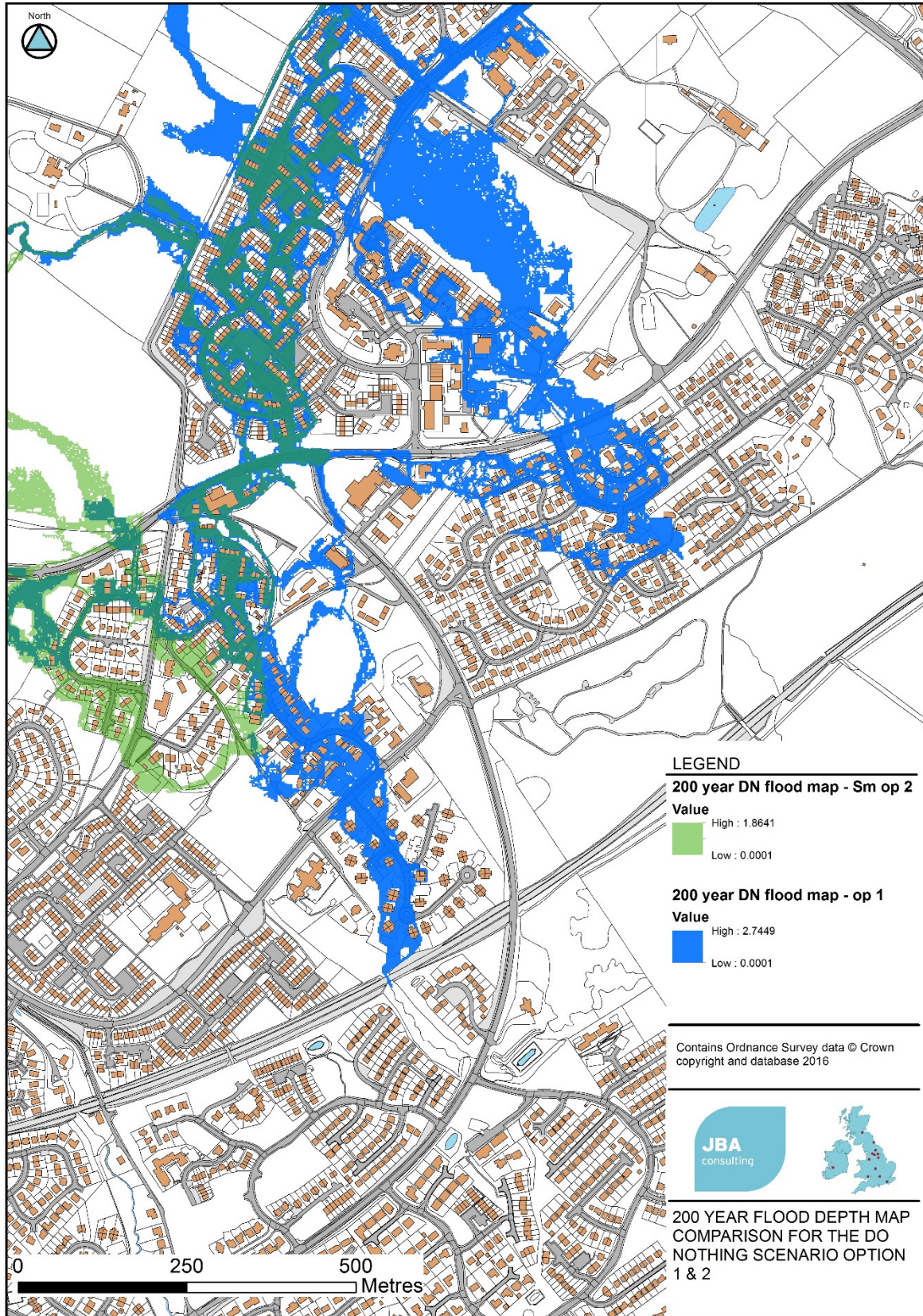
- Upstream of Redburn Avenue.
- Upstream of Culloden Walkway Culvert.
- Adjacent to Keppoch Road.
- Upstream of Murray Road Culvert.
- Gardens of Murray Place.

The flood map shown in Figure 3-1 has been produced to show the flow paths and areas of ponding across the study area as a result of complete blockage of a culvert or channel. Two blockage locations were chosen on the Smithton Burn and one on Culloden Burn West.

In the event of a blockage on the Smithton Burn, out of bank flow occurs at the culvert at Murray Terrace and via a manhole from the culvert in the north corner of Smithton Park (marked in light green in Figure 3-1). In the event of a blockage on Culloden Burn, out of bank flows occur at the Redburn Avenue culvert (marked in blue in Figure 3-1). All flow paths and areas of ponding are for a natural or 'Do Nothing' (DN) scenario, assuming no maintenance is carried out on the watercourses.

The flood risk posed from each of the culverts and under capacity channels have been addressed by the FPS scheme aside from the Culloden Walkway Culvert. At this location in the Do Minimum scenario the 0.5% AP (200 year) flood event flow overtops the culvert. Work to remove a redundant service has been carried out and this will reduce the risk of blockage. There is no increase in flood risk at this location.

Figure 3-1 Flood extents for Smithton Burn in the 0.5% AP (200 year flood) event are shown below



Master Map : © Crown copyright. All rights reserved. Licence number 100023369

60 key structures, which cross either Smithton Burn or Culloden Burn and influence the channel conveyance, were identified. Hydraulic modelling was carried out using 1D steady flow HEC RAS

models to determine the capacity of both the channels and the key structures. 2D modelling in the form of JFlow was used to estimate overland flow paths where the 1D modelling suggested the channel would be overtopped.

Hydraulic modelling output was used to determine the number of properties affected for different flood events. The number of properties flooded in the Do Nothing and Do Minimum scenarios is tabled below;

Table 3-1 Properties at risk in the Do-Nothing and Do Minimum scenarios

Scenario	2	5	10	30	50	100	200	500
Do Nothing	29	53	60	81	91	108	129	159
Do Minimum	0	7	20	40	53	70	93	138

The Do Nothing scenario is a base case which assumes no maintenance of any kind is carried out on the watercourses.

The Do Minimum scenario assumes that the current level of maintenance continues into the future.

Analysis of the flood mapping showed the total number of properties affected for the Do Nothing option for the 0.5% AP (200 year flood) event on the Smithton and Culloden Burn is 129, with residential properties constituting approximately 85% of affected properties.

3.2 Climate Change

The impact of climate change on flood flows is a key risk in the design of a Flood Protection Scheme. Typically for flood studies the potential effects of climate change are considered by upscaling by a factor of 20%, as recommended by SEPA's most recent guidance for flood risk assessment. However recent work in England and Wales has provided regionalised estimates of how climate change will impact upon river flows through the next century based on UKCP09¹ (UK Climate Predictions 09) projections which suggest the best estimate for the effect of climate change in Smithton and Culloden is 29%.

Due to an allowance for limitations on storage the proposed scheme provides a 0.5% AP (200 year flood) standard of protection without climate change allowance. Where possible all other operations have been designed to include for the impact of climate change. This allows for future adaptability of the scheme.

3.3 Post Scheme Flood Risk

After the cause and extent of flood risk was determined, a number of measures were proposed which are intended to work in unison to reduce the flood risk. The principal measures are culvert improvement in the form of screen enlargement or removal, culvert replacement or entire culvert removal combined with two new flood storage areas to control the flow of water in the lower reaches of the Smithton Burn and Culloden Burn. These measures form the Flood Protection Scheme which is intended to remove all properties upstream of Keppoch Road from flood risk in the 0.5% AP (200 year flood) event.

The FPS scheme has been modelled in HEC-RAS and ISIS to evaluate its effectiveness for storm events over a range of return periods. The watercourse channel was modelled in HEC-RAS to determine channel and structure capacity while the reservoirs were modelled in ISIS to determine flow routing through the reservoir's hydrobrakes for the critical storm durations. The outputs from both HEC-RAS and ISIS were used as inputs into JFlow for exceedance events of 0.2% AP (500 year) and 0.1% AP (1000 year). The scheme removes 129 properties from 0.5% AP (200 year flood) event. The scheme will have a beneficial effect on flood events greater than the 0.5% AP (200 year flood) event. Although the focus of the scheme is on properties upstream of Keppoch Road Culvert, properties downstream of the culvert will benefit from a reduction in flows for return period events greater than the 50 year event.

¹ Environment Agency (2011). Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities
 SC-JBA-00-00-RP-C-0001 - Report P4.0

The performance of the proposed scheme in the 0.5% AP (200 year flood) event is shown in Figure 3-2 below. Exceedance flows associated with the 0.1% AP (1000 year flood) event are shown in Figure 3-3 below. The results of the modelling shown in Figure 3-3 demonstrates that exceedance flows do not increase flood risk to properties previously impacted and does not create a flood risk for properties not previously impacted. The scheme reduces 0.1% AP (1000 year flood) risk to the school located near Culloden Park.

Figure 3-2 Extent of Protection provided by 0.5% AP (200 year flood) Scheme

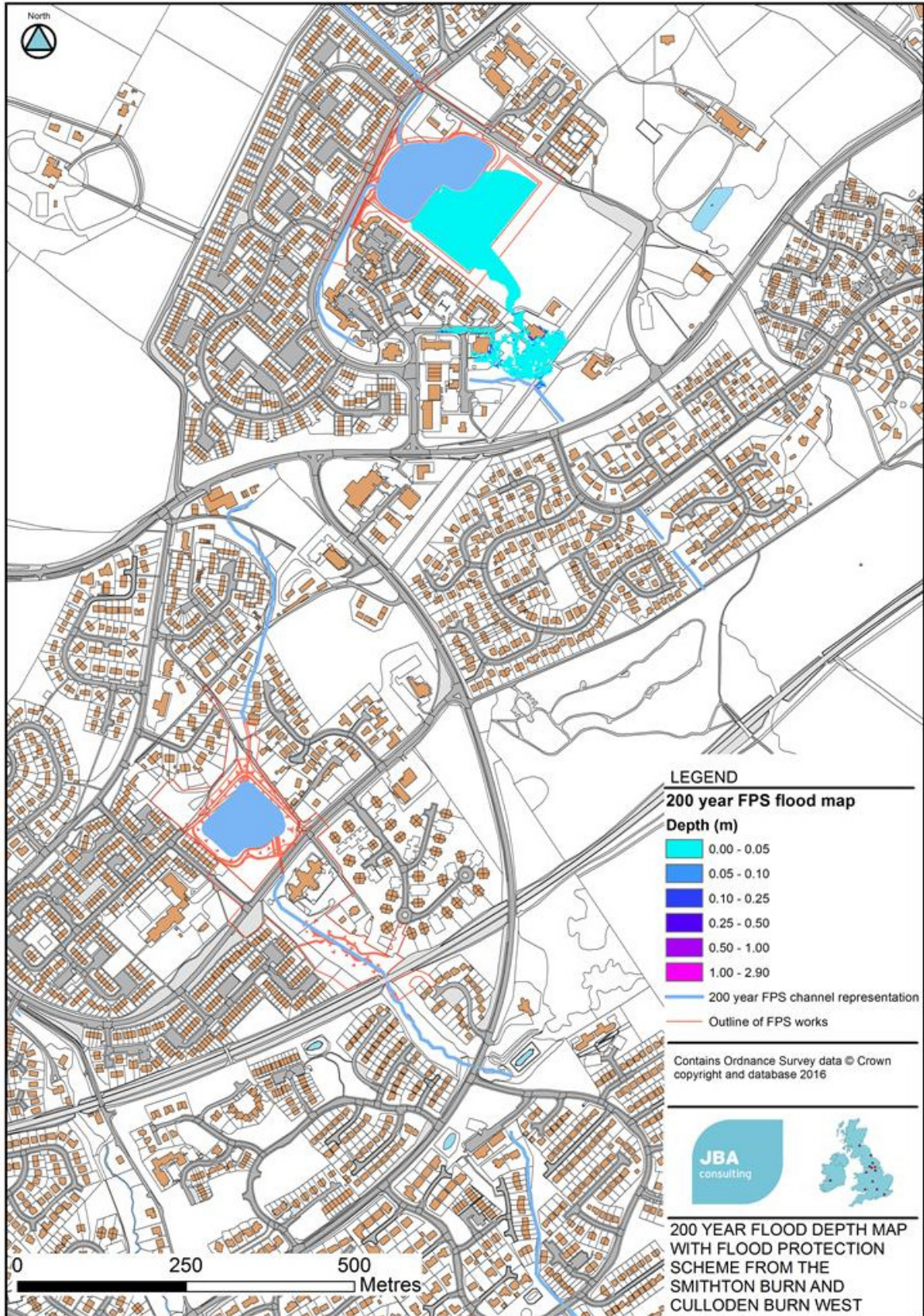
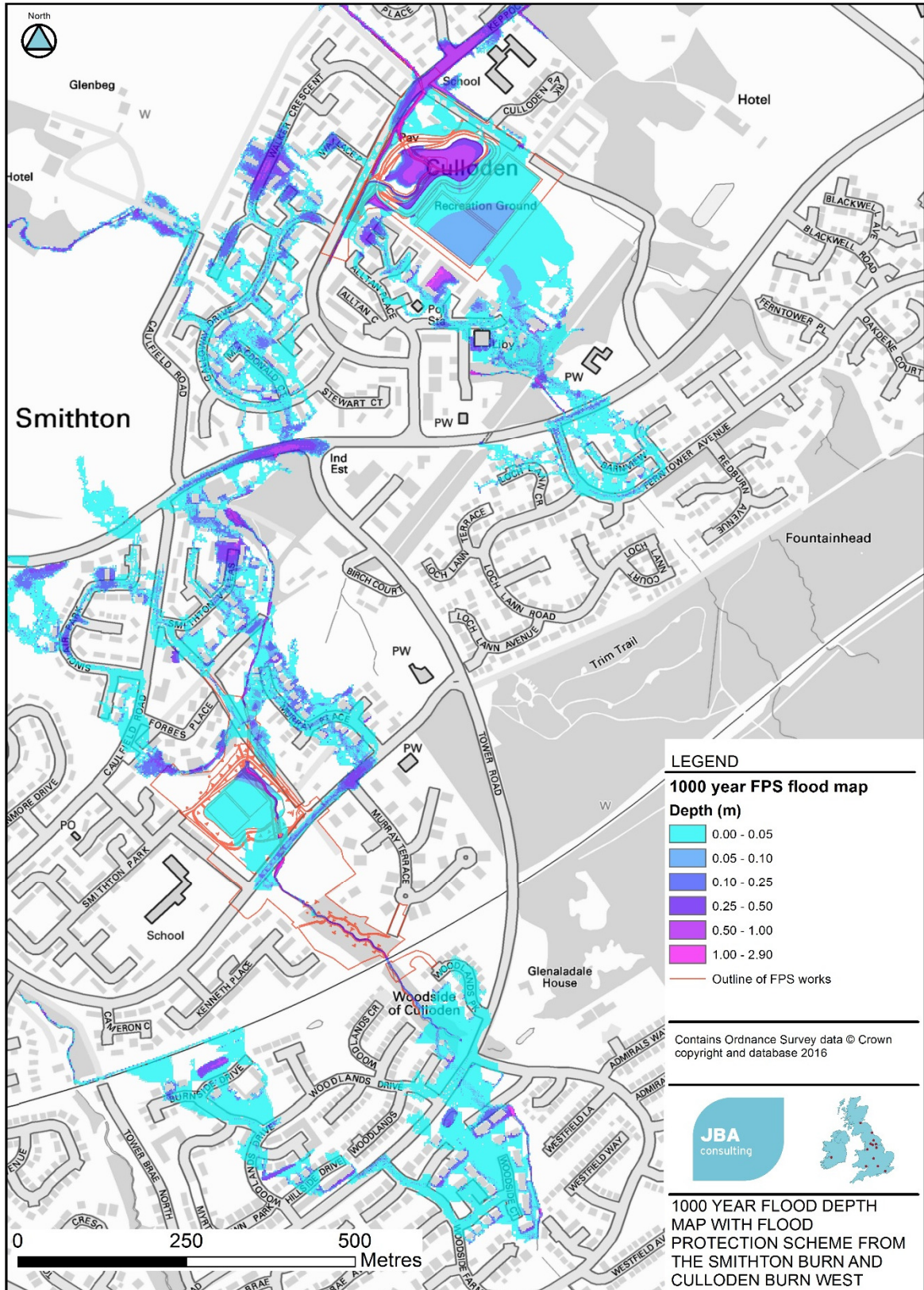


Figure 3-3 Flood extent for 0.1% AP (1000 year flood) event with Scheme



4 Development of the Scheme

4.1 Standard of Flood Protection Objective

Current guidance calls for the review of floods with a range of return periods to determine a sustainable option that includes an allowance for climate change or allows the Flood Protection Scheme to be adapted to meet the requirements of climate change.

The standard of protection for the preferred scheme is for the 0.5% AP (200 year) flood event. The 0.5% AP (200 year) plus climate change event has been considered for the whole scheme area, but is deemed uneconomical to implement at the current time due to constraints caused by existing undersized culverts, existing buildings, infrastructure and constraints on storage area available. Where possible, new elements of the scheme are being designed to a 0.5% AP (200 year flood) standard + CC + adaptation thus allowing potential for the scheme standard of protection to be increased if existing constraints are removed in the future.

4.2 Key Scheme Objectives

The objectives of the Flood Protection Scheme are to:

- Provide robust flood protection and promote most technically sound, economically viable and environmentally sustainable option which mitigates against the major sources of flood risk in the burns; notably the low capacity structures, high blockage risks, unstable channel morphology and sediment movement.
- Provide a minimum scheme standard of protection of 0.5% AP (200 year flood) event and where possible allow for climate change for the 0.5% AP (200 year flood) event.
- Be easy to operate and low maintenance.

4.3 Flood Risk Management Constraints

A range of environmental, infrastructure and structural constraints in developing the scheme have been identified. In summary they are:

- Infrastructure:
 - Roads and railways
 - Existing housing
 - Proposed future development
- Environmental constraints:
 - Protected areas.
 - Protected species
 - Non-native invasive species.
 - Cultural and heritage
 - Water Framework Directive compliance
 - Hydromorphological constraints
- Structural:
 - Culvert capacity
 - Channel capacity

4.4 Pre-FPS works

The preferred package of sub options are arranged into a number of phases of works. Phase 1 to 3 are now complete.

4.4.1 Phase 1 Works

This Phase consisted of works to stabilise the Smithton Burn at the Codfather, remove gabion retention and screen at Murray Terrace, remove screen at Murray Road and other minor works on Smithton Burn along with the removal of a screen at Redburn Avenue along with other minor works on Culloden Burn.

4.4.2 Phase 2 Works

The works consisted of stepped pool construction works on the Smithton Burn at the Codfather and screen replacement at Ferntower Avenue on the Culloden Burn.

4.4.3 Phase 3 Works

These consisted of;

- Works on the Tower Burn to construct a coarse debris screen and channel stabilisation works upstream of Rowan Grove and modifications to the culvert screen at Caulfield Road.
- Operations to stabilise the channel upstream of Tower Road and upstream of the railway at Woodlands Park. Provision of a coarse debris screen upstream of the railway and restoration work downstream of Murray Terrace, all on the Smithton Burn
- A new screen at Culloden Centre and a coarse debris screen upstream of Redburn Avenue on the Culloden Burn.

Phase 1-3 works are, in the main, risk reduction works and have already been carried out as early intervention to deliver a comprehensive solution to flood risk management. The FPS elements of the overall flood risk management approach are those in Phase 4, which are listed below and described more fully in Chapter 6.

4.5 Phase 4 - Balance of works to achieve medium to long term goals

Phase 4 consists of works required to complete and manage flood risk through Smithton and Culloden. Phase 4 scheme includes flood attenuation storage, culvert removal, and watercourse restoration on Smithton Burn and Culloden Burn. Specifically the following operations within the four work zones are proposed:

4.5.1.1 Smithton Burn

- Zone 4 - Removal of culvert pipe at Murray Terrace and reinstatement of the open channel.
- Zone 6 - Deculverting of Smithton Park and provision of flood storage.

4.5.1.2 Culloden Burn

- Zone 2 - Removal of culvert beneath 18/20 Redburn Avenue.
- Zone 7 - Provision of flood storage in Culloden Park.

Community buy-in and a sense of ownership is key to the scheme. The current quality of sports amenity in Culloden Park is poor and local groups favour a scheme which fully meets the wider range of concerns and preferences expressed during public consultation process to date.

5 Social and Environmental Impact Assessment of the Scheme

The environmental and social impacts of the preferred scheme need to be considered. This section describes how environmental impacts and the concerns of statutory stakeholders and the wider public were identified and assessed during development of the outline design.

The work completed on both these aspects is summarised in section 5.1 and 5.2 below. Section 5.3 identifies other statutory consents which will be required for scheme progression while section 5.4 identifies some health and safety risks in the existing system which will be eliminated or mitigated by the scheme.

5.1 Environmental Impact Assessment

A Screening Opinion from the planning authority stated that an Environmental Impact Assessment would not be required.

Although an Environmental Impact Assessment is not required, the potential environmental impacts mentioned in the opinion need to be considered in developing the scheme. The screening opinion called, mainly, for the following environmental aspects to be considered:-

- Characteristics of the development. This included items such physical size, cumulation with other development, use of natural resources, production of waste, pollution and nuisances, risk of accidents with impacts on people or environment and other impacts.
- Location of the development and including items such as existing land use, status of natural resources in the area and absorption capacity of the natural environment,
- Significance of environmental effects. The main considerations are; extent of impact, probability of impact, duration, frequency and reversibility of impact and magnitude and complexity of the impacts.

Pre design surveys were done to establish baselines and this work is described below while the actions taken to mitigate impacts are described in chapter 6.

5.1.1 Environmental Aspects

An ecological audit of the area affected by the works was undertaken in 2013 by way of an ecological walkover survey. This survey consisted of two components:

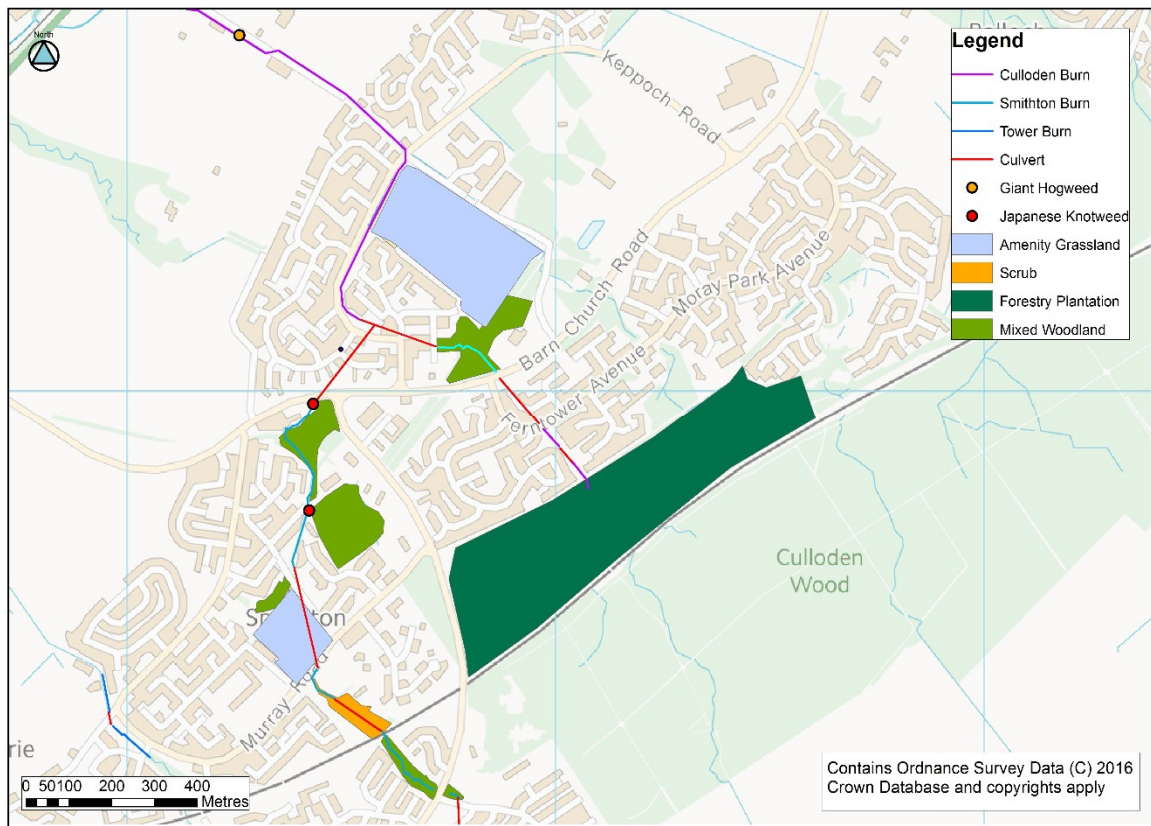
- A desk based survey examining existing records
- A site walkover survey

The audit indicated that the three watercourses in the Smithton and Culloden area which have historically caused flooding are predominantly heavily modified within urban environments. There are few ecological constraints within these sections, with the exception of abundant breeding bird habitat.

The Smithton Burn has the greatest concentration of ecological constraints, particularly from Tower Road to Old Smithton. The uppermost section, upstream of the railway, flows through a narrow valley comprised of semi-natural broad-leaved woodland with large numbers of breeding birds and probable roosting and foraging bats. This area is not part of the Phase 4 works.

Downstream of the railway the Burn enters a long culvert beneath a ridge of made ground, believed to be a result of construction work associated with residential development. This ridge has well-developed scrub and provides ideal habitat for breeding birds and potentially for reptiles. There are two stands of Japanese Knotweed downstream of the next culvert, although these areas will not be subject to any works as part of Phase 4. The more ecologically valuable areas together with areas showing the potential presence of non-native invasive species are shown in the figure below.

Figure 5-1 Non-urban habitats considered to have 'higher' ecological value and possible non-native invasive species



The Culloden Burn is more straightforward, with few areas requiring work in the upper sections likely to have significant impacts. Stickleback were observed in the downstream sections adjacent to the playing fields and there is potential for bats to use the bridge at Caulfield as a roost site. Giant Hogweed was observed downstream of this point in the Milton of Culloden Smallholdings area. Again all these areas are outside of the Phase 4 works however a watching brief will be maintained to ensure that these issues do not affect the Phase 4 work zones during construction.

The recommendations of the ecological walkover survey are summarised below:

- That any vegetation clearance is carried out outside the bird breeding season as this represents a constraint throughout all areas of work.
- The de-culverting on the Smithton Burn at Murray Terrace requires additional surveying to discover if protected animals (reptiles) use the ridge of ground over the culvert. This provides ideal habitat for basking and foraging reptiles.
- Great Crested Newt are not known in the immediate area with the closest record being 2.5km distant, however the SUDs ponds along the Smithton Burn provide breeding habitat and a precautionary approach is recommended.
- Provided that no large trees or other potential bat roost sites are affected, no mitigation for bats is required.
- It would be prudent to map invasive and non-native plant species within the catchment. Himalayan Balsam at Murray Tce (upstream of Railway Bridge and in vicinity of Ph 3B Op 5) and Culloden Park.

5.1.1.1 Additional Ecological Surveys.

Since the completion of the ecological walkover survey and as the design developed some

further ecological work was carried out;

- A survey was carried out to ascertain if any reptiles are living on the Murray Terrace bund. No reptiles were found however it is recommended that the survey be repeated about six months prior to construction.

Coille Alba were contacted to discover what information they might have on invasive non-native species. Their high level indications are that Himalayan Balsam may be present in the area. This was not identified in the area of the works during the ecological walkover survey, however a watching brief will be maintained during the progress of the works.

- The presence of trees on or near a proposed new reservoir embankment is not permitted. This is due to the structural risk they pose to the embankment. The risks are outlined in the Owner's Guide to Reservoir Safety which is published by the Environment Agency and provides guidance to owners on reservoir safety. Sections 3.2 and 5.1 refer to impacts of trees on reservoir embankments. An arboriculturalist was engaged to assist in design development with the objectives of minimising tree removal, proposing mitigation and outlining areas of compensatory planting. This work is more fully described in Chapter 6.

5.1.2 Hydrogeomorphology

An initial hydromorphological audit of the catchment was completed in 2013 to provide a baseline and inform the design of the scheme. The audit revealed a number of significant issues linked to the flow and sediment regime of the watercourse and a number of comments and recommendations are made linked to the design of a sustainable flood protection scheme. In general the findings were that significant reduction in river capacity can occur by a relatively small volume of coarse material in the channel. It has been identified that there is a need to:

- Ensure that high volume sediment input zones are controlled.
- Ensure that lined reaches are not allowed to deteriorate and become sediment source zones.
- Re-engineer sections of the watercourse to minimise hydraulic and sediment transport imbalances.
- Manage the reach scale transfer of sediment ensuring that reaches do not become starved of sediment and that long term sediment stores are not created.
- Develop a post works monitoring and management regime.

The issues raised in the audit relate predominantly to Smithton Burn and have been considered during design development. In general the Phase 4 engineering works on Smithton Burn are located in reaches which in themselves are not sources of sediment; the short reach of about 75m between the downstream end of the works in Murray Terrace and the inlet to the Murray Road culvert is the only sediment source identified in the audit. Since the audit was carried out the Phase 3 Operation 5 works in this location have stabilised the banks and bed and greatly reduced the possibility of sediment erosion.

The Phase 4 design generally focuses on ensuring that the channels in the reaches downstream of the railway bridge do not become sources of sediment in themselves and that sediment transported from upstream of the railway bridge into the engineered reaches is either deposited in suitable locations where it can be efficiently and safely removed, or that it passes through the engineered reaches to the downstream channel, ensuring sustainable sediment transport through the river system.

5.1.3 Cultural Heritage

Culloden Park was identified as the main area of cultural heritage in the work zones as it falls within the area of the Culloden Battlefield. The Council's HET team required a watching brief during site investigation.

5.2 Public and Statutory Consultation

The Flood Protection Scheme was taken to both a pre-application consultation and a public exhibition in early 2015. The revised draft FPS was presented to the PDI Committee on Nov 4th 2015 to seek approval to proceed with formal notification / consultation on the scheme. Approval

by the committee was given on that date. A summary of both consultation processes is given below.

5.2.1 Major Development Pre-application Consultation with Statutory Consultees

A Pre-Application meeting for Phase 4 of the Smithton and Culloden Flood Protection Scheme was held in January 2015 as part of statutory consultation for the flood protection order process. A Pre-Application Advice Pack document was produced by The Highland Council Planning to reflect the opinions of the officers present at that meeting and to guide future progress of the application. The main concerns and issues that were identified are listed below;

- An investigation into non-native invasive plant species is required.
- The use of natural slopes, soil disposal and planting proposals should be addressed. The extent of future maintenance will need to be discussed with community works officers.
- A Design and access statement is required.
- Construction phase impacts should be considered including dust, noise and traffic.
- A formal consultation with Historic Scotland and metal detector survey of Culloden Park needs to be carried out as the scheme is partly on land classified as the Culloden Battlefield.
- An outdoor access plan to address impacts on public access.

Sport Scotland made a separate response to an email query, which is summarised below;

At Smithton Park Sports Scotland feel that the proposals are acceptable provided the replacement pitch is constructed in line with acceptable standards. In addition they are happy to comment on any specification for the new pitch.

In respect of Culloden playing field, Sports Scotland take a similar view as for Smithton Park. Sports Scotland have contacted Highlife Highland and indicated that Highlife Highland are also happy with the proposals provided the proposals are compatible with the overall sporting strategy which they are currently discussing with The Highland Council.

5.2.2 Public Exhibition and Consultation

The objective was to have a comprehensive public participation and feedback session for the implementation of the Scheme. The public consultation process consisted of preparation, attendance on the day, the recording of the comments made and the analysis of those comments. The public meeting was held at Smithton Free Church on 10 March 2015 between 14.00 and 18.30.

The main outcomes from the public consultation were;

- A realignment of the proposed channel and access restrictions to the channel have been suggested during the consultation to minimise risk to children in particular.
- Retention of the existing football pitches at Smithton Park is a priority.
- Concern for the safety of children especially as the present playground is situated so closely to the outfall of the proposed Murray Road culvert.

The public consultation event was reported in The Press and Journal (Highlands & Islands) newspaper of 12 March 2015 where the issue of child safety was acknowledged as the primary concern.

5.2.3 Response to the Pre-Submission and Public Consultations

Changes were made to the scheme design to accommodate the concerns of both groups of stakeholders which had been consulted. In summary they are;

- Changes to the alignment and side slopes of the excavation at Murray Terrace to reduce impact on trees.
- Relocation of the Murray Road culvert and the new open channel alignment to the east of Smithton Park to reduce its proximity to the children's play park.
- Revise to the reservoir footprint in Smithton Park to accommodate two 7-a-side football pitches.

- Revise the alignment of the reservoir outlet culvert from Smithton Park reservoir to minimise impact on trees.
- Revise the reservoir footprint in Culloden Park to minimise impact on trees and playground. This will also involve improvements to two football pitches.

In a separate consultation process with impacted property owners, it emerged that they had access and safety concerns with an open channel reinstatement. It was agreed to change the proposed open channel reinstatement in Redburn Avenue to an online replacement of the existing culvert with a larger capacity culvert.

Other general concerns have been addressed in the outline design as follows;

- Embankment slopes will have gradients varying from a maximum of 1:3 to 1:6 to increase variety.
- An outline of how construction might be carried out and its associated traffic impacts has been done for each site in chapter 6. This includes likely noise and dust impacts. The level of detail includes the elements of a design and access statement.
- Consultation has been carried out with Historic Scotland and latterly with the Historic Environment Team in The Highland Council to identify the correct procedures for works in the Culloden Park area of the Culloden Battlefield.
- Contact has been made with Sports Scotland to discuss their inputs into the scheme.

5.3 Other Statutory Consents

5.3.1 SEPA Licencing

The scheme requires SEPA authorisation to comply with the Water Environment (Controlled Activities) (Scotland) Regulations 2011. Under the Controlled Activity Regulations (CAR), SEPA has a duty to ensure efficient and sustainable use of the water environment. SEPA have been consulted throughout the development of the scheme and an application has been made to SEPA for a CAR licence.

5.3.2 Waste Management Licence

A waste management licence is normally required for movement and disposal of waste material including excess soils from construction sites under the Waste Management Licencing (Scotland) Regulations 2011. SEPA has adopted a regulatory position where it will not require a licence or exemption for the reuse of greenfield soils. The SEPA position is set out in the guidance titled Promoting the sustainable reuse of Greenfield soils in construction. The exemption applies where the producers and users comply with the guidance and where the soil meets the description of greenfield soil in the guidance. In addition the soil must either be reused on the site on which it arose or be reused on other sites as described in the guidance.

The works will in the first instance comply with the reuse of greenfield soils approach. Both park sites contain undeveloped uncontaminated soils and have in the past been landscaped with soil from other undeveloped uncontaminated sites. The soil in Murray Terrace contains soil excavated from the nearby site which is also uncontaminated but does contain a small amount of builder's rubble in one location. Initial ground investigation indications are that the soils are not contaminated. The soils are therefore likely to meet the initial condition in the guidance that they be clean.

Some of the soil will be reused in the works on site and the remainder will be removed off site. If a suitable end use in line with section 4 of the guidance can be found it will be utilised. If an end use in line with section 4 is not found then a waste management licence will be sought.

5.4 Health and Safety Benefits

The provision of the scheme will remove or mitigate some existing health and safety risks associated with works such as raking informal screens during flood events, child or small person entry to relatively small bore culverts, maintenance works removing sediment from small bore culverts, risks to pedestrians from high velocity overland flows and falls from headwalls and structures which currently do not have guardrails. Whilst there is likely to be an environmental loss

from the removal of some potentially unsafe trees, there will be ancillary benefits from their replacement with more suitable tree species and from removal of the berm in Murray Terrace.

6 Smithton and Culloden Flood Protection Scheme Description

The flood protection scheme was revised to accommodate the outcomes of the Pre-Application and public consultations. This chapter describes the modified scheme which is now being promoted and should be read in conjunction with the scheme drawings and the operations shown therein. Overall scheme sustainability is addressed in section 6.1. The revised scheme changes are summarised in sections 6.2-6.5.

Construction related issues are outlined including future maintenance and have been considered for each individual zone. The description relating to construction of the works is intended to give the reader an appreciation for how the works might be constructed and resulting construction related issues. This description does not in any way suggest that this is how the works should actually be constructed and the contractor remains free to carry out the works in the way they think most suitable. The location and elevation of structures may vary from the position shown in plan within limits as defined in the Smithton and Culloden FPS document. Duration of the works is likely to be in excess of 12 months. Impacts on the natural environment, landscape and amenity are outlined along with the mitigation measures taken and any additional benefits provided.

6.1 Scheme Sustainability

Sustainability in the scheme has been considered in line with The Highland Council Sustainable Design Guide. This has informed the outline design philosophy especially in regard to;

- Conserving and enhancing the character of the Highland area. The layout and profile of the storage areas in particular have been integrated into their park settings by siting them in existing low lying areas and profiling the embankments so they do not appear regular and geometric. Landscaping and compensatory tree planting will blend with the park setting of the structures. New planting will reflect species typical of the local area, increasing biodiversity.
- Using resources efficiently. The reuse of site won material for embankment construction will be maximised to reduce scheme costs.
- Minimising the environmental impact of the scheme. The nature of the works will permanently change the hydromorphological environment in particular to some extent due to the introduction of new open channels where none previously existed. The impact on sediment transport has been considered and the new regime has been designed to facilitate sustainable sediment transport. Impacts on the wider environment such as those from transport pollution and carbon footprint have been considered in the design and mitigated by choosing solutions which minimise transport. Short term damage that could be caused by construction activities has been minimised by using natural rock armour instead of concrete wherever possible and minimising use of in-situ concrete by using precast concrete where possible.
- Enhancing the viability of Highland communities. The purpose of the scheme is to reduce risk to life and other economic damage from flooding. Along with making the area safer for existing residents it will allow for sustainable future residential settlement in the area.
- Landscape and visual amenity. The proposals for Murray Terrace, Smithton Park and Culloden Park look to incorporate water as a natural focal point within the landscape, providing interest through sound, movement and visual quality. When integrated into public spaces or parks, these benefits can offer an opportunity for people to appreciate a wider range of natural environments, provide valuable educational resources and encourage an understanding of how water and drainage can be accommodated in more sustainable ways.
- Good parks and open spaces attract people and accommodate activity at all times of the year. Restoring and opening up the original watercourses will help to make these spaces attractive, interesting and inviting. Getting more people into such spaces helps develop a more extensive Green Infrastructure, which can result in wider social, environmental and economic benefits, including health and wellbeing, education, training, social interaction and cohesion and sustainable transport. Greater visitor numbers also encourages better informal surveillance, resulting in less antisocial behaviour.

6.2 Smithton Burn – Zone 02-04; Murray Terrace (MT)

6.2.1 Purpose

The purpose of these works are to remove the cause of flooding due to blockage and/or low capacity in the existing culvert. Instead flows will be conveyed through this reach in an open channel.

6.2.2 Description

Operations MT-01 and MT-02 shown on the plan SC-JBA-02-04-DR-C-0100, will work together to convey flows from the Network Rail railway bridge towards Murray Road via a new open channel. The channel will commence with about 12m of rectangular concrete open channel (MT-01), needed to stabilise the channel around the bridge, which will then flow into a new open natural channel (MT-02).

The new open channel will have a relatively flat gradient (about 1 in 40 for about 110m and the channel will be reinforced to resist scouring up to the 0.5% AP (200 year) flow (3.05 m³/s at approx. 3 m/s). The banks above the 0.5% AP (200 year) water level will have varying side slopes between 1:3 and 1:6 which will allow for mechanised maintenance if required. The varying slopes will give the channel a more natural look.

The final 30m approx. will be a steeper section of the channel (approx. 1 in 5 and will be constructed using step pools to minimise erosion and scour by high velocity flows. Velocity on the steps is estimated to be about 3.75 m/s. The step pools will be constructed using larger rock sizes of up to 1m in diameter designed to be erosion resistant during 0.5% AP (200 year) flows. The existing pipe culvert will be removed where it might protrude into the proposed new channel while in other parts the abandoned culvert will be left in situ and filled with suitable solid material to prevent any water flowing through it. The sections are shown on SC-JBA-02-04-DR-C-0104.

6.2.3 Construction Process

A possible construction sequence is outlined below. This sequence is illustrative only and does not pre-empt how a contractor might set-up and carry out the works

- Site clearance works will include removal of a small number of trees and existing fencing. Tree protection will be constructed and arrangements for overpumping put in place.
- Carry out sewer and electricity diversions.
- Bulk excavation operation to reduce the level of the soil tip to a very shallow vee profile along the new channel alignment.
- Install temporary drainage and construct the new channel (MT-02) and step pool arrangement.
- Remove or fill the abandoned pipe.
- Remove upstream headwall, install temporary drainage arrangement and construct upstream portion (MT-01) of open channel.
- High level consideration has been given to traffic movement associated with the works. It is estimated that more than 1000 loads of material will arrive at or leave the site. A traffic management plan will be submitted by the contractor prior to commencement of construction.
- Reinstatement works will include provision of new pathways and pedestrian bridge with lighting, reinstatement of existing fences but with an access gate added in the west fence between the site and Kenneth Place and a Watergate in the north fence with the former care home site.
- Landscaping will consist or regeneration of vegetation from existing topsoil stored for that purpose or replanting with wildflowers or grass. Compensatory tree planting will also be carried out as indicated on the drawings.

It is possible that some piling and some use of rock breakers may be required. Normal construction noise can be expected and it is also expected that work will generally be carried out during normal Monday -Friday working hours with some work on Saturdays. Changes to work times will be agreed with the client as required. Appropriate dust suppression will be used.

Maintenance and operation

1. The side slopes for the embankment are designed to allow for vegetation clearance if required.
2. The maintenance and operation of this site is expected to have negligible impact on the local transport network.

6.2.4 Environmental and natural heritage issues

An ecological walkover survey was carried out for all zones in phase 4. The most significant issues in this zone were;

1. Potential site for reptiles. Subsequent to the ecological walkover survey of 2013 finding further site walkovers were completed in 2015, which indicated that reptiles are not present. The recommendation is that the site is re-assessed prior to beginning of construction works.

Preliminary screening by Coille Alba indicates that no invasive non-native species are present in the works zone, but the presence of Himalayan Balsam is suspected in adjacent areas. A watching brief will be maintained for Himalayan Balsam and other invasive non-native species.

6.2.4.1 Assessment of tree stock.

The site was surveyed by an arboriculturalist and a schedule of trees to be removed along with those to be retained was determined and are shown (in red) on the drawing SC-JBA-02-04-DR-C-0102. A total of 12 trees are scheduled for removal.

Areas of compensatory planting have been identified on the drawing SC-JBA-02-04-DR-C-0102. The size, number and species of tree of replacement trees shall be agreed with THC tree officer prior to construction.

The impact on the natural heritage is expected to be positive by restoring a more natural appearance to the location.

6.2.5 Landscape and amenity

Along with addressing flood risk the works will provide a new footpath and a bridge that will create an attractive, formal link between two communities. The artificial mounded topography will be replaced with a more open landscape that will encourage active use and informal surveillance, therefore reducing the potential for antisocial behaviour. The following landscape and amenity elements have been included:

1. The new bridge will be constructed in accordance with Eurocode structural codes to meet Approval in Principle requirements of The Highland Council. Design will reflect the *Path Bridges - Planning, Design, Construction and Maintenance* guidance produced by Paths for All. The bridge will have an anti-slip finish.
2. The pathways will be constructed to the Design Manual for Roads and Bridges (DMRB), Highland Council and Lowland Path Construction Guidance standards and will have a rolled bound gravel finish with edging to be agreed with THC.
3. Proposed landscape and tree planting is shown on drawing SC-JBA-02-04-DR-C-0102. New tree planting will offset the loss of some of the large beech trees. Further tree and hedge planting will provide privacy and natural boundaries to residential properties to the northern edge of the site.
4. Efforts will be made to retain the existing site topsoil which will be stored and re-spread onto the reprofiled topography, allowing regeneration of the existing flora. The entire site will be seeded with species-mix grassland that is appropriate to the local area and ground conditions. Further native waterside planting will be accommodated through coir rolls or mats along the channel.
5. Headwalls, wingwalls and concrete channel walls will have a DMRB F5 concrete finish.

6.3 Smithton Burn – Zone 02-06; Smithton Park (SP)

6.3.1 Purpose

The flood storage area in Smithton Park will store a portion of the flows in Smithton Burn, up to 0.5% AP (200 year) flows, and release it at a fixed low flow rate to the downstream channel to reduce flood flows to the downstream properties. The storage will only be used intermittently in the meantime the flood storage area will be available for amenity use by the public. The existing pipe culvert through the park will be replaced mainly by open channel and by a section of new high capacity culvert.

6.3.2 Description

The works are divided into a series of operations which are shown on the drawing SC-JBA-02-06-DR-C-0100. The operations work together as a system to convey and attenuate flows. The burn will pass under Murray Road in a new box culvert into Smithton Park (SP-04 and SP-05) then through the park in a new open naturalised channel, out of the park through a flow control structure (SP-03), which will limit flow to approx. 1.5 m³/s with a pipe through the embankment to a new outlet manhole, OM 1, then into a new larger capacity culvert (SP06), which will finally discharge into the existing open channel. The new natural channel in the park will replace a 100m, or thereby, portion of the existing culvert, which will be removed.

The flood storage basin will have a capacity of not less than 12,000 m³, currently estimated to be sufficient to reduce the 0.5% AP (200 year) peak flow to approx. 1.5 m³/s. During the 0.5% AP (200 year flood) event the reservoir will fill to about 44.9m AOD; a depth of about 1.5m when standing on the new channel bank. When inflows return to normal the stored water will be gradually released to the downstream channel allowing the basin to revert to normal amenity use.

The flood storage basin will be capable of storing over 10,000 m³ of water which means it will be classified as a reservoir as the Reservoirs (Scotland) Act 2011 is progressively implemented. The structure will be designed, inspected and maintained in accordance with the provisions of the Reservoirs (Scotland) Act 2011. A conservative "high risk" designation has been assumed for design purposes, as there are properties downstream of the impoundment

During normal flows of up to about 4% AP (25 year flood) event, no water will be impounded and all flows will pass through the flow control structure and into the existing open channel downstream. During flood events in excess of about 4% AP (25 year flood) event the flow control structure will limit outflows to the downstream channel and the portion of flow in excess of 4% AP (25 year flood) flow will begin to collect in the flood storage basin (SP-01). For progressively larger flood events progressively larger volumes of water will be stored in the basin. At about the 0.5% AP (200 year flood) event the amount of water stored will be the maximum and for flood events in excess of 10.5% AP (200 year flood) event excess water will begin to spill over the crest of the spillway (SP-02) and flow down into a collection swale at the toe of the spillway. The swale will direct the flow northwards towards Forbes Place and Sinclair Park.

6.3.3 Construction Process

A possible construction sequence is outlined below. This sequence is illustrative only and does not pre-empt how a contractor might set-up and carry out the works

- Advance works to establish a site compound, carry out fencing, service diversions, tree removal and tree protection as required.
- A temporary access road is likely to be needed to construct operations SP-03 and SP-06. This haul road could branch to service construction of SP-04 and SP-05. Some overpumping may be required as the existing culvert is progressively diverted into the new structures. The abandoned culvert will be removed.
- The temporary access road could then be progressively removed and the embankments constructed along with the new drainage for the new pitches in the basin. The new open channel could then be constructed and the existing culvert diverted into it.
- High level consideration has been given to traffic movement associated with the works. It is estimated that more than 2000 loads of material will arrive at or leave the site. A traffic management plan will be submitted by the contractor prior to commencement of construction.
- Construction of the access roads and footpaths could now be completed.

- Reinstatement works will be carried out to the existing lit path to the north of the site and to the existing lit unadopted road to the east of the site along with reinstatement of any fencing removed to facilitate the works. The existing playground will be reinstated.
- Compensatory tree planting is shown indicatively on the drawing SC-JBA-02-06-DR-C-0100. The tree species and mix is to be agreed with THC tree officer.

It is possible that some piling and some use of rock breakers may be required. Normal construction noise can be expected and it is also expected that work will generally be carried out during normal Monday-Friday working hours with some work on Saturdays. Changes to work times will be agreed with the client as required. Appropriate dust suppression will be used.

Maintenance and operation

1. Hydraulic operation of the site is expected to be fully automatic with no intervention required.
2. The site will require periodic maintenance mainly to rake accumulated debris off the screen and to remove the debris off site.
3. On an infrequent basis the outlet channel will need to have the lids removed to excavate any accumulated debris which has passed through the screen and been deposited. The open channel in the park area will need to have any large debris which has passed over the cascade structure excavated and removed off site.
4. All side slopes will be 1:3 or slacker to allow safe maintenance by machinery.
5. Paths with slopes of about 1:20 have been provided to allow access for the public. Steps have been provided to avoid walking on potentially slippery slopes during maintenance.
6. During filling of the storage area members of the public should leave the basin area.

6.3.4 Environmental and natural heritage issues

An ecological walkover survey was carried out for all zones in phase 4 as described in Chapter 5. There are no ecologically significant issues with this zone however there are significant numbers of trees impacted by the works. The trees are in the vicinity of the embankments, outlet culvert and in areas where other works such as service diversions may be carried out.

Where embankments form part of an impoundment which is, or may be, regulated under the Reservoirs (Scotland) Act 2011, then the owners of those reservoirs have a legal obligation to ensure the dam is safe. The Owners Guide to Reservoir Safety is published by the Environment Agency and provides guidance to owners on reservoir safety. Tree actions on embankments include heave, creation of flow paths and physical damage in the event of wind blow. These actions pose an unacceptable risk to the safety of the embankment and consequently a risk to the safety of residents living downstream.

The design approach is that if a tree crown spread encroaches within 3m of the embankment toe line then it should be removed. Roots must not penetrate the embankment foundations.

6.3.4.1 Assessment of tree stock

The trees to be retained and those to be removed are shown on the drawing SC-JBA-02-06-DR-C-0100 and described further below. Areas of potential mitigation or compensatory planting is also shown on the drawing.

1. Storage area footprint
In the reservoir embankment area trees: 94-96 and 137 to 145. Also trees 92-93 in the cut area and 146-147 in the proposed new access area will need to be removed; a total of about 17 trees.
2. Outlet culvert
The main impact of adopting this alignment will be the loss of the mature Beech T210 and T148 which currently form a group of 3 locally prominent trees with T149.
The new channel passes through the root protection area of T210. T148 has an unbalanced crown and structural weaknesses, which will be exposed with the removal of T210, and will need to be removed.

It is likely that T149 (mature Beech) can be retained provided that careful measures are adopted to protect this tree during construction. This will include the need for hand-digging any excavation works at the edge of the root protection area. As a precaution, trial pits will be dug in order to assess the root distribution of T149 at an early stage.

The root protection area of Yew (T209) will be fenced off during construction to ensure this tree can be retained. Total of two trees affected.

3. Other works

Trees 45-91 (Monterey Cypress trees) will be removed to facilitate the diversion of services, reconstruction of the playground and to avoid future potential safety issues. A total of about 47 of these poorer quality trees will be removed to facilitate these works.

4. Potential mitigation planting in respect of these works is shown on the drawing SC-JBA-02-06-DR-C-0100. The size, number and species of replacement trees shall be agreed with THC tree officer prior to construction.

While some native trees need to make way for the scheme some non-native poor quality trees such as the Monterey Cypress will also be removed; in total about 66 trees will be removed. The replacement planting, also shown on drawing SC-JBA-02-06-DR-C-0100 will be of higher quality with character and species choice more appropriate to the park.

6.3.5 Landscape and amenity

The local residents expressed a desire to retain the playground and football pitch facilities which already exist in the park and concern that open channel construction might increase risk to their children. The addition of the channel and associated waterside vegetation will offer a new, more attractive feature within the site. A cascade structure will offer further interest through sound, movement and visual quality. New paths will allow access both within the park and alongside the channel. These will allow all-weather access from key entrances to the play area, as well as offering circular routes within the park where none are currently present. Two seven-a-side football pitches will be accommodated within the reservoir area.

The following efforts have been made to address concerns raised by residents;

1. The existing playground will be retained in its current position and upgraded. New paths will allow level access from all main entrances for all users regardless of ability.
2. The existing football pitches will be replaced by two new pitches constructed to Sports Scotland specification. Their location adjacent to the reservoir slopes will offer potential for informal spectator seating.
3. Open channels have been located as far away from the playground as possible and have been designed to maintain shallow depths of flowing water and minimise the number of pools.
4. All new structures will be constructed in accordance with Eurocode structural codes to meet Approval in Principle (AiP) requirements. Concrete structures will generally have an F5 finish to DMRB standards.
5. The pathways are constructed to DMRB, Highland Council and Lowland Path Construction Guidance standards and will have a rolled bound gravel finish with agreed edging to secondary routes within the reservoir. The access road on the embankment crest will have a macadam surface with kerb edging as agreed with The Highland Council be gated at either end. Pedestrian access will be provided alongside each gate which will also accommodate wheelchairs.
6. Proposed landscape and tree planting is shown on drawing SC-JBA-02-06-DR-C-0100. New tree planting will reflect both local species and ornamental value in order to enhance both biodiversity and visual amenity. Suitable tree species which screen, but do not fully block views will be used on boundaries. Steeper slopes will be seeded with species-rich meadow mixes that increase biodiversity and reflect natural assemblages in the local area. Further native waterside planting will be accommodated through coir rolls or mats along the channel.

6.4 Culloden Burn (West) – Zone 03-02; Redburn Avenue (RB)

6.4.1 Purpose

There is currently a blockage risk from a low capacity culvert pipe underneath the garden property in Redburn Avenue which has led to flooding at Loch Lann Court and overland flows towards Barn Church Road.

6.4.2 Description

The works described in the operation RB-01 to replace the pipe will remove this risk and reduce the risk of overland flows bypassing the flood storage area in Culloden Park. The works are shown on drawing SC-JBA-03-07-DR-C-0101 and include;

- Removal of the existing 1.05m diameter culvert pipe and its replacement on line with a larger capacity box culvert pipe, of about 26m in length, 2.4m in width and 1.5m in height or thereby.
- Construction of new headwalls to the new culvert pipe with reinforced concrete side walls and stepped aprons to improve inlet and outlet geometry and also to form a suitable tie-in to the existing erosion protection at the upstream and downstream channel ends. The sidewalls and aprons will be about 5m in length or thereby. The location of the structure from the position shown in plan may vary by $\pm 2\text{m}$ in any direction. The crest of the structure may vary from the level shown in section by $\pm 0.3\text{m}$.

6.4.3 Construction process

A possible construction sequence is outlined below. This sequence is illustrative only and does not pre-empt how a contractor might set-up and carry out the works

- Enabling works will be carried out to create access and to remove fencing and vegetation and carry out any diversions.
- The construction work will be carried out online so an overpumping arrangement will first be installed. The existing culvert will be removed and replaced.
- The downstream 5m of existing culvert will be removed, replaced and backfilled.
- Reinstatement and replanting works will be carried out.
- High level consideration has been given to traffic movement associated with the works. It is estimated that more than 100 loads of material will arrive at or leave the site. A traffic management plan will be submitted by the contractor prior to commencement of construction.
- It is possible that some piling and some use of rock breakers may be required. Normal construction noise can be expected and it is also expected that work will generally be carried out during normal Monday-Friday working hours with some work on Saturdays. Changes to work times will be agreed with the client as required. Appropriate dust suppression will be used.

Maintenance and operation

1. Access for future inspection will be required.
2. The culvert will have no screen and is expected to be self-cleansing. It is expected to operate without supervision in all flow events.

6.4.4 Environmental and natural heritage issues

There are no environmental or heritage issues expected on this site which is in the back gardens of private houses.

6.4.5 Landscape and amenity

Planting within private gardens will be reinstated appropriately in agreement with the property owners. This will include any hedging or screen planting that adjoins the public footpath.

6.5 Culloden Burn (West) – Zone 03-07; Culloden Park (CP)

6.5.1 Purpose

The purpose of the works is to protect the residential areas to the west and north of Keppoch Road from flooding during events when the culvert under Keppoch Road is unable to convey the storm flows. The excess flow will be stored in the storage area and released gradually at a rate which can be accommodated by the Keppoch Road culvert.

6.5.2 Description

Zone 03-07 works include a combination of a concrete flood wall and embankments to provide a flood storage basin with an outlet structure to impound and attenuate high flows. The existing open channel will be diverted through the flood storage area. Associated amenity works will include provision of footpaths, wetland and upgraded football pitches.

The following Operations will work together as a system to convey flows into the Culloden Park storage area. The floodwalls along Keppoch Road (CP 01&CP-07) will direct flows into the storage area (CP-03). Flows will leave the storage area through a flow control structure (CP-04) and back into the existing open channel via a short length of new open channel (CP-06). In the 0.5% AP (200 year flood) event the flow control structure will limit outflows to approx. 3.4 m³/s downstream and when inflows exceed this then water will collect in the flood storage basin (CP-03) to a depth of about 1.2m over a period of about 4.75 hrs. When inflows return to normal the stored water will be gradually released to the downstream channel over a period of about 4 hours allowing the basin to revert to normal amenity use. Flows greater than 0.5% AP (200 year) flows will spill over the side to of the storage area via a designed spillway (CP-05). The overflows will be collected in a swale and directed towards the Keppoch Road culvert. Maintenance works to the structures will be facilitated by provision of an access track and bridge (CP-02) on the embankment crests and a track leading to the screen inlet at basin floor level.

The storage area will have a capacity of about 17,000 m³ which means it will be classified as a reservoir under the Reservoirs (Scotland) Act 2011. The structure will be designed, inspected and maintained in accordance with the provisions of the legislation and a "high risk" designation has been assumed for design purposes. The works will protect the houses in the vicinity from flooding and provide potential for amenity in the storage basin. Additional works will improve the surface quality and drainage of two football pitches on the middle tier. The existing playground, buildings and car parking on the bottom tier will be retained.

6.5.3 Construction Process

A possible construction sequence is outlined below. This sequence is illustrative only and does not pre-empt how a contractor might set-up and carry out the works

- Site compound, site access and temporary haul roads could be constructed first.
- Advance works to carry out fence and tree removal and also tree protection as required. Service protection will be installed.
- The flood walls (CP-01 & CP-07) could now be constructed along with raising and/or widening works to the existing pedestrian bridge; it is likely to require some overpumping. The outlet structure (CP-04) and the bridge (CP-02) could also be constructed at this stage.
- Finally all earthworks and new open channel, CP-03, CP-05 and CP-06, could be constructed along with the new pitches with their drainage.
- High level consideration has been given to traffic movement associated with the works. It is estimated that more than 2000 loads of material will arrive at or leave the site. A traffic management plan will be submitted by the contractor prior to commencement of construction.
- Reinstatement of any fencing removed to facilitate the works along with landscaping works
- Compensatory tree planting is shown indicatively on the drawing SC-JBA-03-07-DR-C-0100.
- It is possible that some piling and some use of rock breakers may be required. Normal construction noise can be expected and it is also expected that work will generally be

carried out during normal Monday -Friday working hours with some work on Saturdays. Changes to work times will be agreed with the client as required. Appropriate dust suppression will be used.

Maintenance and operation

1. Hydraulic operation of the site is expected to be fully automatic with no intervention required.
2. The site will require periodic maintenance mainly to rake accumulated debris off the screen and to remove the debris off site.
3. On an infrequent basis the open channel in the park are will need to have excessive accumulations of silt excavated and removed off site.
4. All side slopes will be 1:3 or slacker to allow safe maintenance by machinery.
5. Paths with slopes of about 1:20 have been provided to allow access for the public. Steps have been provided to avoid walking on potentially slippery slopes during maintenance.
6. During filling of the storage area members of the public should leave the basin area.

6.5.4 Environment and natural heritage issues

An ecological walkover survey was carried out for all zones in phase 4. No significant issues were identified in this zone; however any potential issue with invasive non-native species will need to be monitored. A significant number of existing trees will be impacted by the permanent works as those trees will be in the vicinity of reservoir structures. An assessment of the impacts was carried out and areas of compensatory planting were identified. Provision of enhanced amenity was also considered. These issues are discussed further below.

6.5.4.1 Assessment of tree stock.

Where embankments form part of an impoundment which is, or may be, regulated under the Reservoirs (Scotland) Act 2011, then the owners of those reservoirs have a legal obligation to ensure the dam is safe. The Owners Guide to Reservoir Safety is published by the Environment Agency and provides guidance to owners on reservoir safety. Tree actions on embankments include heave, creation of flow paths and physical damage in the event of wind blow. These actions pose an unacceptable risk to the safety of the embankment and consequently a risk to the safety of residents living downstream of it.

The design approach is that if a tree crown spread encroaches within 3m of the embankment toe line then it should be removed. Roots should not penetrate the embankment foundations.

The trees to be removed and those to be retained are shown on drawing SC-JBA-03-07-DR-C-0100. The number of trees to be removed totals about 39. Areas of potential compensatory planting are shown on the same drawing. The size, number and species of tree is to be agreed with THC tree officer.

Although mature trees will be removed, a large number of replacement tree will be planted and in conjunction with landscape planting and the wetland area the overall impact of the amenity is expected to be positive. The size, number and species of replacement trees shall be agreed with THC tree officer prior to construction.

6.5.5 Landscape and amenity

There are currently four pitches in Culloden Park. The pitch on the lowest level where the storage area will be located is often unusable and will be permanently removed. Local residents expressed a desire to retain both the existing pitches on the middle tier but with improved drainage and also the existing playground, car park and buildings. There are no works planned in the area of the pitch on the upper tier.

The storage area design includes a maintenance track and a series of paths that will allow both circular routes around the park and along the channel edge. These will allow users to view and interact with the channel, enhancing the visual, amenity and ecological qualities of the site, which is largely mown grass at present.

The following efforts have been made to address those concerns;

1. The existing football pitches on the middle tier will be replaced by two new pitches constructed to Sports Scotland specification.
2. The alignment of the flood storage area has been changed to accommodate the playground, car park and buildings.
3. The access road will have one entrance off the public road which will be gated. Pedestrian access (including wheelchairs) will be alongside the gate and also via the footbridge off Keppoch Road.
4. All new structures (will be constructed in accordance with Eurocode structural codes to meet the Approval in Principle requirements of The Highland Council. Concrete structures will generally have an F5 finish to DMRB standards.
5. The pathways are to be constructed to DMRB, Highland Council and Lowland Path Construction Guidance standards. Secondary routes within the basin will have a rolled bound gravel finish with timber edging.
6. Proposed landscape and tree planting is shown on drawing SC-JBA-03-07-DR-C-0100. New tree planting will incorporate both native species that have ecological value and ornamental specimens that provide year-round interest. Native planting within the basin, including pre-planted coir rolls along the channel edge, will provide further ecological and visual interest. Appropriate areas will be seeded with species-mix grassland that increases biodiversity and reflects natural assemblages in the local area.
7. The structures will have a concrete finish to DMRB F5 apart from the flood wall (CP-01 and CP-07) which will have cream harling finish on the Keppoch Road face.

6.5.6 Heritage

1. The Culloden battle ground covers part of the site. Contact was made with the THC Historical Environment Team (HET). The HET have been consulted and their guidance was implemented for the ground investigation works carried out recently. Further guidance from the HET for the construction phase has been sought and this guidance will be implemented during the construction works.

7 Summary and Conclusion

The Smithton and Culloden Flood Protection Scheme is being promoted by The Highland Council under the powers delegated to them through the Flood Risk Management (Scotland) Act 2009.

The proposed Flood Protection Scheme will provide a 0.5% (200 year flood) event standard of protection against flooding. Where possible structural elements of the scheme have been designed to a higher standard and include for possible effects of climate change up to an additional 29% in line with predictions from UKCP09.

The scheme has been developed through sustained and ongoing consultation with stakeholders and the public since 2012. The concerns and opportunities provided by the consultation process have been considered and where possible incorporated into the flood protection scheme to provide a high standard of protection whilst providing environmental improvements and wider amenity benefits to the local community.

It is the opinion of The Highland Council that the proposed flood protection scheme provides the best technical and economical solution to flood risk management in Smithton and Culloden.

The community are encouraged to engage with this consultation and are key to the mitigation of objections to the scheme during the Statutory Approval Process. If any valid objections to the scheme arise during the statutory consultation period The Highland Council will try and resolve these and work with persons to remove objections. If the Council are not able to conclude the satisfactory withdrawal of any valid objections received then the scheme will need to be referred to the Scottish Ministers who will consider the scheme further and may be required to hold a public local enquiry.

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