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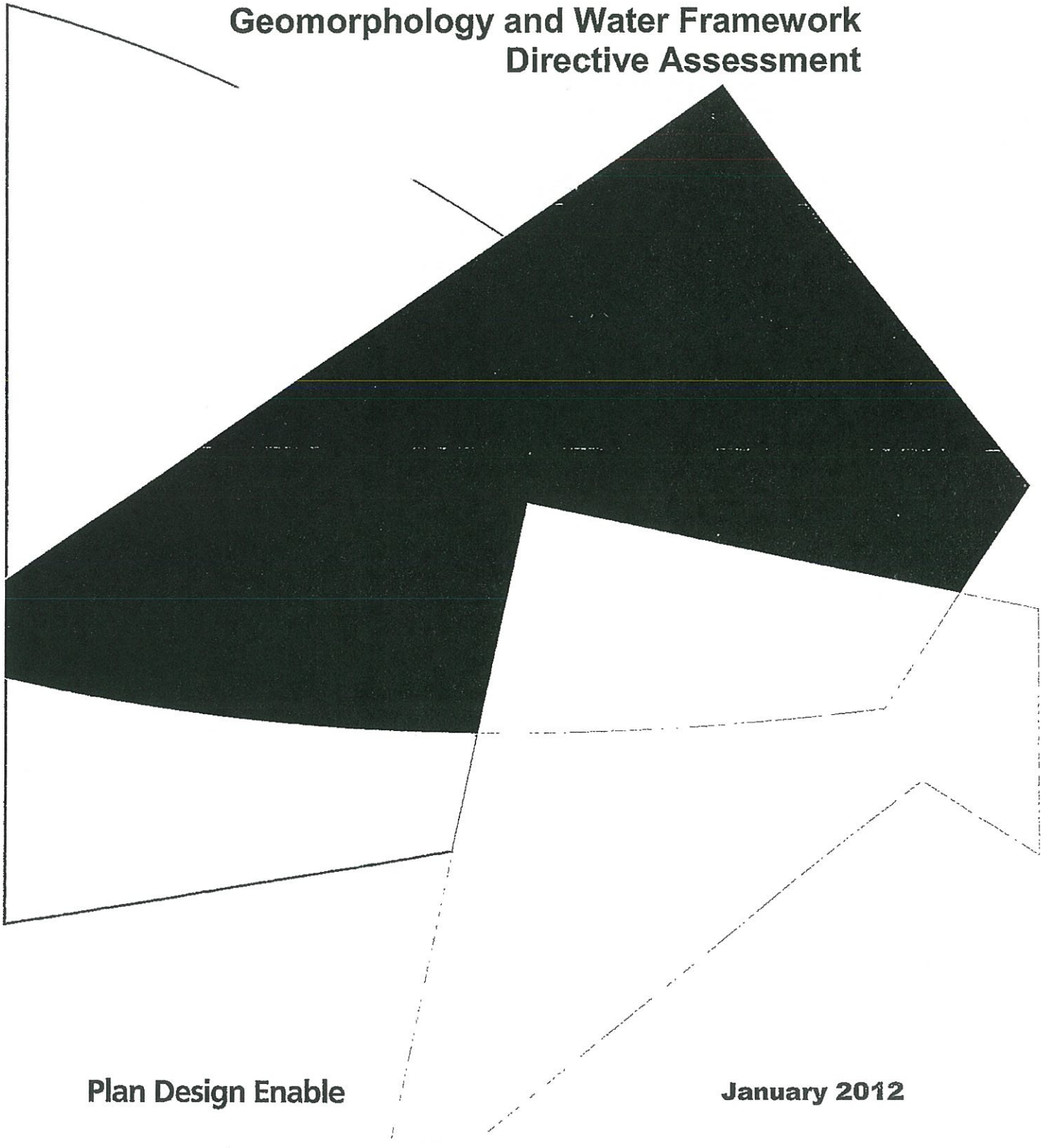
Huntly Flood Alleviation Scheme, Huntly, Aberdeenshire

Geomorphology and Water Framework Directive Assessment



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January 2012

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Planning Application for Huntly Flood Alleviation Scheme, Huntly, Aberdeenshire

Geomorphology and Water Framework Directive Assessment

On behalf of

Aberdeenshire Council

January 2012

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Abbreviations

WFD	Water Framework Directive
FAS	Flood Alleviation Scheme
HMWB	Heavily Modified Water Body
RBMP	River Basin Management Plan
GES	Good Ecological Status
GEP	Good Ecological Potential

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Glossary

Water Framework Directive	European Union legislation – Water Framework Directive (2000/60/EC) – establishing a framework for European Community action in the field of water policy.
River Basin Management Plans	For each River Basin District, the Water Framework Directive requires a River Basin Management Plan to be published. These are plans that set out the environmental objectives for all the water bodies within the River Basin District and how they will be achieved. The plans will be based upon a detailed analysis of the pressures on the water bodies and an assessment of their impacts. The plans must be reviewed and updated every six years.
Good Ecological Status	The objective for a surface water body to have biological, structural and chemical characteristics similar to those expected under nearly undisturbed conditions.
Good Ecological Potential	Those surface waters which are identified as Heavily Modified Water Bodies and Artificial Water Bodies must achieve 'good ecological potential' (good potential is a recognition that changes to morphology may make good ecological status very difficult to meet). In the first cycle of river basin planning good potential may be defined in relation to the mitigation measures required to achieve it.
Heavily Modified Water Body	A surface water body that does not achieve good ecological status because of substantial changes to its physical character resulting from physical alterations caused by human use, and which has been designated, in accordance with criteria specified in the Water Framework Directive, as 'heavily modified'.

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Summary of Findings

- Overall, the development proposals offer a geomorphologically sustainable option for flood risk management at Huntly. The set-back option is good for the river system because it allows the floodplain to be better linked to the river channel.
- The development proposals include limited in-channel and in-bank works only. There is no change to the flow regime. The potential for increased sediment inputs is therefore limited. Green bank protection is included in the development proposals at Arnhall Cottages and good practice guidance will be adopted as part of the CAR licence requirements to ensure that any sediment-related risks are managed during construction and operation. The residual risk of increased sediment inputs is likely to be negligible.
- The development proposals will not affect fish passage. No new structures that could affect fish passage are included in the development proposals. Best practice design guidance will be used.
- The development proposals may require restricted access for fishermen during construction in order to comply with Health and Safety requirements. Full access will be reinstated during operation.
- The Water Framework Directive (WFD) is European legislation that requires all water bodies to meet good status. Good status relates to the quality of the river's form and flow, ecology and water quality. The proposed development will not affect the ability of the water body that includes the Site to comply with the objectives of the Water Framework Directive.
- The River Deveron within the Site is an active, dynamic channel. The channel bed and banks are likely to change in the future as a result of natural processes that are not linked to the development proposals. This change is unlikely to affect the development proposals because they are set-back from the river channel but a watching brief is recommended so that the Site can be managed proactively if required.

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1. Introduction

Development Proposals

1.1 This Geomorphology and WFD Assessment is submitted to accompany the application for Full Planning Permission for the proposed engineering works for Huntly Flood Alleviation Scheme (FAS). The proposal is approximately 9.9ha, and as such is deemed a 'major' development under the Town and Country Planning (Hierarchy of Developments) (Scotland) Regulations 2009.

1.2 The proposed FAS will be developed under the processes of the Water Environment (Controlled Activities) Regulations 2005 and Flood Risk Management (Scotland) Act 2009.

1.3 The proposed operations are along sections of the River Deveron, Ittingstone Burn and Meadow Burn, on lands to the north of Huntly. Aberdeenshire Council considers that the operations will substantially reduce flood risk to residential and commercial properties within the within the area known as the Meadows.

Site Context

1.4 The proposed site which the application relates to ('the Site') is located on lands north and west of Huntly, Aberdeenshire. Refer to Figure 1 below. The town of Huntly is situated approximately 65 kilometres north-west of Aberdeen on the main A96 Aberdeen to Inverness Trunk Road.

1.5 The origins of the town date back to a settlement serving Huntly Castle. The Castle is located to the north of the town centre on the banks of the River Deveron. The River Deveron flows west-east, forming the northern boundary of the town.

1.6 The majority of the town is located on high ground to the south of the Castle. However between the town centre and the River Deveron there is a flat low-lying area called "The Meadows". In the more recent past this area has been developed for housing and leisure purposes, (Meadows Housing estate, a care home, a caravan park and the Nordic Ski centre). There are also two special needs housing units located within the estate.

1.7 A number of main rivers and burns are confluent in the vicinity of the town. As well as the River Deveron these include the River Bogie, the Ittingstone Burn and the Meadow Burn.

1.8 The Ittingstone Burn joins the River Deveron in the Milton area to the west of the town. The River Bogie has its confluence with the River Deveron about 1km downstream of Huntly Castle and the Meadows Burn flows through 'the Meadows' to a confluence with the River Bogie to the north east of the town.

1.9 The Meadows has experienced several significant flood events within living memory, and damage has been caused to many residential and commercial properties. The area was flooded in September 1995, April 2000, October and November 2002, and most recently September and November 2009.

1.10 The A96(T) and the A920 are also affected by flooding causing significant disruption to transportation links in the area.

1.11 Following the 1995 event, a raised flood defence was built to the north and west of the Meadows Estate. This affords protection against direct inundation from the Deveron. However the flooding mechanisms in the area are complex, with overland flow from the Deveron, the Meadow Burn and from the Ittingstone Burn still posing a significant risk to the Meadows Estate.

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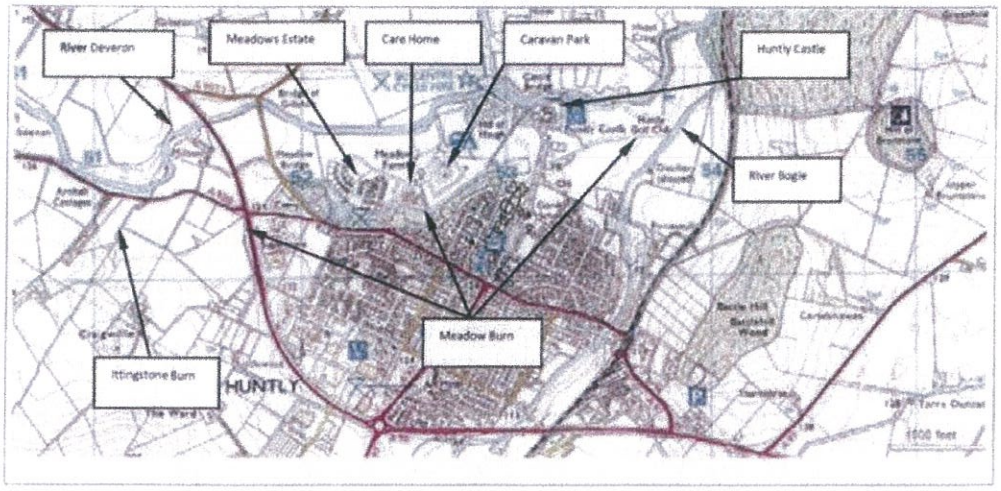
Figure 1 – Location Plan



Need for the Development Proposals

1.12 Despite the construction of raised defences to the north and west of the Meadow Estate, the area is still at risk from overland flow paths which develop from the west. See Figure 2 below.

1.13 Flood waters from the River Deveron overtop the banks in the area of Milton Farm. Overland flow paths develop over the A920 and enter the catchment of the Meadow Burn.

1.14 Flows in the Meadow Burn are dramatically increased. It has been estimated that during the November 2009 event, the flow in the burn was 24 cumecs. Without a contribution from the River Deveron we would normally expect a 0.5% (1 in 200) annual chance event in the burn to be in the order of 3 cumecs.

1.15 The conveyance available within the channel and existing culverts systems on the Meadow Burn are not even capable of containing the flows generated from within its own catchment.

1.16 Flood waters spill from the Burn inundating properties within the Meadows Estate, the care home, the special needs units and the caravan park.

1.17 Based on detailed modelling studies carried out by our consultants Atkins has concluded that the flood risks to the community are as follows:

- Overtopping of the banks of the River Deveron in the area of Milton Farm commences at a 20% (1 in 5) annual chance event;
- The A920 and the A96(T) are affected by flood events greater than the 20% (1 in 5) annual chance event;
- Property flooding within the Meadows estate commences at the 10% (1 in 10) annual chance event;
- The care home and caravan park start to be effected at the 10% (1 in 10) annual chance event; and
- A total of 50 properties are affected during a 0.5% (1 in 200) annual flood event.

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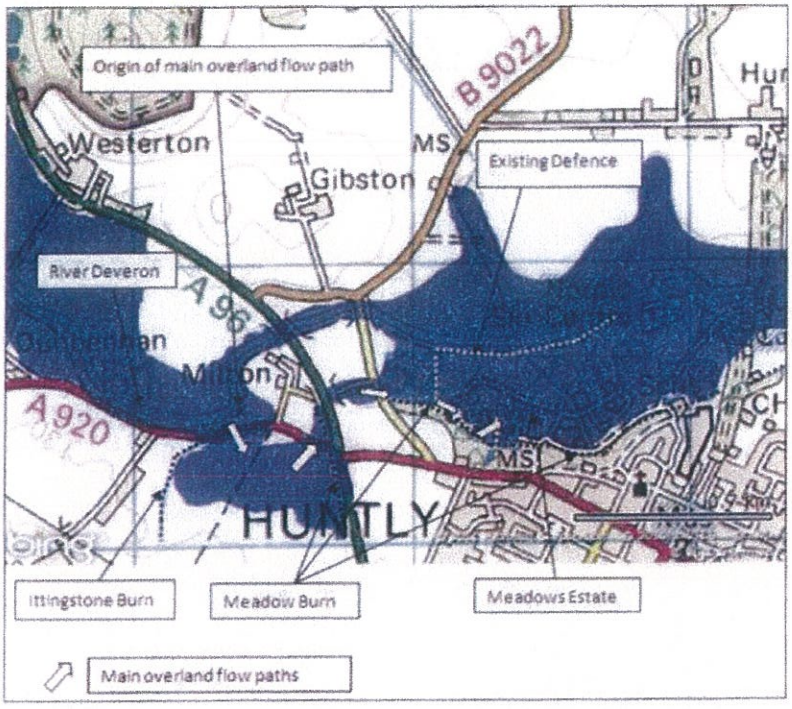
Figure 2 – SEPA Flood Outline



Source: SEPA http://go.mappoint.net/sepa/

Design Process

Options Appraisal

1.18 As part of the optioneering undertaken during the design process and in response to comments received from consultees, various flood defence approaches were considered. Furthermore, different forms of construction of the flood defence were considered and other high-level design options. These options included:

- **Sheet piled walls** – Dismissed: Due to cost, environmental concerns on potential impact of construction noise and vibration, hydrological impact of working within the watercourse, impact on ground water flow and aesthetic appearance and in consideration for the Water Framework Directive (WFD) parameters and objectives for Scottish Water bodies (physico-chemistry, biological elements, specific pollutants, hydromorphology).
- **Concrete walls** – Dismissed: Due to cost, environmental concerns on potential water quality impacts due to possible increased sedimentation; ground water flow impacts, aesthetic appearance, and in consideration of the WFD.
- **Storage** – Dismissed: No areas were available and the volume of storage required was not feasible.
- **Retreat** – Dismissed: Economically unviable nor socially feasible, or practical.
- **Earth embankments** – Progressed: The most cost-effective preference of all of the options with the least environmental impact. The simplest method of construction.

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Detailed Design

1.19 Following on from the preliminary options appraisal, Atkins has progressed the FAS from concept design, by taking into account the environmental, physical, legislative, practical and socio-economic feasibility of various flood alleviation options, to detailed design. We have also taken cognisance of comments received from statutory and non-statutory consultees, and the local community, during the 12 week pre-application consultation period referred to below.

1.20 The scheme being taken forward considers the 0.5% annual exceedance probability (1:200 year) event including an allowance for climate change, which was determined through hydraulic modelling developed at concept design stage together with collated topographic information, hydrological modelling of rainfall and available gauging data from SEPA. This has allowed us to determine flood levels for the area.

1.21 The works comprise: constructing new raised defences; raising and strengthening existing defences; replacing or increasing the size of existing culverts; creation of local storage areas; associated accommodation works; and, ecological and landscape enhancements.

1.22 It is proposed to reinforce the riverbanks on the right hand side of the Deveron at Arnhalll Cottages and to replace the existing Ittingstone Burn flap valve. No further works on the river bank are proposed, nor the construction of any other instream or bankside structures.

1.23 With the exception of the replacement flap valve at the Ittingstone Burn culvert, there will be no work directly within any watercourse and no change to the river regime

1.24 The design does not include any perched / hanging structures, nor are there any Irish Pipe Bridges.

Consideration of Environmental Aspects

1.25 At the western edge of the scheme adjacent to the A920, two sub options were considered regarding the position of the flood defence.

1. place the embankment on the river bank; or,
2. set back the defence at Milton Farm.

Due to WFD compliance the set back option was taken forward.

1.26 The flood defence was not extended past the Hill of Haugh due to constraints associated with the scheduled area of Huntly Castle. Embankments to the north side of Meadow Burn were removed to avoid potential noise and vibration impact and due to potential construction difficulties and possible degradation to the Meadow Burn.

1.27 Atkins has received a Screening Opinion under the Environmental Impact Assessment (Scotland) Regulations 1999 (as amended) that the Huntly FAS is not considered to be an EIA development and, therefore, that an Environmental Statement is not required to be submitted with the planning application.

1.28 In respect of this Screening Opinion outcome Atkins has agreed with the Planning Officer at Aberdeenshire Council (Ms. Aude Chaiban) to prepare a number of tailored environmental assessments as appendices to the Supporting Planning Statement, which will accompany the planning application.

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2. Appraisal Methodology

Introduction

2.1 The role of this section is to provide an assessment of the geomorphological risks and opportunities associated with the development proposals and to confirm compliance with WFD objectives.

2.2 An initial understanding of the geomorphological and WFD baseline for the Site and the associated risks and opportunities of a range of potential options was provided in a Geomorphological Assessment undertaken at the options appraisal stage (by Atkins in February 2011)[1] to inform selection of a preferred option. This preliminary report is provided in Appendix A as a context for this assessment.

2.3 This assessment considers the geomorphological and WFD implications of the option dated 06.10.11. The assessment considers the overall option and other specific elements. In particular, the following are considered:

- Overall potential geomorphological impact;
- Potential impact on sediment dynamics (i.e. erosion and deposition);
- Potential impact on fish passage;
- Potential impact on access;
- Potential impact on WFD compliance; and
- Opportunities for mitigation.

Policies and Guidance

2.4 The Scottish Government has established a comprehensive framework for managing the waters of the Scotland River Basin District. The river basin planning process was established under Water Environment and Water Services (Scotland) Act 2003. The supporting regulatory framework includes the introduction of controls on activities likely to have an adverse impact on the water environment through the Water Environment (Controlled Activities) (Scotland) Regulations 2005. The framework also identifies a range of responsible authorities and sets out their various roles in implementing the plan.

2.5 The key policy driver for this assessment is the WFD. The WFD 2002[2] requires all natural water bodies to achieve both good chemical status and good ecological status (GES). The River Basin Management Plans (RBMP) outline the actions required to enable natural water bodies to achieve GES. Artificial and Heavily Modified Water Bodies (HMWB) may be prevented from reaching GES due to the modifications necessary to maintain their function. They are, however, required to achieve good ecological potential (GEP), through implementation of a series of mitigation measures outlined in the applicable RBMP.

2.6 New activities and schemes that affect the water environment may adversely impact biological, hydromorphological, physico-chemical and/or chemical quality elements (WFD quality elements), leading to deterioration in water body status. They may also render proposed improvement measures ineffective, leading to the water body failing to meet its WFD objectives for GES/GEP. Under the WFD, activities must not cause deterioration in water body status or prevent a water body from meeting GES/GEP by invalidating improvement measures.

[1] River Deveron At Huntly: Geomorphological Assessment, Atkins, February 2011
[2] Water Framework Directive (Directive 2000/60/EC), implemented in England and Wales by the Water Environment (Water Framework Directive) Regulations (SI 3242/2003).

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2.7 The overall ecological status of a water body is *primarily* based on consideration of its biological quality elements and determined by the lowest scoring of these. These biological elements are, however, in turn supported by the physio-chemical and hydromorphological quality elements. Assessment of hydromorphological quality is not explicitly required for a water body to achieve moderate ecological status or lower. However, to achieve the overall WFD aim of GES or higher, hydromorphological quality must be considered within the classification assessment.

2.8 In addition, to achieve the overall WFD aim of GES, a water body must pass a separate chemical status assessment, relating to pass/fail checks on the concentrations of various identified priority/dangerous substances.

2.9 A summary of key WFD concepts is presented in Figure 3.

Approach

2.10 The assessment is qualitative and based on desk study, consultation and best professional judgment. Desk study includes consideration of the findings of the initial qualitative site walkover survey undertaken by Atkins in February 2011[3] and the development proposals dated 06.10.11.

[3] River Deveron At Huntly: Geomorphological Assessment, Atkins, February 2011

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Figure 3 - Background to the Water Framework Directive

WFD Objectives

The WFD is a European Directive which introduces a new strategic planning process for the purposes of managing, protecting and improving the water environment. The main objectives of the WFD are to:

- Prevent deterioration in the status of aquatic ecosystems, protect them and improve the ecological condition of waters;
- Aim to achieve at least 'Good Status' for all waters by 2015 (2021 or 2027) where fully justified within an extended deadline under Article 4.4;
- Promote sustainable use of water;
- Conserve habitats and species that depend directly on water;
- Progressively reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment;
- Progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants; and
- Help reduce the effects of floods and droughts.

SEPA is the lead agency for implementing the WFD and already monitors, advises and manages many aspects of the water environment though regulating discharges, abstractions and processing environmental permits and licenses. SEPA is committed to implementing environmental improvements by reducing the physical impacts of flood risk management activities (within artificial or heavily modified water bodies).

WFD Classification

The WFD classification for a defined water body is produced by assessment of a wide variety of different 'elements' which includes:

- '*biological elements*' such as fish, invertebrates, phytobenthos (which includes plants, macro-algae, phytoplankton);
- '*supporting elements*' that include chemical measurements such as ammonia, dissolved oxygen, pH, phosphate, copper, zinc and temperature; and
- '*supporting conditions*' (sometimes referred to as hydromorphology) that assess the physical attributes of the water body such as 'quantity and dynamics of flow' and 'morphology'.

The assessment given for each element is also accompanied by a measure of certainty in the result. The status classification is published in the RBMP and provides a baseline condition against which compliance and future improvements can be measured.

WFD Compliance

There are four key objectives against which the impacts of proposed works on a water body need to be assessed to determine compliance with the overarching objectives of the WFD:

- Objective 1: The proposed scheme does not cause deterioration in the status of the biological elements of the water body;
- Objective 2: The proposed scheme does not compromise the ability of the water body to meet its WFD status objectives;
- Objective 3: The proposed scheme does not cause a permanent exclusion or compromise achieving the WFD objectives in other bodies of water within the same RBD; and
- Objective 4: The proposed scheme contributes to the delivery of the WFD objectives.

The first three obligations must be met to avoid infraction of the WFD. The delivery of the fourth objective is central to SEPA's implementation of the WFD, where it can be supported through its operational activities. If it is considered that the scheme is likely to cause deterioration in water body status or prevent a water body from meeting its ecological objectives then an assessment would be made against the conditions listed in Article 4.7 of the WFD. Article 4.7 can be invoked if; 'new modifications' are of overriding public interest and/or the environmental and social benefits of achieving the WFD objectives are outweighed by the benefits of the new modifications to human health, safety and sustainable development; there are no significantly better environmental options that are technically feasible or not disproportionately costly; and all practicable steps for mitigation have been taken.

Artificial or Heavily Modified Water Bodies

These water bodies cannot achieve GES due to substantial modification, e.g. for flood risk management. Instead, they are required to reach GEP. The presence or absence of a set list of mitigation measures is used as a proxy for biological indicators. If all mitigation measures have been taken, the water body is assigned a preliminary tag of 'GEP or better'. Good chemical status is a prerequisite for GEP. 'Moderate or worse' is used if some mitigation measures are yet to be implemented. HMWBs may therefore have an element rated 'poor' but not be considered 'poor' in overall status.

Hydromorphology

Hydromorphology is a term used in the WFD to describe the processes operating within, and the physical form of, a water body. The term encompasses both hydrological and geomorphological characteristics that, in combination, help support a healthy ecology. Hydromorphology is a supporting condition unless a water body is classified as being of 'high' ecological status. In these cases, hydromorphological elements contribute towards status classification.

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3. Appraisal

Baseline Conditions

3.1 A broad baseline understanding of the geomorphological characteristics and the WFD status of the Site are presented on a reach-by-reach basis with representative photographs in the initial assessment in Appendix A[4].

3.2 A summary of the key geomorphological characteristics is provided in Table 3.1.

Table 3.1 - Summary geomorphological characteristics of the Site

Characteristic	Description
Topography	Extensive floodplain on left bank; embankments on selected sections of right bank; A96 runs within floodplain on right bank side
Land use	Rural: predominantly rough grazing; urban domestic land use through Huntly; A96 runs close to upper end of study area along right bank
Channel banks	Channel width variable – from ca. 5m to ca. 15m Banks predominantly comprise easily erodible silts with cobble lower horizons. Riparian vegetation is limited to ruderals and occasional trees: bank sides are exposed and bank tops are largely cleared. Bank stability is low overall. Widespread erosion has occurred during the November 2009 event and exposed and unstable banks are prevalent. The potential for future erosion is high.
Channel bed	Dominated by high volumes of coarse sediment plus sands where stream power is relatively low. Evidence of overall flux and mobility due to knickpoint migration and lack of stabilisation by vegetation.
Vegetation	Bankside vegetation is limited to rough grazing. No in-channel vegetation. Limited vegetation regeneration on bar deposits.
Channel modification	Predominantly unmodified by hard engineering. Block stone and gabion baskets along right bank meander bend at Milton Farm. Evidence of active natural channel change via channel erosion and redistribution of bed sediments.
Floodplain	Extensive on the left bank; disconnected on right bank locally by embankment
Flow	High velocity; high stream power; turbulent flow locally; typically 'run' type flow
Environmental designations	There are no environmental designations within 2km of the site.
Sediment dynamics	Active, dynamic channel. High sediment supply. High channel bank erosion and inputs of silts, sands and coarse sediment. High remobilisation and transport of coarse bedload during flood events. Deposition of sands and coarse material in locations of relatively low stream power. High potential for future change.

[4] River Deveron At Huntly: Geomorphological Assessment, Atkins, February 2011

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3.3 The WFD status of the Site is summarised below:

- The study area falls within water body 23182: River Deveron – Black Water to Huntly. The water body is 27.69km long in total and the Site therefore represents a small proportion of this length.
- The water body is not designated as heavily modified. It was classified in 2008 as having an overall status of Moderate with Low confidence; with an overall ecological status of Moderate and an overall chemical status of Pass. The target for the water body is Moderate for the first, second and third River Basin Management Planning cycles, with a target of Good by 2027.
- The key pressures on the water body are morphological alterations associated with roads, such as culverts. These impact on river continuity, fish passage and impose barriers to fish migration. The ecology of the river is classified as High for all biological parameters, with the exception of Moderate for 'Fish Barrier'. The hydromorphology of the water body is classified as Good for both morphology and hydrology.
- These classifications suggest that the ecological and morphological function of the water body is good (i.e. has a high degree of naturalness) overall.

Potential Impacts

Overall geomorphological impact

3.4 Overall, the development proposals offer a geomorphologically sustainable option for flood risk management at Huntly.

3.5 The development proposals include limited works in-channel and in-bank and no change to the river regime. There is therefore limited potential for negative impacts on sediment dynamics and the stability of the river system. Minor, local impacts only are anticipated (e.g. in association with the reinforced channel bank at Arnhall Cottages and blockstone toe protection upstream of the Nordic Ski centre) and the potential exists for these to be mitigated with green engineering techniques (see section 3.9). In addition, the development proposals offer potential benefits to the fluvial system. The set-back embankments will enable improved linkage between the river channel and the floodplain on the right bank as the existing bunds deteriorate over time.

Sediment dynamics

3.6 Overall, the development proposals are unlikely to have a significant adverse impact on sediment dynamics. The residual risk of elevated suspended sediment loads as a direct result of the development proposals following mitigation is likely to be negligible. The corresponding impact on salmonid populations is likely to be negligible. The potential exists for channel change as a result of the natural variability of the fluvial system. This change is not linked to the influence of the development proposals.

3.7 During construction, the potential exists for increased inputs of fine sediment to the river channel due to an increase in exposed surfaces within the Site. In view of the limited in-channel and in-bank works, the risk of such sediment inputs is likely to be low overall. Mitigation of this risk should be achieved by following appropriate Pollution Prevention Guidelines[5] for the timing of works and on-site sediment management. Negligible residual risk is anticipated.

3.8 The preliminary assessment[6] identified that the right bank through the Site from the upstream extent to Milton Farm is currently subject to active erosion due to meander bend development coupled with deterioration and collapse of existing adjacent flood defence bunds where present.

[5] Works and Maintenance in or Near Water PPG 5 http://publications.environment-agency.gov.uk/PDF/PMHO1107BNKH-B-E.pdf
[6] River Deveron At Huntly: Geomorphological Assessment, Atkins, February 2011

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This erosion provides a supply of fine and coarse sediment to downstream reaches. The potential for further bank retreat is high and its rate will be linked to flood magnitude and frequency. It is important to note that the development proposals will not exacerbate this existing erosion and that it is not likely to present a significant risk to the set-back embankments. As such, no mitigation of the erosion is included within the development proposals. The landowner at this location may wish to consider mitigation of this ongoing natural erosion separately to the development proposals; using green bank protection if increased stability of this reach is required[7]. The existing bank upstream of the Nordic Ski Centre is subject to erosion and visible bank protection works exist on the meander. The development proposal to provide toe protection to the setback embankment to reduce the risk of the setback embankments being undermined would have no significant effect on erosion or sediment transport.

3.9 The baseline rapid geomorphological assessment of the Site characterised it as a dynamic sediment system. The potential for ongoing channel bank erosion and meander development has been identified above. In addition, the potential for change to rates and patterns of coarse and fine sediment deposition within the Site exists. In view of the very limited in-channel and in-bank works proposed, this change will be within the natural variability of the system and not as an outcome of the development proposals. It is, however, important to note that change to the fluvial system is linked to the inputs of sediment and water. These inputs are dependent on the magnitude and frequency of flow events and are unpredictable. It is likely that the impact of change as a result of high frequency events will be low. Extreme, low frequency events could have a significant impact on the Site and on the development proposals – this would be true for any option on a dynamic river system. Mitigation of sediment-related concerns arising as part of the ongoing natural change to the fluvial system at the Site can best be achieved by adopting a watching brief and undertaking adaptive management as necessary.

Fish passage

3.10 The development proposals do not include structures that are known to reduce fish passage. There are no perched/hanging structures and no Irish Pipe bridges. Replacement of the flap valve on the Ittingstone Burn culvert is the only instream work proposed. Design of the flap valve should consider the guidance provided in the Scottish Government document 'River Crossings and Migratory Fish'[8]. No residual impact on fish passage is anticipated.

Access

3.11 The current right bank from the upstream extent of the Site to Milton Farm includes bank side access for fishing via an informal path across the embankment top. The path is under threat from erosion of the right bank in the short to medium term i.e. 5-10 years. During construction, access will be considered but may be restricted for Health and Safety reasons. During operation, the development proposals would support ongoing access for fishing across the top of the new embankment at Arnhall Cottages. No residual impact on access is anticipated.

WFD compliance

3.12 Assessment of WFD compliance considers the risk of potential impacts on hydromorphological, biological and physico-chemical quality elements. Assuming appropriate mitigation, the residual impacts on all elements are likely to be negligible. Local impacts are restricted to a change in bank material at Arnhall Cottages and upstream of the Nordic Ski centre – and this will employ green bank protection. This change is highly localised and minor within the context of the water body that is 27.69km in length. Consequently, no risk of deterioration in the status of the water body or in the ability of the water body to meet future status objectives is anticipated in association with the development proposals and hydromorphological impacts. No risk to compliance with WFD is therefore identified and no requirement for a detailed compliance assessment is indicated with respect to hydromorphology quality elements. It is important to note that the final decision on the need for WFD compliance assessment lies with SEPA based on the potential risks of non-compliance associated with biological and physico-chemical quality elements.

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[7] SEPA Good Practice Guide: Bank Protection – WAT-SG-23

[8] River Crossings and Migratory Fish: Design Guidance. Scottish Executive, 2000. http://www.scotland.gov.uk/consultations/transport/rcmf-01.asp

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4. Mitigation Proposals

4.1 The opportunities for mitigation of potential impacts associated with the development proposals and the likely residual impacts are summarised in Table 4.1.

Table 4.1 - Summary of opportunities for mitigation and residual impacts

Potential issue	Proposed mitigation	Likely residual impact
Increased sediment inputs during construction	PPG 5: Works and Maintenance in or near water (combined guidance for England, Wales, Scotland and Northern Ireland) CAR Regulations To ensure pollution prevention controls are in place and that timing of works is optimum	Negligible
Increased bank erosion in association with in-channel and in-bank works e.g. at Arnhall Cottages and the Ittingstone Burn outfall	Reinforcement of channel banks at these sites using green protection is part of the development proposals SEPA Good Practice Guide: Bank Protection WAT-SG-23	Negligible
Ongoing bank erosion in association with existing development of the meander bend and deterioration of the existing bund downstream from Arnhall Cottages to Milton Farm	Not required within the scope of the proposed development due to distance from set-back embankments Reinforcement of channel banks may be required by the landowner separately. Green protection is advised. SEPA Good Practice Guide: Bank Protection WAT-SG-23	No change from present
Fish passage	Development proposal design will not affect fish passage Scottish Executive River Crossings and Migratory Fish: Design Guidance	None
Access for fishing	H&S risk assessment to screen for access during construction Access available during operation	None
Dynamic sediment system	A watching brief is recommended in order to support adaptive management as necessary	Likely to be low for high frequency flood events – but extreme events could have a significant impact

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5. Concluding Statement

5.1 Overall, the development proposals offer a geomorphologically sustainable option for flood risk management at Huntly.

5.2 The development proposals include limited works in-channel and in-bank and no change to the river regime. There is therefore limited potential for negative impacts on sediment dynamics and the stability of the river system. Minor, local impacts only are anticipated (e.g. in association with the reinforced channel bank at Arnhall Cottages and the toe protection upstream of the Nordic Ski Centre). No impact with respect to WFD compliance is anticipated. In addition, the development proposals offer potential benefits to the fluvial system. The set-back embankments will enable improved linkage between the river channel and the floodplain on the right bank as the existing bunds deteriorate over time.

5.3 The opportunity for mitigation exists in association with the potential issues identified. Adoption of best practice guidelines for sediment management and design; and inclusion of green bank protection within the development proposals will ensure that the residual risks on geomorphology, fish passage, the WFD and access are negligible.

5.4 A watching brief is recommended to support adaptive management if required in association with channel changes due to the natural variability of the dynamic fluvial system at this location.

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Appendix A – River Deveron at Huntly: Geomorphological Assessment

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River Deveron at Huntly Geomorphological Assessment

Date
07.03.11

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1. Introduction

Background

1.1 Aberdeenshire Council has commissioned Atkins to develop flood risk management options for the River Deveron and Meadow Burn in Huntly. Part of the scheme will involve constructing raised defences on the River Deveron adjacent to Milltown Farm. Two options are being considered.

1. Option 1: Construct bankside defences
2. Option 2: Construct set-back defences

1.2 These options are indicated on 5097730-RC-GA_01 and 04. Copies of these drawing are appended to this report. Of these, Option 1 is the preferred option of the client, Aberdeenshire Council. One outcome of the consultation with SEPA was to highlight geomorphological concerns with respect to this option and to highlight the need for specialist consideration of potential issues.

1.3 In view of the above, there is a need for an improved understanding of the geomorphological risks and opportunities associated with the proposed flood risk management scheme at Huntly in order to inform the selection of flood risk management options.

1.4 Against this background, a Rapid Geomorphological Assessment (RGA) was undertaken by Dr Jo Shanahan of Atkins on 8th February 2011. The findings of the assessment are presented in this report. They provide a preliminary, qualitative understanding of the geomorphology of the River Deveron in the study area and an assessment of the potential issues associated with the options.

Aims

1.5 The aims of the assessment are to:

- Provide a brief baseline understanding of the fluvial geomorphology within the study area as a context for the assessment; and
- Provide an assessment of the key potential geomorphological risks and opportunities associated with the proposed scheme, with particular reference to Option 1; and
- Provide an assessment of the key Water Framework Directive (WFD) implications of the proposed scheme, with particular reference to Option 1; and
- Provide recommendations and identify the need for further assessment as necessary.

Approach

1.6 Rapid Geomorphological Assessment

Fluvial geomorphology is the study of the processes, forms and dynamics of river channels and their catchments. Geomorphological assessments can provide a cost-effective and sustainable approach to managing the water environment.

1.7 A RGA is a pragmatic, targeted assessment of a specific sediment-related issue in a river catchment. It is used to provide a solution-focused understanding of fluvial geomorphology at the reach scale or to assess the need for a more detailed investigation.

1.8 The River Deveron at Huntly

This report presents the findings of a RGA of a ca.2km reach of the River Deveron at Huntly, Aberdeenshire. The study area is shown in figure 1. The approach comprised the following:

- Consultation with the project team (Alistair Chan, Huw Richards) and SEPA (Alasdair Matheson);

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- Desk study of secondary material, including design drawings, maps, reporting and correspondence;
- A walkover survey of the study area:
  - The survey was undertaken on the 8th February 2011 by Jo Shanahan (Senior Geomorphologist) and Alistair Chan (Project Manager). Channel flow was greater than baseflow due to antecedent rainfall. The weather was overcast and visibility was high.
  - The overall geomorphological characteristics of the study reach were noted. Characteristics recorded included bed and bank structure and stability, sediment characteristics and dynamics, flow type, vegetation, channel modification and adjacent land use. A photographic record was obtained.

1.9 It is important to note that the approach is qualitative only. It does not consider quantitative data relating to flow or suspended sediment. It is based on best professional judgement of the evidence derived from the methodology as outlined above.

Fig. 1. **Location of the study reach**

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2. Geomorphological baseline

Overview

2.1 A broad baseline understanding of the geomorphological characteristics and the Water Framework Directive status of the study area are presented below as context for the assessment.

Geomorphological characteristics

2.2 The study area at Huntly lies within the Middle Deveron, 17 miles downstream from its source in the Ladder Hills of West Aberdeenshire. The River Bogie tributary joins the Deveron at Huntly. The key geomorphological characteristics of the study area are outlined in table 1 and briefly below. Representative photographs of the channel bed and banks are provided in table 2.

2.3 In addition, the meander bend at Milton Farm is considered in more detail in order to support an understanding of the potential issues associated with Option A. The bend has been divided into six reaches as shown on figure 2. Representative photographs and geomorphological characteristics are presented for each reach within this specific area in table 3.

General Overview

2.4 Overall, the river channel in the study area is active, dynamic and meandering. It is characterised by high stream power and high levels of sediment supply, deposition, transport and flux. The channel bed and channel banks are locally unstable and the potential for channel change is high. In particular, slumping, scour and failure of channel banks is widespread.

2.5 These characteristics may be explained in part by the impact of an extreme flood event on 2nd November 2009. Rainfall totals of 50mm in 24 hours were recorded in the Northeast area of Aberdeenshire and Avochie on the River Deveron recorded the highest river levels since 1959.

2.6 The magnitude of the event appears to have triggered accelerated erosion and deposition in an already dynamic fluvial system at Huntly. The potential for bedload transport and channel bank erosion during future flood events is high and ongoing channel change is likely as the system progresses towards a new, post-event equilibrium. The rate and nature of change will be linked to flood magnitude and frequency and, in particular, is likely to include ongoing erosion of channel banks and this could occur in areas where erosion is currently absent.

Channel banks

2.7 Channel banks comprise silts and sands with cobble horizons. Riparian vegetation comprises ruderals with occasional trees. Cantilever failure, slumping and basal scour of channel banks is widespread and outer meander bends are particularly unstable and subject to erosion.

2.8 Block stone and gabion baskets are present locally as bank protection e.g. along the right bank at Milton Farm. There is some deterioration of the protection and overtopping and collapse of specific sections has occurred.

2.9 The potential for ongoing channel bank failure and bank retreat is particularly high where flows are concentrated against bank edges. Key locations include outer meander bends such as the right bank at Milton Farm.

Channel bed

2.10 The channel bed comprises high volumes of sands, gravels and cobbles. Cobbles represent the predominant particle size. Boulders and granite outcrops are present locally, particularly in the downstream sections of the study area.

2.11 Field evidence suggests that the bedload is relatively mobile and available for remobilisation and transport during storm events of sufficient magnitude. There is evidence of active knickpoint

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erosion and stabilisation of deposition by vegetation is limited: some growth was noted on the bar deposit near Milton Farm.

2.12 Bedforms such as point, side and mid-channel bars are present. The deposit near Milton Farm is substantial in size (ca. 100m long by ca. 15m wide). They comprise a range of particle sizes from drapes of sands in areas of relatively low stream power to extensive cobble and boulder bars. All are unconsolidated, largely unvegetated and available for remobilisation during storm events of sufficient magnitude. The sediment dynamics of the channel bed are therefore likely to be characterised by a high degree of flux.

Table 1. Summary geomorphological characteristics in the study area

Characteristic	Description
Topography	Extensive floodplain on left bank; embankments on selected sections of right bank; A920 runs within floodplain on right bank side
Land use	Rural: predominantly rough grazing; urban domestic land use through Huntly; A920 runs close to upper end of study area along right bank
Channel banks	Channel width variable – from ca. 5m to ca. 15m Banks predominantly comprise easily erodible silts with cobble lower horizons. Riparian vegetation is limited to ruderals and occasional trees: bank sides are exposed and bank tops are largely cleared. Bank stability is low overall. Widespread erosion has occurred during the November 2009 event and exposed and unstable banks are prevalent. The potential for future erosion is high.
Channel bed	Dominated by high volumes of coarse sediment plus sands where stream power is relatively low. Evidence of overall flux and mobility due to knickpoint migration and lack of stabilisation by vegetation.
Vegetation	Bankside vegetation is limited to rough grazing. No in-channel vegetation. Limited vegetation regeneration on bar deposits.
Channel modification	Predominantly unmodified by hard engineering. Block stone and gabion baskets along right bank meander bend at Milton Farm. Evidence of active natural channel change via channel erosion and redistribution of bed sediments.
Floodplain	Extensive on the left bank; disconnected on right bank locally by embankment
Flow	High velocity; high stream power; turbulent flow locally; typically 'run' type flow
Environmental designations	There are no environmental designations within 2km of the site.
Sediment dynamics	Active, dynamic channel. High sediment supply. High channel bank erosion and inputs of silts, sands and coarse sediment. High remobilisation and transport of coarse bedload during flood events. Deposition of sands and coarse material in locations of relatively low stream power. High potential for future change.

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Table 2. Representative photographs

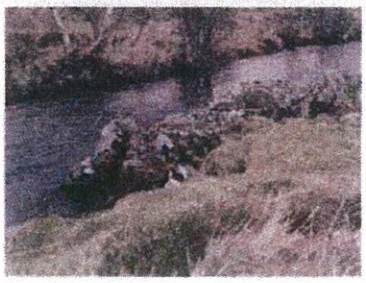
Channel banks	
 Erosion of outer meander bend at Milton Farm	 Cantilever failure and basal scour
 Channel bank failure	 Undercutting on inner meander bend
Channel bed	
 Coarse bar deposit with limited vegetation	 Knickpoint erosion of coarse bedload
 Granite outcrops	 Sandy deposition where stream power is low

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Fig. 2. **Meander bend at Milton Farm**

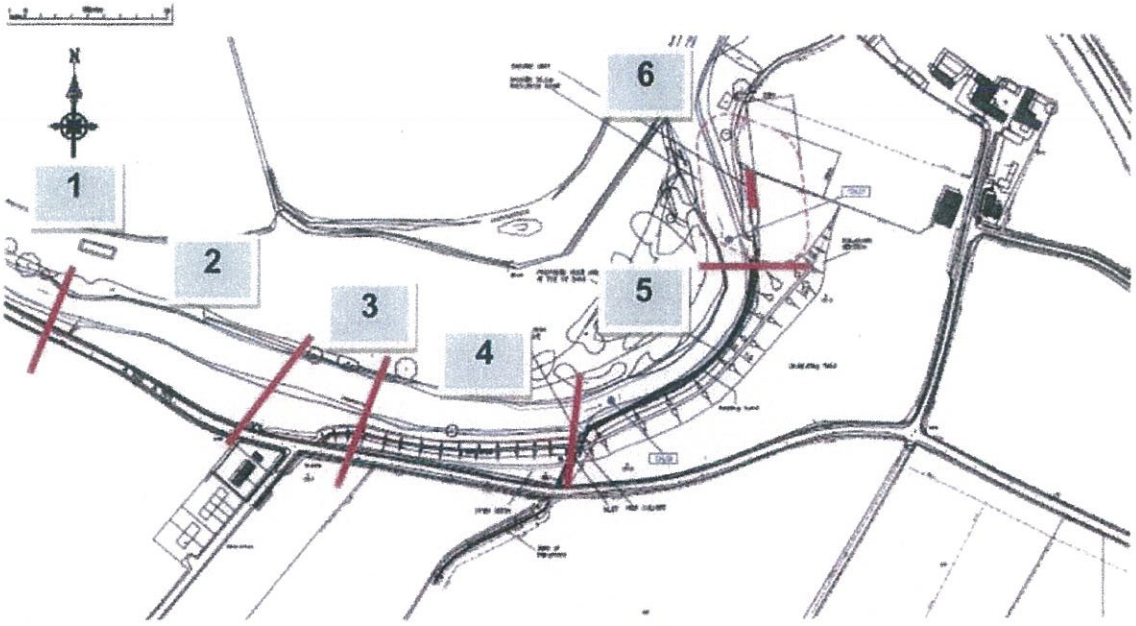

Table 3. Representative photographs: reach characteristics

Reach 1: upstream meander bed, vegetated left bank	**Upstream view of Reach 1**
Channel narrower than downstream Left bank protected by trees Some instability and slumping on right bank where riparian vegetation is cleared Floodplain along both banks – rough grassland; A920 adjacent to right bank	
Reach 2: upstream meander bend, cleared banks	**Upstream view of Reach 2**
Channel width and gradient increase relative to reach 1 Trees absent along both banks – ruderal vegetation only Active erosion along right bank; evidence of bank collapse and meander bend development Flow directed towards the right bank Potential for ongoing erosion to encroach on fishermans' access track	

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Reach 3: upstream end of embankment – set back section	View of set-back embankment at Reach 3
Set back embankment along right bank adjacent to A920 Active erosion along right bank evidence of bank collapse and meander bend development Flow directed towards the right bank Potential for ongoing erosion to encroach on fisherman's access track and embankment	
Reach 4: mid-channel bar upstream Burn of Ittingstone	**Downstream view of Reach 4: coarse sediment bar, channel bank scour**
Embankment alongside right bank Extensive coarse bar deposit ca. 100m long by 15m wide; limited stabilisation by vegetation; sandy deposition where stream power is low Channel narrowed on left bank side of bar with flow deflected towards the left bank Increased gradient and velocity of flow; flow turbulent Knickpoint erosion of coarse bedload Right bank exposed, scoured and unstable; potential for further scour during high flow events Potential for erosion of fisherman's access track and embankment subsequently; tree and boulders anchor bank locally	
Reach 5: embanked meander bend through Milton Farm downstream Burn of Ittingstone	**Downstream view of Reach 5: failing embankment along right bank outer meander bend**
Turbulent flow at upstream end of reach Scour and bank failure along left bank Embankment along right bank comprising block stone bank protection overlain by gabion baskets; collapsing locally and likely to degenerate further and reduce flood protection to A96 and Milton Farm. Flow and scour concentrated at toe of right bank; increased channel depth Potential for continued collapse of embankment and for flood risk to adjacent field and loss of fisherman's access path	

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Reach 6: downstream embanked reach	Downstream view of Reach 6: coarse sediment side bar on inner meander bend
Channel narrower Gravel/cobble side bar on right bank; meander development of left bank Local channel bank erosion via slumping and collapse Channel appears to be regaining stability and equilibrium through local adjustment following the 2009 flood	

Water Framework Directive status

2.13 The study area falls within water body 23182: River Deveron – Black Water to Huntly. The water body is 27.69km long in total and the study area therefore represents a small proportion of this.

2.14 The water body is not designated as heavily modified. It was classified in 2008 as having an overall status of Moderate with Low confidence; with an overall ecological status of Moderate and an overall chemical status of Pass. The target for the water body is Moderate for the first, second and third River Basin Management Planning cycles, with a target of Good by 2027.

2.15 The key pressures on the water body are morphological alterations associated with roads, such as culverts. These impact on river continuity, fish passage and impose barriers to fish migration. The ecology of the river is classified as High for all biological parameters, with the exception of Moderate for 'Fish Barrier'. The hydromorphology of the water body is classified as Good for both morphology and hydrology.

2.16 These classifications suggest that the ecological and morphological function of the water body is good (i.e. has a high degree of naturalness) and that impacts on geomorphology and sediment dynamics are likely to be limited overall and linked primarily to morphological alterations in association with the barriers to fish migration.

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3. Assessment

Overview

3.1 Against a background understanding of the key geomorphological characteristics of the project study area, the role of this section is to provide an assessment of the potential geomorphological and WFD-related issues in the study area with respect to the proposed options for flood risk management. Particular consideration is given to Option 1.

Overall geomorphological issues

3.2 The broad geomorphological issues associated with the study area are summarised below.

- The sediment dynamics of the study area are unpredictable. The study area is part of a dynamic river system with high inputs of flow and sediment. Moreover, it is undergoing a period of adjustment following the November 2009 event. Future changes in the channel bed and banks will be related to the magnitude and frequency of storm events
- There is a lack of data relating to the rate of future channel change. The rates and patterns of future erosion of the channel banks and mobilisation of bed and bar material are not known. No data are currently available e.g. to quantify rates of bank retreat alongside the fishermans' access track;
- Future sediment supply is 'unlimited'. Sediment deposition on the floodplain and in the channel as bedload and bars is extensive both in the study area and within upstream reaches of the River Deveron. The potential for future channel bank erosion is high. The potential for sediment inputs from upstream reaches is high. As a result, the sediment dynamics of the study area are likely to be characterised by ongoing changes in patterns and rates of erosion and deposition;
- Future bank erosion is likely - particularly along the right bank in Reaches 1-6 as detailed at Milton Farm Bank where surfaces are exposed and unstable. The main focus of the flow lies against the right bank. The potential for further bank retreat and deterioration of existing protection, where present, is high. This potential is exacerbated by the easily erodible bank material and lack of bank side vegetation. The rate of bank retreat will be linked to flow magnitude and frequency. The adjacent fisherman's access track and embankment are threatened in the short to medium term i.e. 5-10 years.
- Overall. The above issues suggest that there is significant potential for risk associated with the viability and longevity of capital works in or alongside the River Deveron in the study area. The site is an active, dynamic channel and, moreover, is in a state of flux following the November 2009 event. The potential for significant future changes to the channel bed and banks exist. Moreover, the rates and patterns of such change are unpredictable and will be related primarily to future flood magnitude and frequency.

Option 1: specific geomorphological risks and opportunities

The proposal

3.3 The current, preferred, proposal for Option 1 is to:

- Dig out the channel bed and insert rock armour keystones;
- Cut and resection the bank to a 1:3 slope and secure with permanent turf reinforcement over the exposed surface; and
- Import material to construct an adjacent flood defence bund.

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3.4 It is anticipated that the vegetation will take up to a year to regenerate on the surface of the turf reinforcement. It is the aim of the option to ensure erosion protection for a specific range of design flows.

Potential risks

3.5 The following key potential geomorphological risks are identified:

- Increased instability of the channel bed: as a result of disturbance and redistribution of coarse bed sediments during construction and in association with scour due to accelerated flows along the keystone base;
- Ongoing impact on hydromorphological quality in situ: the option will sustain the current impact i.e. impeding natural meander development, channel bank processes and lateral connectivity. This impact will be ongoing and is distinct from the current modification in that a 'do nothing' option would result in deterioration of the existing protection and an increase in natural meander development processes and increased floodplain connectivity over time; and
- Increased instability and the potential for accelerated erosion upstream and downstream as a result of the engineered bank surface: The outcomes of this risk may include preferential erosion of channel banks and associated loss of land. The most likely site for the erosive energy to be dissipated is via erosion of the outer meander bend upstream in Reaches 2-4 (right bank) and downstream in Reach 6 (left bank). The rate of scour would be linked to flood magnitude and frequency.

3.6 It is important to note the following:

- Whilst this option has the potential for local, reach-scale geomorphological impacts in reaches adjacent to Option 1 in Reach 5, the potential also exists for these impacts to be mitigated by ongoing monitoring to inform maintenance alongside management of impacts as necessary. Management options would include protection of banks in adjacent reaches using soft engineering techniques and these are considered below;
- It is assumed that the selection of materials for Option 1 presents some opportunity for environmental advantage over more traditional hard engineering techniques such as sheet piling and concrete lining. The specific design of the option together with provision for bio-engineering as required in adjacent reaches contributes to mitigation of the potential impacts in situ in Reach 5; and
- It is assumed that the design of Option 1in Reach 5 will negate the opportunity for erosion on the right bank within Reach 5 and that erosion will not be a risk here under the design range of flows. It is assumed that the option will be correctly installed in order to ensure its design efficacy and that its specification will reflect the necessary flow velocities required for erosion resistance in this location.

Potential geomorphological opportunities

3.7 Two key potential geomorphological opportunities are identified:

- Set-back embankment; and
- Soft engineering for bank protection.

Set-back embankment – Option 2

3.8 It is clear that flood protection for the A920 and Huntly is required and that protection from out of bank flow at Milton Farm is an important component of the flood risk management package. It is also likely that Option 1 as it stands has the potential to promote geomorphological instability in adjacent reaches and curtail meander development and lateral connectivity in situ. Additional management using bio-engineering in adjacent reaches and watching brief would be required to provide mitigation.

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3.9 Against this background, a raised, set-back embankment at Milton Farm would appear to offer a more geomorphologically sustainable opportunity for flood risk management. Whilst it is recognised that protection for the field itself would not be provided, it is also recognised that the field is within the natural floodplain of the River Deveron and, as such, the option has the following geomorphological benefits:

- No in-channel works: no impact on the current sediment dynamics of the reach or adjacent reaches – therefore no introduction of additional instability and the potential for increased erosion;
- The existing protection would deteriorate over time, however, the bank is currently stable relative to the adjacent reaches that have no protection and there is the potential for natural regeneration of vegetation to keep step with further deterioration. The existing protection would therefore offer longevity to the set-back embankment; and
- Increased connectivity between the river channel and the floodplain and therefore an improvement in the hydromorphological functioning of the system. Increased storage of water on the floodplain and a wetter floodplain overall may have ecological benefits; and
- Natural meander development would be reinstated in reach 5 as the existing protection deteriorates over time. It should be noted that this would lead to an increase in the rate of erosion of the right bank compared to that of the existing protected bank. Natural regeneration of vegetation and bioengineering could be employed as mitigation.

Selected pros and cons of both the bank-top and set-back options are summarised in table 4.

Soft engineering for bank protection (Reaches 3 and 4)

3.10 It is clear that flood protection for Huntly the A96 and the A920 is required and that the proposed renovated embankment upstream from the Burn of Ittingstone in Reaches 3 and 4 is an important component of the flood risk management package. However, the right bank in these reaches is unstable; future erosion is likely and could be rapid.

3.11 Soft engineering for bank protection in these reaches is therefore proposed for the right bank in order to support the longevity of the proposed embankment and the fisherman's access path and to promote stability within the reaches. For example, brushwood mattress protection may be an applicable technique in this location. A thick layer of branch cuttings are installed to cover and physically protect stream banks. The mattresses are effective at trapping fine sediment during flooding and work well on a wide range of steep banks and fast flowing streams. Green toe protection such as un-mortared rocks can be used in conjunction with the mattresses. Further information can be found in SEPA's Engineering Guidance for Bank Protection (WAT-SG-23). If a soft engineering approach is taken forward it is recommended that the advice of an expert in bioengineering is consulted to determine the most appropriate technique and arrangement of measures.

Fig. 3. **Brushwood mattress protection (Source: SEPA)**

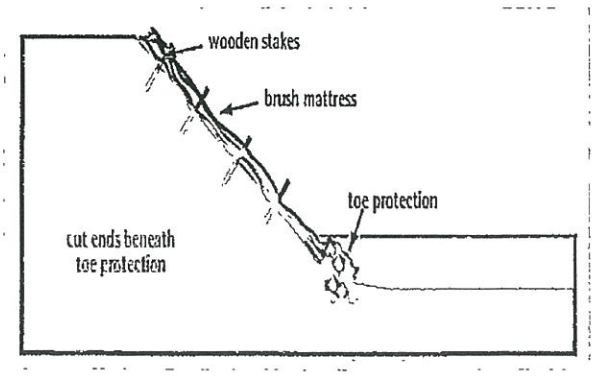

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Table 4. Summary assessment: bank-top vs set-back embankments

Parameter	Rationale	Bank-top embankments	Set-back embankments
Geomorphological impacts - stability	Scheme should seek to minimise geomorphological impacts. Reduced stability has the potential to lead to accelerated erosion and associated deposition within the study area	Potential for reduced channel bed and bank stability; in particular, leading to accelerated bank erosion in adjacent reaches upstream and downstream, Mitigation may be required.	Limited impact – the status quo of the existing channel will be unchanged as no in-channel works are required. Over time, reinstatement of natural meander processes as existing protection deteriorates could increase erosion rates on the right bank and mitigation may be required.
'Terrestrial' impacts	Scheme should seek to minimise 'terrestrial' impacts.	No need to divert overhead line; potential for land take	Divert overhead line, potential for land take, flooding to Milton farm field ongoing; potential for meander development to lead to loss of land; likely landowner resistance
Water Framework Directive	Scheme should support no deterioration in WFD status and not prevent status objectives from being attained	Potential for deterioration in hydromorphological quality elements within the study area. Associated potential for deterioration in ecological quality elements.	No change likely with respect to hydromorphological and ecological quality elements for the water body. The currently modified reach will remain and deteriorate towards natural over time.
Flood risk	Scheme should be designed to minimise the impact on flood levels and risk elsewhere	Will manage flood risk. No potential for additional storage	Will manage flood risk. Potential for additional storage. This is insignificant from a flood risk point of view but may have ecological and hydromorphological value under the WFD.

Parameter	Rationale	Bank top embankments	Set-back embankments
Environmental enhancement	Scheme should seek to support potential for enhancement of the fluvial system.	River channel remains disconnected from floodplain and becomes further modified. Opportunities for enhancement of channel banks in adjacent reaches.	River channel is better connected to floodplain. Opportunities for enhancement of channel banks in adjacent reaches and in association with increased connectivity in reach 5 subject to management agreements.
CAR licence	Required for in-channel engineering activities	Complex licence application likely to be required	No licence application likely to be required for this component of the scheme,
Maintenance burden	Scheme should seek to minimise maintenance burden for cost and environmental reasons	Management of sward on embankment to maximise erosion resistance, Adaptive management recommended for study area.	Limited – the status quo of the existing channel will be unchanged. Management of sward on embankment to maximise erosion resistance, Adaptive management recommended for study area.
Cost	Scheme should seek to minimise cost within	Costs due to in-channel works and	Costs due to 'terrestrial' works – including cost of land purchase

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Parameter	Rationale	Bank top embankments	Set-back embankments
	the context of environmental constraints	maintenance	or compensation agreement, services diversions
Key opportunities		**Supports flood risk management; avoids terrestrial impacts and associated costs; has potential for enhancement of channel banks in adjacent reaches**	**Supports flood risk management; supports geomorphological stability and enhancement, both of channel banks and Milton Farm; supports WFD;no cost of in-channel works**
Key constraints		**Has the potential to promote geomorphological instability; may compromise WFD requirements; high cost of in-channel works**	**Terrestrial impacts and associated costs**

The WFD: potential issues

3.12 The potential issues that relate to the WFD comprise the impacts of Option 1 on the hydromorphological quality elements and, in turn, the impacts on their ability to support the biological quality elements.

3.13 The existing bank-top embankment option includes in-channel hard engineering and therefore has the potential to have a negative local impact on selected hydromorphological quality elements such as:

- Quantity and dynamics of flow;
- Structure and substrate of the river bed; and
- Structure of the riparian zone.

3.14 It is important to note the following:=

- The proposed length of the works is <200m and is small in proportion to the overall length of the water body within which the WFD status and objectives are set. The reach comprises <1% of the length of the water body and relates to only one bank. However, it is clear that in this instance other options exist which would not have the potential to compromise the WFD hydromorphological quality elements; and
- Opportunities for mitigation exist in association with Option 1 that may support enhancement of WFD quality elements. For example, installation of brushwood mattresses to promote bank stability in adjacent reaches may support increased geomorphological stability and have ecological value via improved riparian habitat.

3.15 It is SEPA's role to decide whether this potential local deterioration in river hydrology and morphology could compromise the hydromorphological status of the water body or compromise the ability for the water body to reach its objective of Good by 2027 when placed in the context of its full length.

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4. Conclusions and recommendations

Conclusions

4.1 The following key points are highlighted:

- The river channel in the study area is active, dynamic and meandering. It is currently undergoing adjustment following the impacts of the November 2009 event;
- The potential for future change in the channel bed and banks is high and unpredictable. No quantitative data are available regarding the rates and patterns of change. Change will be related to the magnitude and frequency of flood events;
- Option 1: Bank-top embankments would contribute to the package of flood risk management for Huntly. However, it could present a number of geomorphological issues including increased instability in adjacent reaches. Ongoing monitoring and maintenance would be required to mitigate and support enhancement opportunities;
- The option for a set-back embankment under Option 2 would offer a more sustainable contribution to the package of flood risk management measures for Huntly from a geomorphological perspective. It would avoid introducing instability to the fluvial system and enhance the linkage between the floodplain and the river channel;
- Bank instability is high upstream from Milton Farm, particularly on the right bank. Consideration of soft engineering methods of bank protection in adjacent reaches as a supporting component to the wider proposals has been highlighted as desirable;
- The WFD classification of the water body is currently Moderate, with barriers to fish migration and river continuity being the limiting factor. The hydromorphological quality is classed as Good despite the reach around Milton farm currently demonstrating modification. This modification will be sustained under Option 1. However, when placed in the context of the whole water body, this impact is relatively small and opportunities for mitigation exist. Under Option 2, deterioration of the modification over time will allow an increase in hydromorphological quality locally as the natural meander development process becomes reinstated; and
- Overall, the set-back Option 2 offers the preferred option from a geomorphological and WFD perspective. However, it should be noted that both options are viable from a flood risk management perspective and that the geomorphological issues associated with Option 1 have the potential for mitigation with additional green bank protection in adjacent reaches and a watching brief.

Recommendations

4.2 Against this background, the following recommendations are made:

Recommendation 1: consider the pros and cons of both the bank-top and the set -back option

4.3 The set-back option offers a preferred solution from a geomorphological perspective. It reduces the risk of negative impacts on the stability of the system and the associated costs. It also offers a range of wider WFD-related benefits. The bank-top option could increase the risk to the stability of the fluvial system in adjacent reaches. However this would, in part, be related to flood magnitude and frequency and would be an additional component of the wider instability in this adjusting system. Mitigation and enhancement opportunities are available in association with both options.

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Recommendation 2: consider soft engineering techniques for the exposed right bank in reaches 2-4 and in reach 6 as necessary

4.4 The assessment has highlighted the instability of the right bank in reaches 2-4 and the potential for ongoing erosion to compromise the proposed embankment and the path at this location. Implementation of soft engineering techniques would improve the longevity of the scheme, improve the stability of the reaches and enable natural vegetation regeneration and associated habitat enhancement.

Recommendation 3: set up a pragmatic monitoring programme for the site

4.5 The site is dynamic. It is recommended that as a minimum, pragmatic, simple monitoring at key sites are undertaken in order to inform the need for management and maintenance. This could include taking photographs at fixed points and measuring rates of bank retreat against erosion markers such as stakes fixed into the ground. Measurements could be taken at regular intervals (e.g. monthly) and following high flow events.

Recommendation 4: ongoing geomorphological input

4.6 The assessment has identified clear risks associated with sediment erosion and deposition. It is recommended that detailed design and implementation of a preferred option should include geomorphological input as part of an integrated, multi-disciplinary team in order to minimise the risks and maximise the opportunities identified.

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5. References

http://www.sepa.org.uk/water/river_basin_planning.aspx
The Water Environment (Controlled Activities) (Scotland) Regulations 2005. A Practical Guide.
http://www.sepa.org.uk/water/water_regulation/guidance/engineering.aspx

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