The Moray Flood Alleviation Group

ELGIN FLOOD ALLEVIATION SCHEME

Recommendation Report

Moray Council Environmental Services

February 2004
Final Report
9M8860

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CONTENTS

1 INTRODUCTION

The purpose of this report is to recommend a preferred flood alleviation scheme for Elgin and set out the next steps for taking the scheme forward to Flood Prevention Order and construction.

Section 2.0 of this document describes the need within Elgin for investment in flood alleviation works. Sections 3.0 and 4.0 outline the scheme development and describe the three options that have been investigated in detail. Section 5.0 compares the options and sets out the estimated scheme costs. Section 6.0 sets out the conclusions of this report before describing the next steps to be taken in Section 7.0. Finally the recommendations are described in Section 8.0.

2 STATEMENT OF NEED

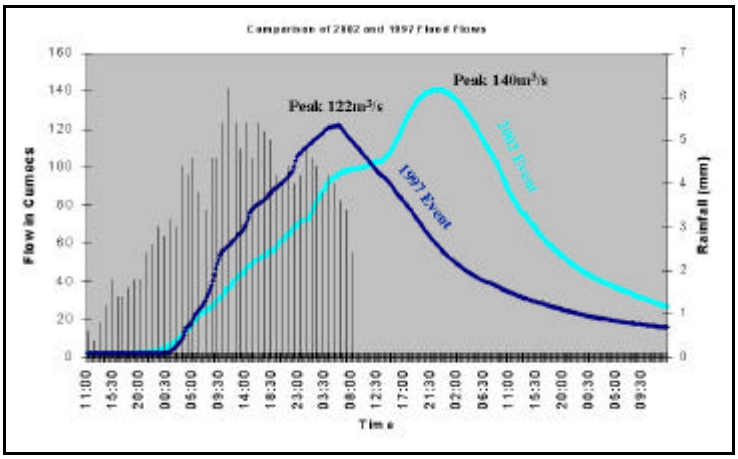
2.1 Introduction

Elgin is one of Scotland's oldest towns and has grown along the banks of the River Lossie for over 900 years. The River Lossie, including the Black Burn and Mosstowie Canal, drains an area of 270km^2 to the sea at Lossiemouth. Flooding in Elgin is not a new problem. The River Lossie has a documented history of flooding dating back 250 years. Twenty flood events have been recorded since 1750, with 11 floods in the last 50 years. Most recently the city has flooded in 1997, 2000 and 2002.

Recognising the need for flood alleviation the Moray Council's Chief Executive, reporting at a meeting of the Moray Council on 21st June 2000, stated that "Flooding is a very complex issue and the Council is committed to making long term improvements to the rivers and watercourses within Moray". The following sub-sections clearly demonstrate the need for this commitment to flood alleviation in Elgin.

2.2 Recent Flood History

Severe flooding occurred in Elgin in July 1997 and November 2002. During both events extreme rainfall fell for over 48 hours on the upper part of the catchment on already saturated ground. Normal flow in the River Lossie is approximately 5m^3/s. During the 1997 and 2002 events the flow reached 122m^3/s and 140m^3/s respectively, as shown by the graph below.

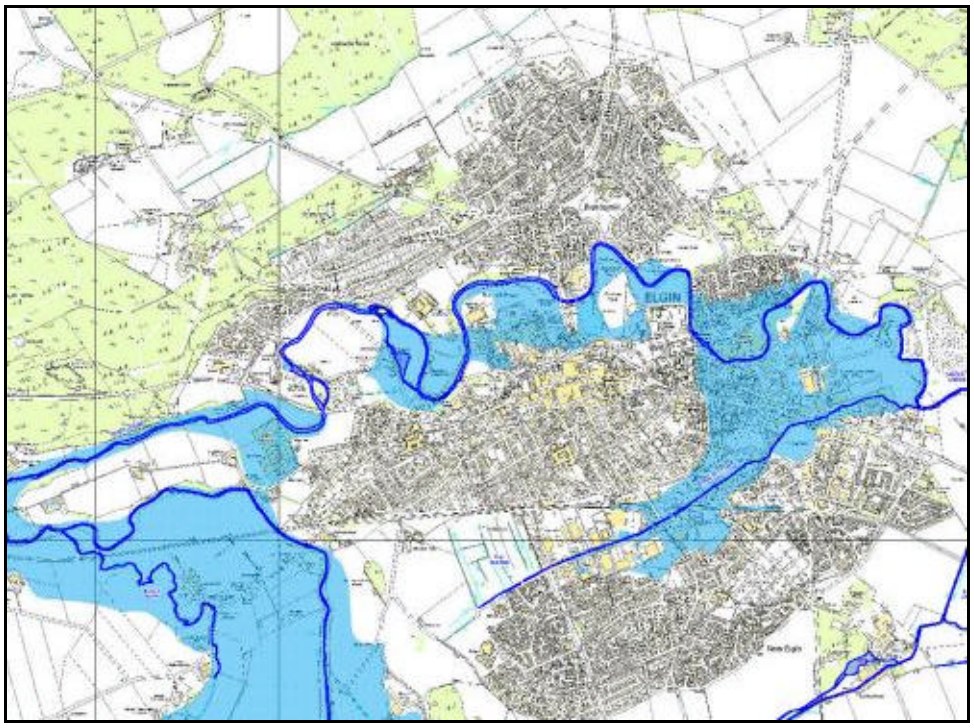


1997 and 2002 hydrographs

The 1997 event is estimated to have a return period of 1 in 40 years. The event inundated approximately 600 residential and 170 commercial properties. The 2002 event is estimated to have a return period of 1 in 60 years. In this instance more than 650 residential and 180 commercial properties were inundated. Typical flood depths during the two events ranged between 0.15m and 1.0m. The photos below show flooding from these two events.

Residential Flooding, 2002

The Tyock Burn, 1997



The 1997 flood extent

During major flood events in Elgin, key transport links that serve the north east of Scotland are severed. During both the 1997 and 2002 flood events the A96 trunk road was closed for more than 48 hours, whilst the Inverness to Aberdeen railway line suffered considerable damage and was closed for several weeks.

Flooding causes great disruption and distress to the community of Elgin. In 2002 over 200 households were evacuated and 10 people had to be airlifted to safety.

2.3 Existing Flood Risk

The River Lossie catchment acts as a natural buffer by attenuating peak flood flows and reducing the extent of flooding in the city. However, the existing standard of flood defences in Elgin is still very low (less than 1 in 5 years). The table below gives the number of residential and commercial properties currently at flood risk in Elgin.

Number of properties at risk from flooding

Return Period (years)	Number of properties at risk of flooding		
	Residential	Commercial	Total
1 in 5	135	10	145
1 in 10	340	45	380
1 in 25	405	135	540
1 in 50	690	185	870
1 in 100	765	235	1000
1 in 200	865	275	1135

The effect of climate change and increasing land use pressures will exacerbate the future flood risk leading to more frequent flooding within Elgin.

2.4 Flood Damages

In economic terms, without investment in flood alleviation the flood damage losses in Elgin will exceed £110million, at current prices, over the next 50 years. This statistical estimate only includes direct damage to residential and commercial property and does not take account of significant further loses from:

- Road and rail disruption;
- Infrastructure damage;
- Loss of services;
- Distress and social impacts.

Furthermore, this estimate does not account for deterioration of the existing defences or increasing flood risk due to climate change.

Statistics aside, the losses due to the floods in 1997 and 2002 are estimated to jointly exceed £100million.

3 SCHEME DEVELOPMENT

The development of a flood alleviation scheme for Elgin has been undertaken through a process of consultation, investigation and appraisal. The Moray Flood Alleviation Group initially investigated the problem by carrying out a literature and historic review of Elgin's flooding problem. Consultation with individuals affected by the flooding provided the Group with valuable local knowledge on flood mechanisms and flood risk areas. Further work included geomorphological studies, preliminary geotechnical investigations, modelling of the flood mechanisms, climate change analysis, production of flood risk maps and investigation of environmental opportunities and constraints associated with flood risk management in Elgin. These investigations and surveys formed the baseline for the option development and the ongoing appraisal process.

Early in the development of the project, the Group held a workshop to generate ideas for solving the flooding problem in Elgin. Council and statutory consultees, including Scottish Environment Protection Agency and Scottish Natural Heritage, attended the workshop. Potential solutions identified through the option development process included floodplain storage, embankments through Elgin, channel widening, diversion of the River Lossie permanently to the east or west of Elgin, temporary flood defences, pumping, afforestation of the River Lossie catchment and construction of multiple flood storage areas upstream of Elgin. The range of options that have been considered include both hard and soft approaches to flood risk management. Scheme criteria believed to be important to ensure the success of the scheme were also identified through discussion with the stakeholders.

Through investigations, further research and surveys, the wide range of options were narrowed down to three strategies: flood diversion to the Spynie Canal, flood defences and widening through Elgin, and flood storage combined with works through Elgin. Subsequently the options have been developed through geotechnical investigations and mapping, hydraulic analysis, use of aerial survey, environmental surveys, and environmental consultation with a diverse range of consultees.

Public and statutory consultation has played an important role in the development of the flood alleviation proposals and will continue to inform and influence the design and construction of the final scheme. The options described and discussed in this report are a development of the proposals exhibited in July and October 2003. The following sections of this document provide a summary of the key issues and opportunities associated with the three options that have been investigated in detail.

4 DESCRIPTION OF THE OPTIONS

4.1 Introduction

This section outlines the three flood alleviation options that have been the subject of consultation and detailed appraisal over the past six months. The options are:

Option 1 – Flood diversion to the Spynie Canal
Option 2 – Flood walls and embankments through Elgin
Option 3 – Flood storage with walls and embankments through Elgin

Based on consultation responses and the investigation findings the following subsections set out the principal issues and opportunities associated with taking each of the schemes forward to Flood Prevention Order and construction.

Each scheme provides Elgin with a standard of flood protection equivalent to at least 1 in 100 years. The description of each scheme accommodates future climate change predictions and other factors of safety. The schemes all provide a direct benefit to the community and businesses in Elgin. Indirectly, Options 1 and 3 also provide a reduction in flood risk immediately downstream of Elgin. Furthermore, Option 3 provides some reduction in flood risk to areas upstream of Elgin.

4.2 Option 1 – Flood Diversion to the Spynie Canal

4.2.1 Overview

This option involves diverting flood flow from the River Lossie to a new washland incorporating the Spynie Canal and then on to the sea at Lossiemouth. The diversion from the River Lossie to the washland comprises three tunnels typically 4.7m in diameter and 2.2km in length.

The development of this option was strongly influenced by the presence of a natural basin within the Spynie Canal catchment. The basin was historically a tidal inlet, which was drained in the 18th century to increase agricultural production. The area is currently prone to localised flooding and is at flood risk from the River Lossie, most recently observed in November 2002. Although the scheme necessitates a change to land-use within the washland area, more than 90 percent of the Spynie catchment would be unaffected or benefit from new drainage arrangements.

Option 1 – Flood Diversion to the Spynie Canal

4.2.2 Summary of the Works

This option consists:

- Inlet works comprising two weirs and an entrance to three tunnels situated at Old Mills. The weirs will create a permanent shallow lake through which the River Lossie will flow. Works will be installed to capture large floating debris and to prevent unauthorised access into the tunnels.
- Three tunnels typically 4.7m in diameter and 2.2km in length.
- Construction of a 4.5km^2 washland in an area of a low-lying agricultural land confined by existing ground levels and three new earth embankments. The main embankment, situated to the east of Covesea Road, is up to 3m above the existing ground level. The remaining embankments are typically 1.5m high. The lowest

areas within the washland will be permanently flooded to create a shallow lake or wetland.
- Construction of a gravity outfall from the new washland. The outfall is located on the River Lossie 1.5km upstream of Seatown.
- Installation of a substantial pumping station on the Spynie Canal.
- Flood defences at Glen Moray Distillery and Sheriffmills.
- Channel improvement works, including widening, bridge works and defences, will be constructed along the length of the Tyock Burn.

4.2.3 Key Issues

The main issues associated with this option are:

Impacts on Loch Spynie and Surrounding Area
Loch Spynie is a site of national and international significance and is afforded protection under a range of legislation, including EC Directive 79/409/EEC and the transposing legislation, Conservation (Natural Habitats &c.) Regulations 1994. Sensitive design will be essential to protect the loch. Negotiation with a wide range of stakeholders and interested parties will be necessary to implement this scheme.

Cultural Heritage
The area within and adjacent to the proposed Spynie washland is rich in archaeological and historical sites. A number of the sites are designated as Listed Buildings under the provisions of the Planning (Listed Buildings and Conservation Areas) Act 1997; and Scheduled Ancient Monuments under the provisions of the Ancient Monuments and Archaeological Areas Act 1979.

Some of the designated sites will be directly affected by the development including the listed Market Cross of Spynie and Salterhill, both of which are located within the proposed washland area. Other scheduled monuments, such as Spynie Palace, Duffus Castle and the earthworks west of Caysbriggs will be indirectly affected by landscape changes in the vicinity of the sites. It is likely that listed building and scheduled ancient monument consents will be necessary to construct and operate this scheme.

Legislative Constraints
The Spynie Canal Land Drainage Order, issued under the provisions of the Land Drainage Act 1958 governs the maintenance and operation of the Spynie Canal. This option requires amendment to the land drainage order, which presents an uncertain legislative constraint to this scheme.

Loch Spynie is currently governed by the requirements of the Reservoirs Act 1975. The proposed washland would also be subject to the legislative requirements of the Reservoirs Act.

Impact on RAF Lossiemouth
A key element of the scheme is the proposed washland, which encompasses a permanent body of water covering an area of approximately 1km^2. The area of permanent inundation may encourage an increase in the local bird population, which could have a detrimental impact on operations at the RAF base. This will require further investigation.

Tunnel Construction
The tunnelling operations present a risk to this scheme. This risk will need to be managed by detailed geotechnical investigation to confirm design and construction requirements, and scheme costs.

Visual Impact
Although a significant part of this scheme does not have a visual impact, being located underground, there are still impacts associated with the inlet works, the embankments surrounding the washland and the requirement to raise the A941. This impact will need to be sensitively addressed and considered during the design phase of the works.

Benefits to Local Communities
In addition to providing flood alleviation to people and businesses in Elgin, this option also reduces the flood risk to communities immediately downstream of Elgin. However, this scheme does not change the flood risk to areas upstream of the city.

Disruption during Construction
With the exception of the tunnel inlet, a significant benefit of this scheme is the construction works are located away from centres of population. The inlet works however are located adjacent to the Elgin Academy and access to the inlet works from the A941 would need to be carefully planned and managed to avoid disruption and protect the public.

Operation and Maintenance
There are significant land management responsibilities associated with the creation of the 4.5km^2 washland. Furthermore, a pumping station will be required on the Spynie Canal and this will require long term investment. These issues, in addition to other operation and maintenance requirements represent a long-term operational responsibility and cost for the Moray Council.

4.2.4 Opportunities

Creation of Amenity
The proposed washland provides opportunities for amenity and recreation use in the Spynie Catchment.

Habitat Enhancement
The creation of the washland provides an opportunity for sustainable habitat creation, including floodplain woodland in keeping with UK and local Biodiversity Action Plan targets.

4.3 Option 2 – Walls and Embankments through Elgin

4.3.1 Overview

This option involves channel widening and where practical the set-back of flood walls and embankments throughout the centre of Elgin. The objective of the works arrangement is to make best use of the natural floodplain and provide a sustainable flood corridor through the city. This requires the removal of a number of residential and commercial properties, the travelling peoples' site and loss of designated industrial land.

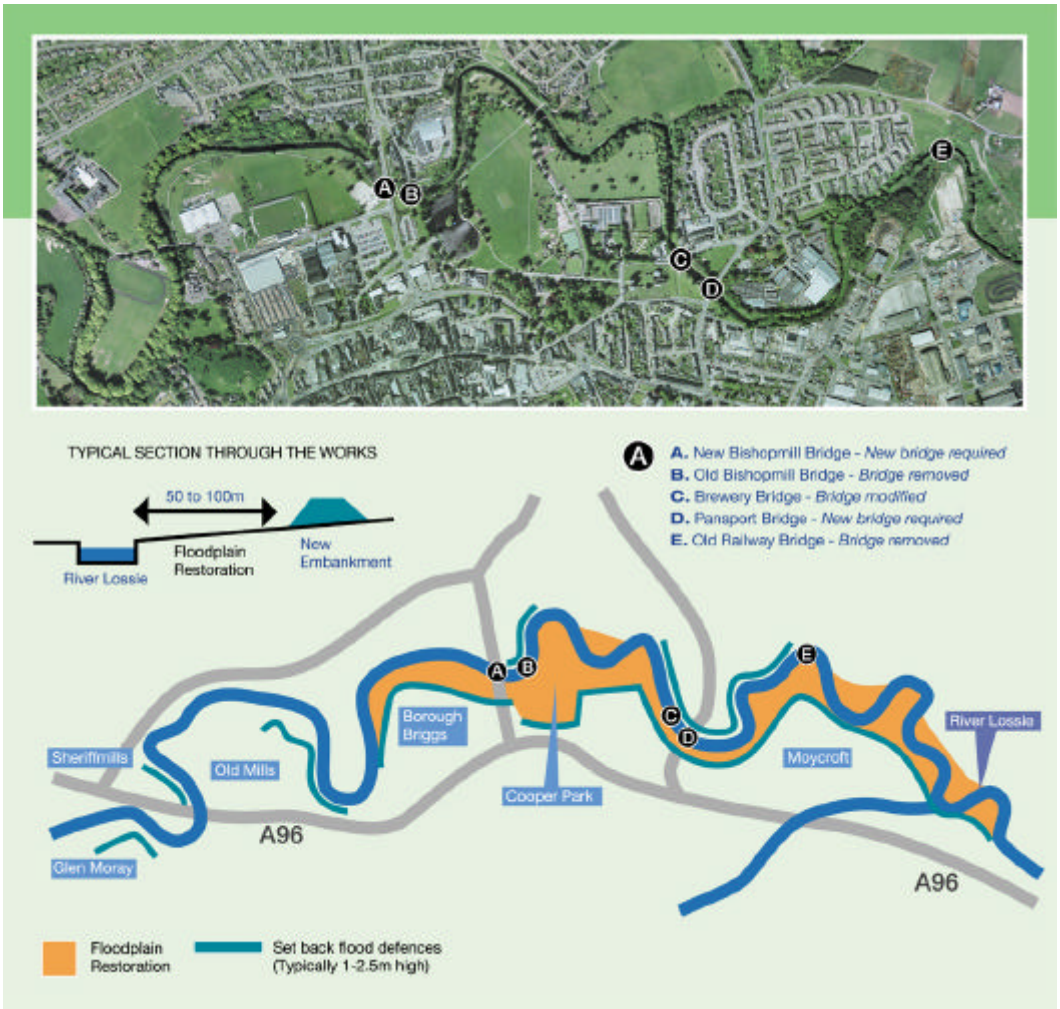
The flood wall and embankment works are extensive, comprising 7.6km of walls and embankments following the course of the River Lossie and 2.5km of defences associated with the Tyock Burn. The walls range in height from 0.6m to 2.5m with an average height of 1.5m. Significantly the scheme also requires works to five bridges comprising the demolition of four bridges and modifications to another. The highway bridges will be replaced with new structures. Two of the affected bridges are listed buildings.

This scheme will also require works to the surface water drainage system, the relocation of services and the remediation of contaminated land within Elgin. Although the scheme has a significant impact on the city, the investment provides an opportunity for regeneration of the River Lossie corridor, taking into account the long history of flooding in Elgin.

4.3.2 Summary of Works

The main elements of work are described below. Where defence heights are quoted they correspond to the height above ground level.

- Three defences, with a combined length of 1900m will be constructed to protect Glen Moray Distillery, Sheriffmills and Old Mills. The proposed defences are typically 1.5m high, but locally up to 2.5m, and comprise earth embankments and a short section of wall at Glen Moray distillery.
- Mansion House and Borough Briggs will be defended by 900m of defences, typically 1.7m in height, but locally up to 2.4m. The defences comprise earth embankments and a new wall between Mansion House and the river.
- Old and New Bishopmill Bridges will be demolished and a new highway bridge constructed. Old Bishopmill Bridge will be replaced with a new footbridge.
- A combination of embankments and walls typically 1.2m in height, will protect the area in the vicinity of Decora.
- A 600m earth embankment, typically 1m in height but locally up to 2.5m in height, will be constructed through Cooper Park. The defence will be landscaped into the parkland.
- The channel will be widened to at least 60m from Deanshaugh to Brewery Bridge. A 300m length of wall will be used to confine the edge of the channel and provide a defence in front of Kingsmills. A short length of wall will also be required on the bank opposite Kingsmills immediately upstream of Brewery Bridge. The defences in this area are less than 1m high.



Option 2 – Flood walls and embankments through Elgin

- Two arches, with similar aesthetic characteristics to the existing bridge, will be added to Brewery Bridge on the Kingsmills side of the river. A number of residential properties will be removed to provide space for the enlarged bridge and associated channel widening.
- Pansport Bridge will be replaced with a new longer span structure. The channel between Brewery and Pansport Bridge will be widened to approximately 70m. Embankments will be constructed along both sides of the river between the two bridges. The height of the embankment along the cathedral side of the channel will be typically1m.
- The narrow channel from Pansport Bridge to the old railway bridge will be widened to 60m, with walls confining the sides. The widening will require the removal of the commercial premises between Grampian Road and the river. Grampian Road will be permanently closed at two locations.
- The old railway bridge will be demolished and replaced with a new footbridge.
- Downstream of the old railway bridge the existing defences will be removed and the ground level lowered to provide a high flow channel at least 50m in width. 900m of embankment, typically 2m high, but locally up to 2.5m, will be constructed along the southern side of the river. The travelling peoples' site will be relocated.
- The Tyock Burn will be diverted from its current confluence to a new confluence approximately 1500m further downstream. Channel improvement works, including

widening, bridge works and defences, will be constructed along the length of the burn.
- Works to accommodate the surface water drainage system through Elgin will also be undertaken.

4.3.3 Key Issues

The main issues associated with this option are:

Removal of Residential and Commercial Properties
This option will require the removal of a number of residential properties due to the set back of defences in the Kingsmill area. Furthermore, some commercial properties will be removed and areas of commercial land will be lost.

Planning Challenge and the Impact on Existing Designations
This option impacts upon many planning designations and represents a departure from both the Local and Structure Plans. Consequently there will be a requirement for changes to these Plans to accommodate the flood alleviation scheme and take account of future flood risk in Elgin. A review of the Local Plan is due to commence in 2004 and necessary changes to accommodate the scheme could be incorporated when the existing plan is updated. Alternatively the project could be considered an acceptable departure to the existing Development Plan.

Cultural Heritage
The area alongside the River Lossie corridor is rich in archaeological and historical sites with a number of structures designated as Listed Buildings and/or Scheduled Ancient Monuments. This option will significantly impact upon these sites and the cultural heritage of Elgin. The category B listed Old Bishopmill Bridge will be removed, and the category B listed Brewery Bridge and the B listed masonry wall at Mansion House Hotel, will both require structural alteration. Elgin Cathedral and Pansport, both of which are Scheduled Ancient Monuments, will be indirectly affected as the works will change the landscape within which they are situated. In all instances, listed building consent and/or Scheduled Monuments Consent will be required and a legal process will need to be followed.

Contaminated Land
A review of historic land use maps, consultation with the Moray Council and preliminary site investigations have identified that key areas of land identified for excavation in this option are contaminated. Contamination associated with land filling was found in both the Borough Briggs/Lossie Green area and Woodside, while contamination associated with the former gasworks site was identified in the Cooper Park. It is anticipated that numerous other sites of contamination will be identified and these will require further investigation. This represents a significant risk and adds to the complexity to the scheme as the contaminated land will require remediation in accordance with relevant legislation.

Visual Impact
The city landscape along the River Lossie corridor encompasses a wide range of land uses including recreation and parkland, historic buildings and infrastructure, residential and industrial areas. Generally, the quality of the view is good and in areas such as the Cathedral great care will be needed to sensitively accommodate the flood defences. In

other areas however, such as Grampian Road the scheme presents the opportunity to improve the visual setting of the River Lossie.

The works described in this option consist of fixed flood defences. In some areas where the visual impact is critical and the impact of the defences would be significant it may be possible to use a combination of both fixed and demountable flood defences providing this does not compromise the security afforded by the scheme.

Amenity and Recreation
This option will result in the loss or alteration of several existing community assets including recreational facilities at the Cooper Park and the loss of land at Borough Briggs which is likely to result in the loss of public land used for funfairs and circuses.

Surface Water Drainage
This option requires surface water drainage improvements to avoid surface water flooding at times of high flow in the River Lossie.

Scheme Benefits
This option reduces the flood risk within Elgin but does not afford protection to upstream and downstream communities.

Disruption during Construction
The construction disruption is likely to last for more than three years with construction traffic and highway bridge replacement requiring careful traffic management throughout that period.

Complexity of Scheme
This scheme involves a large number of elements located throughout the built environment of Elgin. Irrespective of the level of investigations undertaken, there will still be a significant risk of unforeseen problems such as the discovery of services and archaeological sites. These risks have been taken into account in the cost evaluation and comparison exercise, but it is important to note that as a result of these issues, significant changes to individual scheme elements may be necessary during detailed scheme development.

Operation and Maintenance
This option will require regular channel maintenance and inspection. Furthermore, changes to surface water drainage are likely to require the future operation and maintenance of surface water pumping stations.

4.3.4 Opportunities

This option presents significant opportunities to enhance and improve the existing environment within Elgin.

Enhancement of Designated Green Corridor through Elgin
The River Lossie corridor through Elgin has been designated in the Local Plan as having a high environmental value. There is considerable opportunity to improve and enhance this important existing ecological asset, and to incorporate amenity, access, recreation and tourism value particularly in the lower section of the area as the river flows through the industrial area.

Enhancement of Access to Recreational Areas of Elgin
This option provides an opportunity to enhance access to and the continuity between existing recreational areas by integrating footpaths and cycle paths with the defence works. The river corridor downstream of the cathedral is currently unattractive and inaccessible. In particular the removal of commercial premises along Grampian Road provides scope for improved landscaping, access and seating. This could also encourage utilisation by people working and living in the area.

Infrastructure Renewal and Improvement
This option presents opportunities for infrastructure renewal by integrating road and surface water drainage improvements within the scheme.

Remediation of Contamination in Elgin
Investigations have shown that contaminated sites are affected by this scheme. This option therefore provides an opportunity for the Council to remediate existing areas of contamination in a strategic and cost effective manner with regard to relevant legislation.

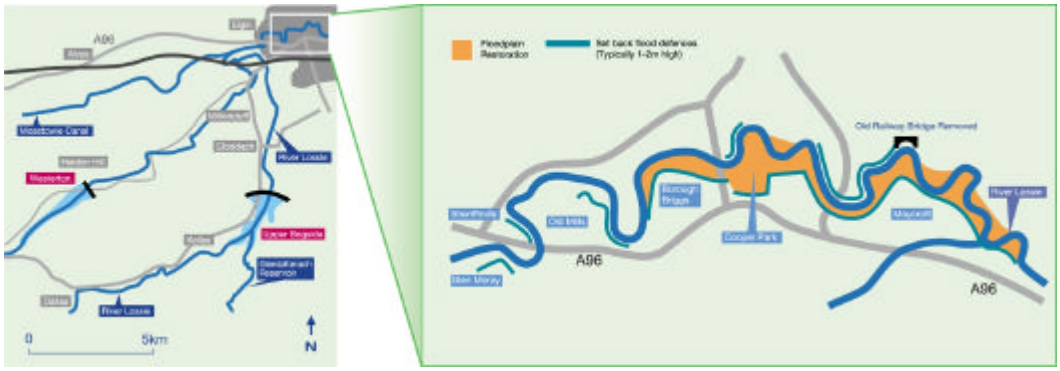
Resolution of Planning and Development Issues
This option presents an investment opportunity to jointly manage flood risk and long term development within Elgin; such that the proposed flood defences and development needs are not compromised in the future.

4.4 Option 3 – Flood Storage with Walls and Embankments through Elgin

4.4.1 Overview

This option involves the temporary storage of floodwater upstream of Elgin, and the subsequent controlled release of flow through Elgin. The storage will consist of two flood storage reservoirs, one on the River Lossie at Upper Bogside and one on the Black Burn at Westerton. The storage structures will be earth embankment dams.

In addition to the two storage sites, channel improvement and flood defence works will be required through Elgin to convey the remaining flow. These defences will be of a lesser scale than defined in option 2, however, it will still be necessary to remove a number of commercial properties and the travelling people's site. The flood defences comprise approximately 7km of walls and embankments following the course of the River Lossie and 2.5km of defences associated with the Tyock Burn. The defences will be up to 2.5m high, with an average height of 1.5m.



Option 3 – Flood Storage with Walls and Embankments through Elgin

4.4.2 Summary of Works

The main elements of work are described below. Where defence heights are quoted they correspond to the height above ground level.

- A flood storage reservoir will be constructed on the River Lossie at Upper Bogside. The dam will consist of an embankment between 25m and 30m high. The downstream face will be grassed and the upstream face covered in rock for protection against wave erosion. Mechanical gates will be installed to enable the flow to be regulated and an overflow spillway will be provided.
- A second dam will be constructed on the Black Burn at Westerton, approximately 1.5km upstream of Pluscarden Abbey. The dam will consist of a grassed embankment approximately 10m high. Mechanical gates will be installed to enable the flow to be regulated and an overflow spillway will be provided .
- Three defences, with an overall length of 1600m will be constructed to protect Glen Moray Distillery, Sheriffmills and Old Mills. The proposed defences are typically 1.0m high, but locally up to 2.0m, and comprise earth embankments and a short section of wall at Glen Moray distillery.
- Mansion House and Borough Briggs will be defended by 900m of defences, typically 1.5m in height, but locally up to 2.2m. The defences comprise earth embankments and a new wall between Mansion House and the river.

- A combination of embankments and walls typically 1.2m in height, will protect the area in the vicinity of Decora.
- 600m of earth embankment, typically less than 1m in height but locally up to 2.4m in height, will be constructed through Cooper Park. The defence will be landscaped into the parkland.
- A 300m length of wall, typically less than 1m high, will provide a defence in front of Kingsmills. Some widening will be undertaken just upstream of Brewery Bridge.
- Embankments will be constructed along both sides of the river between Brewery and Pansport Bridges. The height of the embankment along the cathedral side of the channel will be less than 1m.
- The channel from Pansport Bridge to the old railway bridge will be widened to 50m, with walls confining the sides. The widening will require the removal of the industrial units between Grampian Road and the river. Grampian Road will be permanently closed at two locations.
- The old railway bridge will be demolished and replaced with a new footbridge.
- Downstream of the old railway bridge the existing defences will be removed and the ground level lowered to provide a high flow channel at least 50m in width. 900m of new embankment typically 1.5m high, but locally up to 2.2, will be constructed along the southern side of the river. The travelling peoples' site will be relocated.
- The Tyock Burn will be diverted from its current confluence to a new confluence approximately 800m further downstream. Channel improvement works, such as widening, bridge works and defences, will be constructed along the length of the burn.
- Works to improve the surface water drainage system through Elgin will also be undertaken.

4.4.3 Key Issues

The key issues associated with this option are:

Removal of Commercial Properties
This option will result in the removal of some commercial properties, the travelling people's site and the loss of commercial land.

Planning Challenge and the Impact on Existing Designations
This option impacts upon many planning designations and represents a departure from both the Local and Structure Plans. Consequently there will be a requirement for changes to these plans to accommodate the flood alleviation scheme and take account of future flood risk in Elgin. A review of the Local Plan is due to commence in 2004 and necessary changes to accommodate the scheme could be incorporated when the existing plan is updated. Alternatively the project could be considered an acceptable departure to the existing Development Plan.

Cultural Heritage
The areas alongside the River Lossie corridor are rich in archaeological and historical sites with a number of structures designated as Listed Buildings and/or Scheduled Ancient Monuments. This option will significantly impact upon these sites and the cultural heritage of Elgin. In particular the Category B Listed masonry wall at Mansion House Hotel will require structure alteration. In addition, the storage site at Westerton is close to the listed Pluscarden Abbey and further consideration of this is necessary. In all instances, Listed Building Consent and/or Scheduled Ancient Monument Consent may be required and a legal process will need to be followed.

Contaminated Land
A review of historic land use maps, consultation with the Moray Council and preliminary site investigations have identified that key areas of land identified for excavation in this option have a significant risk of contamination. Contamination associated with land filling was found in both the Borough Briggs/Lossie Green area and Woodside while contamination associated with the former gasworks site was identified in the Cooper Park. It is anticipated that numerous other sites of contamination will be identified and these will require further investigation. This represents a significant risk and adds to the complexity to the scheme as the contaminated land will require remediation in accordance with relevant legislation.

Visual Impact
The city landscape along the River Lossie corridor encompasses a wide range of land uses including recreation and parkland, historic buildings and infrastructure, residential and industrial areas. Generally, the quality of the view is good and in areas such as the Cathedral great care will be needed to sensitively accommodate the flood defences. In other areas however, such as Grampian Road the scheme presents the opportunity to improve the visual setting of the River Lossie.

The works described through Elgin consist of fixed flood defences. In some areas where the visual impact is critical and the impact of the defences would be significant it may be possible to use a combination of both fixed and demountable flood defences providing this does not compromise the security afforded by the scheme.

Similarly the construction of the dams, in particular at Upper Bogside, will have an effect on the overall rural character of the dam sites. Furthermore, the change in land will have an effect on the character and visual amenity of the surrounding landscape, which is designated as an Area of Great Landscape Value for both Upper Bogside and Westerton sites.

Amenity and Recreation
This option will result in the loss or alteration of several existing community assets including recreational facilities at the Cooper Park and the loss of land at Borough Briggs which is likely to result in the loss of land used for funfairs and circuses.

Surface Water Drainage
There is a need to substantially improve surface water drainage such that during flooding events the risk of surface water flooding is removed. This adds to the complexity of the scheme.

Scheme Benefits
This option reduces the flood risk in Elgin and also reduces the severity of flooding in other agricultural areas both upstream and downstream of Elgin. Communities such as Palmerscross and Calcotts would also benefit from the reduced flood flows in the River Lossie.

Disruption during Construction
The construction disruption is likely to last for more than three years requiring careful traffic management throughout that period.

Habitat
Large areas of woodland, and the flora and fauna inhabiting the woodland, will be detrimentally affected by floodwater submersion during operation of the flood storage sites. The impact is particularly serious in the upper reaches of the flood storage facility at Upper Bogside where the Buinach and Glenlatterach SSSI is affected. This impact will need further appraisal during development of the scheme.

Complexity of Scheme
This scheme involves construction at several sites and a large number of the elements are located throughout the built environment of Elgin. Irrespective of the level of investigations undertaken, there will still be a significant risk of unforeseen problems such as the discovery of services and archaeological sites. These risks have been taken into account in the cost evaluation and comparison exercise, but it is important to note that as a result of these issues significant changes to individual scheme elements may be necessary during detailed scheme development.

Operations and Maintenance
The storage schemes will require maintenance and operation under the Reservoirs Act 1975. The nature of the works presents a long term operational responsibility and cost for the Moray Council.

4.4.4 Opportunities

Enhancement of Designated Green Corridor through Elgin
The River Lossie corridor through Elgin has been designated in the Local Plan as having a high environmental value. There is considerable opportunity to improve and enhance this important existing ecological asset, and to incorporate amenity, access recreation and tourism value particularly in the lower section of the area as the river flows through the industrial area.

Enhancement of Access to Recreational Areas of Elgin
This option provides an opportunity to enhance access to and the continuity between existing recreational areas by integrating footpaths and cycle paths with the defence works. The river corridor downstream of the cathedral is currently unattractive and inaccessible. In particular the removal of commercial premises along Grampian Road provides scope for improved landscaping, access and seating. This could also encourage utilisation by people working and living in the area.

Infrastructure Renewal and Improvement
This option presents opportunities for infrastructure renewal by integrating road and surface water drainage improvements within the scheme.

Remediation of Contamination in Elgin
Investigations have shown that contaminated sites are affected by this scheme. This option therefore provides an opportunity for the Council to remediate existing areas of contamination in a strategic and cost effective manner with regard to relevant legislation.

Resolution of Planning and Development Issues
This option presents an investment opportunity to jointly manage flood risk and long term development within Elgin; such that the proposed flood defences and development needs are not compromised in the future.

5 OPTION COMPARISON

5.1 Introduction

This section compares and ranks the three options against a range of performance criteria. The evaluation criteria and methods documented in the following sub-sections are as follows:

- Performance Matrix Evaluation
- Sustainability Assessment
- Environmental Impact
- Scheme Operation
- Scheme Maintenance
- Health and Safety
- Cost-Risk Evaluation

Where criteria scoring has been used in the evaluation the scores are tabled in the following sub-sections. In the relevant tables a score of 100 points has been given to the best option (ranked in first place). The scores for the other two options are presented as a proportion of 100 points.

5.2 Performance Matrix Evaluation

During the period December 2003 to January 2004 a Working Group of the Council developed and assessed a performance matrix to evaluate the non-monetary benefits of the options. The Working Group comprised representatives from each department of the Council.

The evaluation model was approved by the Environmental Services Committee on the 4 of February 2004 and comprises 23 criteria under the five headings of community, environment, economy, programme and technical. The scoring of the assessment and the associated option ranking is shown below.

Performance rating and option ranking

Description	Option 1 – Diversion to Spynie	Option 2 – Walls and Embankments	Option 3 – Storage and Walls
Performance Matrix Evaluation			
Performance Evaluation Rating	100	73	70
Ranking	1	2	3

Option 1 scored highest in all of the categories. Option 2 scored joint first in terms of technical performance, second in environment, economy and programme, and last in terms of the community criteria. Option 3 scored last place in all categories except community where it was ranked second. Overall the combined evaluation of Options 2 and 3 show the benefits of the two options to be comparable. Sensitivity analysis was undertaken on the scores and weightings. The findings and option ranking are not sensitive to the evaluation model.

5.3 Sustainability Assessment

Each of the options has been assessed against 29 sustainability indicators. The indicators provide a benchmark for evaluation and development of the flood alleviation scheme for Elgin. The indicators are grouped under the headings of:

- Project development – design and construction of sustainable solutions;
- Environment – effective and long term protection of a healthy environment;
- Economy – maintenance of a prosperous economy;
- Community – an inclusive society which recognises the needs of everyone.

The findings of the assessment of the options are summarised below.

Sustainability rating and option ranking

Description	Option 1 – Diversion to Spynie	Option 2 – Walls and Embankments	Option 3 – Storage and Walls
Sustainability Assessment			
Sustainability Assessment Rating	100	70	73
Ranking	1	3	2

The results indicate that Option 1, Diversion to the Spynie Canal, performs best against the indicators and represents the most sustainable of the three options in each category. Factors and opportunities that reflect this conclusion include the fact that the diversion scheme is relatively insensitive to external man-made or environment changes, makes good use of landform to manage flood risk, provides a good opportunity to minimise waste and recycle tunnel arising within the embankment works.

Options 2 and 3 score comparably. The key factors for these options scoring lower than option 1 are the impact on the landscape and existing assets within Elgin and waste related issues.

5.4 Environmental Impact

This section compares the environmental implications of the three options. The comparison rates each of the options against a range of criteria to determine an overall environmental ranking. The criteria used to assess the options are:

- Land Use and Local Community
- Policies, Plans and Legislation
- Hydrology and Water Quality
- Geology and Soils
- Ecology and Nature Conservation
- Landscape and Visual Impact
- Recreation and Amenity
- Traffic and Access
- Noise and Vibration
- Air Quality

The table below summarises the environmental rating and ranking of each option. The best option is ranked 1.

Environmental rating and option ranking

Description	Option 1 – Diversion to Spynie	Option 2 – Walls and Embankments	Option 3 – Storage and Walls
Environmental Rating			
Environmental rating	100	78	69
Ranking	1	2	3

As can be seen from the table above, Option 1 was awarded the highest rating over the range of topics considered. In eight out of the eleven topics considered, Option 1 received the highest score. The option was marked down in three sections as a result of the potential impact on both the environmental and cultural heritage designations of Loch Spynie and surrounding area.

Option 2 received the second highest overall score being ranked second against seven of the eleven criteria. This option was considered to have the least impact on ecology and nature conservation. This option was also considered to offer the greatest opportunity to remediate contaminated land through Elgin. This option was marked down primarily as a result of its significant impact on Elgin's cultural heritage.

Option 3 received the lowest score overall being ranked third in four of the eleven criteria, second in five of the criteria and first only twice. Despite the benefits generally afforded by flood storage, the storage sites also present environmental problems relating to the impact the sites have on the woodland. Furthermore, this option involves considerable works through town, which has several impacts as outlined for Option 2.

5.5 Operation and Maintenance

5.5.1 Introduction

The following sub-sections compare the operation and maintenance issues associated with the three options.

5.5.2 Operation

All three options all rely on both active and reactive operational tasks being carried out if they are to function effectively. However the dependency of each option upon those operational activities vary. They are described in order of increasing reliance upon active operation.

Option 2, walls and embankments through Elgin, would not rely on any active operation to convey the design flows. This does assume that large debris would not cause blockage of bridges. Therefore it may be necessary to react to such occurrences.

The high river levels through Elgin will prevent gravity drainage of adjacent surface water. Consequently the avoidance of flooding from this source is reliant upon multiple pumping stations that would have to be provided. The operation of the scheme will rely upon their effective operation.

Option 1, Diversion to Spynie Canal would rely on the opening of any gates across the entry and exit to the tunnels (provided to exclude the public) to allow the diversion to

function. Thereafter this option would not require any further active operation. However, it may be necessary to react to large debris which threatens to block the tunnel intakes.

Operation of the pumping station on the Spynie Canal would required long-term resource commitment.

Option 3, Flood storage would rely upon the control of the discharges from the two flood storage reservoirs and the monitoring of flows throughout the catchment. As for Option 2, there are no requirements for active operation in relation to the flows downstream of the storage reservoirs through Elgin, but there may be a need to react to debris threatening to block bridges.

As for Option 2, the high water levels through Elgin would place reliance upon the operation of the numerous surface water pumping stations and there may be a need to react to any malfunctioning units.

5.5.3 Maintenance

The principal maintenance aspects of the three options are described below in order of increasing work content.

Option 2, Walls and embankments through Elgin - Maintenance would involve grass cutting of the embankments and maintenance of the high flow channel and river corridor. Also to ensure the river channel is ready to receive high flows it would be necessary to remove trash and sediment from the riverbed. The numerous surface water pumping stations would need to be maintained to ensure that when needed, they operate efficiently.

Option 1, Diversion to Spynie Canal – The trash screens upstream of the tunnel and at the outlet structure would need to be kept clear. Sediment would need to be removed from the inlet works and from the area downstream of the outlet works. The tunnel would require regular inspections and the clearing of debris. The gates or screens at the upstream and downstream ends would need to be maintained to ensure they operate when effectively.

The washland pumping station would be operating continuously and will need to be maintained and its screen regularly cleared. The washland embankments would require grass cutting.

Option 3, Flood Storage – This option would rely upon the river channel through Elgin conveying high flows and consequently this part of the scheme would require similar maintenance to Option 2. The numerous surface water pumping stations would need to be maintained to ensure that when needed they operate efficiently.

The two flood storage reservoirs would require regular inspections by in accordance with the Reservoirs Act. The trash screens would need to be kept clear to ensure normal flows were maintained and to prevent premature storage of high flows. The mechanical and electrical operation of the flow control equipment would need to be maintained. The downstream slopes of both dams would require regular grass cutting.

5.6 Health and Safety

This section compares the health and safety implications of the three schemes. The comparison takes account of construction, operation and maintenance impacts. It has been assumed that health and safety risks have been mitigated during design and construction in accordance with legislation and good practice.

The risk associated with the individual options have been rated as the sum of the individual severity and likelihood scores. The cumulative results are as follows:

Comparison of Health and Safety Risks

Activity Risk	Option 1 – Diversion to Spynie	Option 2 – Walls and Embankments	Option 3 – Storage and Walls
Health and Safety Risk Rating			
Construction Risk Rating	100	91	85
Operation and Maintenance Risk Rating	66	100	59
Combined Rating	93	100	81
Ranking	2	1	3

The results show that Option 2, walls and embankments through Elgin, has the least overall health and safety risk score of the three options. However, it should be noted that it does not have the least health and safety risk score during the construction phase. This is due to the extensive work to be carried out through Elgin and the hazards that this creates working in close proximity to the local population and traffic. It would be imperative that these construction risks are eliminated or mitigated during the outline and detailed design phases. Once Option 2 is completed, it represents the safest of the three options.

Option 1, Diversion to Spynie Canal has the least construction health and safety risks due to the majority of the works being remote from the main populated areas of Elgin. Although the tunnelling operation has its own inherent risks, it is self-contained. The primary access to the tunnelling will be from the north and this minimises risks to the public, as spoil disposal to the washland area will be along haul roads or rural public roads.

Once Option 1 is completed, there remain significant health and safety risks concerning the possibility of the public gaining entry to the tunnel when dry and also being swept into the tunnel when the river diversion is in operation.

Option 3, Flood Storage has the highest construction and operational health and safety risk scores primarily because it incorporates two flood storage reservoirs in addition to major works through Elgin. Although the works through Elgin are not as extensive as for Option 2, they involve most of the same activities and therefore incur most of the risks. The addition of two water retaining structures with discharge culverts and control mechanisms, albeit in remote locations, results in significant additional risks. Option 3 therefore scores the lowest on health and safety grounds because of the number of major elements, which individually add to the cumulative level of risk.

5.7 Cost and Risk Evaluation

The following table summarises the findings of the cost-risk evaluation.

Cost-Risk Evaluation Results

Description	Option 1 – Diversion to Spynie Canal	Option 2 – Walls and Embankments	Option 3 – Storage and Walls
Cost Risk Summary (£million)[1]			
Basic construction cost[2]	73	54	74
Non -construction costs[3]	14	15	14
Risk and design contingency[4]	28	26	32
Appraisal best estimate[5]	115	95	120
Estimated Cost range[6]	100-135	75-115	100-140

Table Notes:

1. All estimates costs are quoted at 2004 prices.
2. *Basic Construction cost,* represents the cost of building the scheme as described in Section 4.
3. *Non – construction costs,* includes design, site investigations, maintenance and operation, and other costs such as compensation.
4. *Risk and design contingency,* includes allowances for unforeseen circumstances and changes to the scheme resulting from investigations, consultation and design development. This allowance takes account of optimism bias in accordance with treasury guidelines.
5. *Appraisal Best Estimate*, this is the total sum of the basic construction cost, the non-construction costs including maintenance and operation, and the risk and design contingency. In treasury terms this cost represents the Base Case which is the best estimate of how much the scheme will cost in economic terms including allowance for risk and optimism.
6. *Estimated Cost Range,* estimated lower and upper confidence limits.

The table above clearly demonstrates that Option 2, flood walls and embankments through Elgin, presents the most cost effective solution to flooding within Elgin.

The appraisal best estimate for Option 2 is £95million. It is anticipated that with further development of the scheme including ground investigation, and full identification of stakeholder requirements, the risk and design contingency can be reduced and the final scheme delivered at a lower cost. This view is supported by our Contracting partner AWG, based on recent experience on the Perth Flood Alleviation Scheme and other successful flood defence projects in Scotland. However, at this stage it is prudent to retain the appraisal best estimate for the scheme at £95million.

The appraisal best estimates for both Options 1 and 3 exceed the Option 2 estimate by £20million and £25million respectively. More significantly the lower bound estimates for both Options 1 and 3 exceed the appraisal best estimate of Option 2.

5.8 Summary

The table below summarises the assessment of the options and the ranking of each option against the following evaluation criteria and methods:

- Performance Matrix Evaluation
- Sustainability Assessment
- Environmental Impact
- Scheme Operation
- Scheme Maintenance
- Health and Safety

A ranking of 1 represents the best option against each heading. Ratings or comparative scores are included in the table where they have been determined.

Quality Evaluation and Ranking

Description	Option 1 – Diversion to Spynie	Option 2 – Walls and Embankments	Option 3 – Storage and Walls
Performance Matrix Evaluation			
Performance Evaluation Rating	100	73	70
Ranking	1	2	3
Sustainability Assessment			
Sustainability Assessment Rating	100	70	73
Ranking	1	3	2
Environmental Impact			
Environmental Assessment Rating	100	78	69
Ranking	1	2	3
Scheme Operation			
Ranking	2	1	3
Scheme Maintenance			
Ranking	2	1	3
Health and Safety			
Sustainability Assessment Rating	93	100	81
Ranking	2	1	3

The table below summarises the cost-risk evaluation and presents appraisal best estimates for scheme costs.

Cost-Risk Evaluation and Ranking

Description	Option 1 – Diversion to Spynie	Option 2 – Walls and Embankments	Option 3 – Storage and Walls
Cost Evaluation			
Basic construction cost, excluding significant risks and uncertainties. (£million)	73	54	74
Best estimate* of non - construction costs. (£million)	115	95	120
Cost range including risks and contingency for changes to the works definition (£million)	100-135	75-115	100-140
Ranking	2	1	3

* Base Case as defined in the Treasury Green Book.

No single option performs best on all the assessment criteria. In cost terms, Option 2, flood walls and embankments, clearly represents the most affordable and cost effective solution to flooding. Option 2 also represents a good investment in terms of operation and maintenance, and in terms of minimising health and safety risks over the operational life of the scheme.

Option 3 represents a poor investment as it is the most expensive scheme and is ranked in 3rd place in nearly all of the evaluation criteria.

Option 1 scores well in terms of the Council's performance evaluation, environmental impacts and the sustainability assessment. However, the minimum scheme cost estimate for option 1 exceeds the best estimate of option 2. Therefore, Option 1 is unlikely to be justifiable in appraisal terms.

Taking account of all of the assessment criteria, Option 2 represents the best way forward for the Council and the scheme most likely to obtain funding.

6 CONCLUSION

The conclusion of this report is that Option 2, Flood walls and embankments through Elgin, represents the best way forward for the Council and the scheme most likely to obtain funding.

Option 2 involves channel widening and where practical the set-back of flood walls and embankments throughout the centre of Elgin. The objective of the works arrangement is to make best use of the natural floodplain and provide a sustainable flood corridor through the city. This requires the removal of a number of residential and commercial properties, the travelling peoples' site and loss of designated industrial land.

The flood wall and embankment works are extensive, comprising 7.6km of walls and embankments following the course of the River Lossie and 2.5km of defences associated with the Tyock Burn. The walls range in height from 0.6m to 2.5m with an average height of 1.5m. Significantly the scheme also requires works to five bridges comprising the demolition of four bridges and modifications to another. The highway bridges will be replaced with new structures. Two of the affected bridges are listed buildings.

This scheme will also require works to the surface water drainage system, the relocation of services and the remediation of contaminated land within Elgin. Although the scheme has a significant impact on the city, the investment provides an opportunity for regeneration of the River Lossie corridor, taking into account the long history of flooding in Elgin.

7 NEXT STEPS

The principal next steps are:

Period March – May 2004.

- Consultation with people directly affected by the proposed footprint of the works. This includes, but is not limited to, residential and commercial property owners, such as owners of bankside property in the Kingsmill area and commercial property owners located on Grampian Road.
- Consultation with Historic Scotland to obtain a formal response to the preferred scheme and in particular works at Brewery Bridge and Old Bishopmill Bridge;
- Consultation with the Scottish Executive to confirm requirements for the business case submission and obtain feedback on the proposals and funding availability;
- Consultation with other key statutory consultees;

Period April - June 2004

- Prepare a project plan and programme for design of the scheme and submission of a flood prevention order;
- Compile business case for submission to the Scottish Executive and key statutory consultees.

Period July 2004

- Commence ground investigation for the preferred scheme.

Period August 2004

- Following feedback from the Scottish Executive, Historic Scotland and other directly affected parties, confirm scheme selection to the Council;
- Hold a public exhibition in August to consult on the design and construction of the preferred scheme.

Period September 2004

- Present project plan and programme to Council for approval on the 1 September 2004.

8 RECOMMENDATION

It is recommended that:

- Option 2 – Flood walls and embankments is taken forward as the preferred scheme to alleviate and manage the flood risk in Elgin;
- Option 1 – flood diversion to the Spynie is held in reserve as the second placed scheme, in the event that significant risks or impediments emerge on Option 2.
- Consultation on the preferred scheme is undertaken with the following key parties: The Scottish Executive, Historic Scotland, other key statutory consultees, and people directly affected by the proposed works footprint;
- The Elgin flood alleviation scheme business case is prepared for submission to the Scottish Executive and key statutory consultees in June 2004;
- A further public exhibition is held in August 2004 to provide information related to the scheme selection and to consult the public on the design of the preferred scheme;
- Following the public exhibition, a project plan and programme is prepared for the approval of the Council on the 1 September 2004.