

Q7. Do you agree that Local Authorities, Scottish Water, the Forestry Commission, and SNH should be identified as responsible authorities?

7. Answer; *We agree that the bodies named above should be identified as the principal responsible authorities.*

Q8. Which other bodies should be identified as responsible authorities?

8. Answer; *On a case-by-case basis there may be other responsible authorities such as port authorities, public utilities and other members of the Flood Liaison Advisory Groups.*

Q9. Do you agree that responsible authorities should have a duty to work together within Flood Advisory Groups to produce plans?

9. Answer; *The responsible authorities should work together in the Flood Advisory Groups. It is not clear where responsibilities and duties would lie in the event of agreement not being reached.*

Q10. Do you agree the proposals are sufficient to support wider stakeholder and community engagement in the flood risk management planning process?

10. Answer; *The proposals offer the opportunity for wider engagement in the flood risk management planning process but the success of this will rest on the level of contribution and commitment from individual members. This should not be an issue on a local scale due to Shetland's geographical isolation; however, direct interaction with stakeholders on an Area basis would be more limited.*

Q11. Do you agree that the Bill should set out a process similar to that for River Basin Management Planning for the preparation by SEPA of area flood risk management plans?

11. Answer; *The same broad process would be applicable, however, I feel there would be advantages in sub-dividing the country into smaller areas of with similar geographic and settlement characteristics.*

Q12. Do you agree that Ministers have the power to approve, reject or modify Area Flood Risk Management Plans?

12. Answer; *This would seem to be appropriate.*

Q13. Do you think that integrated urban drainage plans should be included as part of a Local Flood Risk Management Plan?

13. Answer; *The integrated urban drainage plans should be included as and when available. Neither one should be dependable on the other.*

Q14. Should Flood Risk Management Plans inform the way that development plans are prepared, or should there be a stronger linkage such as a requirement on planning authorities to show that they have regard to the FRMPs?

14. Answer; *Local development plans should take account of FRMPs and incorporate appropriate spatial policies to further the aim of flood prevention and risk management; the local development plan should not conflict with the Flood Risk Management Plan.*

Q15. Do you think that the granting of deemed planning permission at the end of the statutory process for flood risk management will deliver a more streamlined approach to the delivery of flood risk management?

15. Answer; *Yes, but the Council believes that Option 2 (Relying on a local authority based procedure) would be more effective.*

Q16. Should Ministerial confirmation be made necessary even where features of a scheme do not require planning permission?

16. Answer; *If planning permission is being sought it is understood that relevant checks and processes are being followed, however if planning consent is not being sought it is important for a named official body to oversee the application. If option 1 is chosen, Ministerial confirmation should remain as an integral part of the process.*

Q17. Is the present procedure for Ministerial confirmation satisfactory for this new purpose or are there revisions e.g. to timescales which should be considered?

17. Answer; *The existing procedures for ministerial confirmation have not caused us any problems to date, however any opportunities to streamline them would be welcomed.*

Q18. Do you think that the option to rely on a local authority based process in a similar way as other local authority development activity should be taken forward?

18. Answer; *The Council believes that option 2 is likely to result in the more straightforward and effective process for those affected by or administering schemes or works proposals. The Council further considers that the opportunity for consideration by Scottish ministers, following public inquiry if necessary, should be*

maintained so as to ensure continuing proper safeguards for all involved in the process.

Q19. What would be the appropriate timescales for notification and response?

19. Answer; *Timescales should be in line with other similar processes.*

Q20. Would it be appropriate for such a process to carry deemed planning consent?

20. Answer; *For a procedure similar to other, established procedures, yes.*

Q21. How should the issue of technical expertise and capacity to ensure the necessary technical standards are observed, be addressed?

21. Answer; *Due to Shetland's geographical location there will be issues in relation to using technical expertise from outwith the Islands and, whilst, on the basis of the number and extent of schemes that have been promoted in the past the Council believes that it has sufficient engineering skills to take a lead in technical scrutiny of proposals. However, if that basis were substantially incorrect then the Council would not be able to undertake that role without the input of additional resources at an appropriate level.*

Q22. Are there any additional alternatives to the options outlined above which would simplify procedures?

22. Answer; *The Council does not envisage any other options that would be more effective than the proposals outlined.*

Q23 Do you consider local authorities' powers are sufficient to take necessary action to avert danger to life and property?

23. Answer; *In Shetland almost all actions carried out to avert danger to life and property will involve engineering operations at some level. From an engineering point of view we would ideally be able to enter any property at any time to carry out any works we consider necessary to avert danger from flooding.*

Q24. Do you agree that streamlining the CAR and flooding/planning processes can be managed through better guidance?

24. Answer; *There is certainly a necessity for clearer guidance on the flooding/planning process and it is hoped that would assist it running the multiple processes in parallel in an efficient way, although given the range of legislation*

involved any benefits will ultimately depend more on the determination of the overseeing bodies to see this happen, and may involve changes in their internal procedures.

Q25. Do you think there is anything further SEPA, the Scottish Government or others should be doing to promote joined-up regulation?

25. Answer; *At present flood risk would be considered by*

1) Local planning policy

Development zones

2) Individual planning application

The local authority

SEPA

Scottish Water

SNH

Roads authority

3) Building standards

The local authority

4) CAR regulations

SEPA considering licence

Other issues

Permissions for connections to Roads and/or SW plant

These processes will largely run in parallel, but at present changes required by one body under one area has the potential to set other processes back, or potentially require a new application/licence. While some of these issues can be addressed by advanced consultation with the relevant bodies before any applications, this does not deal with all changes that come to light as a development proceeds.

Q26. Do you think that there is an alternative approach to simplifying the process of promoting flood measures to those discussed above which the Government should consider?

26. Answer; *The options outlined above in response to questions 24 and 25 covers a wide range of available alternatives.*

Q27. Do you agree that the form and content of the biennial reports should be more systematic, and subject to direction from Ministers?

27. Answer; *There are benefits to a systematic approach giving a clearer overall picture of flooding on a national level, however care should be taken to maintain the flexibility required to cover the wide variety in form and scale of flooding events in different parts of the country.*

Q28. Do consultees agree that the proposals as outlined will improve flood risk management and ensure Scotland is equipped to implement sustainable flood management?

28. Answer; *The less prescriptive nature of the measures proposed give the opportunity to improve matters but different flooding issues will predominate in different areas of the country and the proposals need to be flexible enough to cover the full range of issues. For example there are no large rivers in Shetland but over 900 miles of coastline (10% of Scotland's total coastline). Therefore large scale flood prevention schemes would almost exclusively consist of coastal protection schemes rather than the more usual range of fluvial flood prevention schemes.*

Q29. Do consultees feel that this is enough to ensure that flood risk is addressed or should local authorities have a new duty to promote measures to alleviate flooding?

29. Answer; *The proposals outlined in this report together with existing duties covered in the previous acts are sufficient to ensure flood risk is addressed.*

RESERVOIR SAFETY

Q30. Do you believe enforcement responsibilities under the Reservoirs Act 1975 should be transferred to a single national body?

30. Answer; *Yes the Council does see benefits of the act being enforced by a single body.*

Q31. If so, should it be SEPA or another as yet unidentified body?

31. Answer; *Given that a single competent authority is required we agree that SEPA seem to be best placed to take the lead role.*

Q32. Are you content with the proposals for dealing with reservoir flood maps under the provisions of the Floods Directive, or do you think that there should be a statutory duty on reservoir undertakers to prepare reservoir inundation maps and plans, similar to the duty in the 2003 Water Act for England and Wales?

32. Answer; *Given the work SEPA has previously carried out on flood mapping they would seem to be best placed to prepare reservoir inundation maps to the same consistent standards across Scotland.*

Q33. Do agree that enforcement powers be extended and post incident reporting included as an additional requirement?

33. Answer; *Yes we agree.*

Q34. Views on crown application and any other comments?

34. Answer; *We see no reason why the act should not apply to all bodies.*

Consultation on 'The Future of Flood Risk Management in Scotland

Douglas Wright
Secretary of Royal Burgh of Peebles and District Community Council
16 Drovers Way
Peebles
EH45 9BN

- 1 I am responding on behalf of a group
- 2 NA
- 3 Yes
- 4 Yes

Q1. Do you believe the definition of Sustainable Flood Management is helpful and of practical benefit to flood risk management?

A definition is essential to allow all stakeholders to be aware of where the boundaries and requirements are set.

To not have a definition will make control difficult, and very likely end up with situations and results that are undesirable. The definition can be tuned in time to such as new technologies e.g., in flood defences, building materials and designs, improved understanding of weather and climate change, changes in public perception in what can be safely accepted, etc.

Q2. Do you think the definition is clear and simple to understand?

The definition given in box 2 by the FIAC seems simple to understand, however, it does seem to indicate that some level of flooding may be acceptable. Certainly for housing and other essential developments such as hospitals, power stations, pollution sources, etc., this should not be accepted. The more developments that are built in flood plains, or that cause flooding in other properties, the greater will be the social, economic and ecological cost when flooding occurs, and the greater the inability for the economy to cope, locally or nationally.

Also any development that may cause a flood impact elsewhere cannot be acceptable.

Q3. Do you agree with the conclusion as set out in paragraph 3.17?

There does need to be a national body that ensures that all the separate parts are dealing properly with flood management, and that at local, regional or estuary level there is no conflict of interest between local authorities.

Q4. Do you agree that there should be a single competent authority with a national remit for implementing the Floods Directive, and that it should be SEPA?

Whilst SEPA is currently the only single body that has the expertise and resources to carry out this function, there are concerns that some of their aims such as protecting wildlife habitat may conflict with the aims of flood management, and for this reason, it would be better that those parts of SEPA that would provide the correct expertise and resources are set up as a separate National Flood Agency, concentrating on Flood Management, minimising impact and hardships which is of immense social and economic importance.

Q5. Do you agree that this is a sound basis for the development of Local Flood Risk Management Plans? If not what alternative do you propose?

As long as there is a competent authority with sufficient resources overseeing the making of Local Flood Risk Management Plans to ensure compliance and efficiency, and that they are seamlessly integrated with regional and national plans, then this seems reasonable.

COMMUNITY COUNCIL of the ROYAL BURGH of PEEBLES and DISTRICT

Q6. Should Ministers or SEPA have the power to designate a lead authority within a local area, or should it be left to the partners?

One would expect that neighbour authorities would have a common sense approach to flood plans that by their nature cross into adjacent authority areas, however there may be occasions when an authority has to decide on priorities. For this reason, some mechanism would have to be in place to deal with such problems should they arise.

Q7. Do you agree that Local Authorities, Scottish Water, the Forestry Commission, and SNH should be identified as responsible authorities?

In 3.32 the responsibilities listed above also includes "amongst others" - which are not listed. We think all the emergency services need to be listed, as they have to respond/clean up if it all goes wrong. There may be other responsible authorities that need to be identified.

Q8. Which other bodies should be identified as responsible authorities?

Along with Q7 above, emergency services including Coastguard, NHS, other national and local voluntary services that assist, e.g., WRI, RNLI etc., as all of these will have issues that should be considered in the Plan to reduce damage, financial burdens, human suffering, casualties, fatalities, etc., during and after a flooding incident. Householders and businesses in affected areas should also have some say in the Plan, and therefore should be represented.

Q9. Do you agree that responsible authorities should have a duty to work together within Flood Advisory Groups to produce plans?

Yes

Q10. Do you agree the proposals are sufficient to support wider stakeholder and community engagement in the flood risk management planning process?

All those that will be affected or involved in the event of a flooding incident need to be identified and included in the plan preparation, therefore support for wide stakeholder and community involvement is essential.

Q11. Do you agree that the Bill should set out a process similar to that for River Basin Management Planning for the preparation by SEPA of area flood risk management plans?

Yes. The structure plan approval system is tried and tested, however note previous comments regarding SEPA, whereby flood management and planning needs to be separated from SEPA's other responsibilities.

Q12. Do you agree that Ministers have the power to approve, reject or modify Area Flood Risk Management Plans?

Provided they are fully conversant with and fully understand why they are doing so, and that any modifications benefit the communities involved or likely to be involved in flooding incidents or affected by such as the building of flood defences, but not necessarily at risk of flooding.

Q13. Do you think that integrated urban drainage plans should be included as part of a Local Flood Risk Management Plan?

Yes, especially if it will remove the so-called grey areas. In addition, water will follow route of least resistance, and will not differentiate between urban drainage systems, roads, open areas, rivers, other waterways and therefore all routes need to be included.

COMMUNITY COUNCIL of the ROYAL BURGH of PEEBLES and DISTRICT

Q14. Should Flood Risk Management Plans inform the way that development plans are prepared, or should there be a stronger linkage such as a requirement on planning authorities to show that they have regard to the FRMPs?

Recently, more and more planning applications are referred to SEPA. There has to be some recognition/guideline of how to determine which planning applications are referred to the Flooding Authority (see earlier comments on SEPA) as the appropriate body. The current SEPA maps, especially in this locale, cannot be relied upon as they are too general, and indicate the main street at flooding risk when this is extremely unlikely to happen. So a stronger linkage is essential

Option 1

This seems an appropriate method for large-scale flood risk management schemes that cross more than one authority area, the exact definition of which should be agreed.

Q15. Do you think that the granting of deemed planning permission at the end of the statutory process for flood risk management will deliver a more streamlined approach to the delivery of flood risk management?

Only provided all the requirements of a planning application have been met. There should really be no reason why both cannot be carried out at the same time and under the same jurisdiction, ensuring that the requirements for both planning applications and flood risk management are met. Any public notifications, public enquiries etc. should clearly indicate that it is both that are being considered.

Q16. Should Ministerial confirmation be made necessary even where features of a scheme do not require planning permission?

Yes, if it is of large scale and affects much and many and crosses several authority areas.

Q17. Is the present procedure for Ministerial confirmation satisfactory for this new purpose or are there revisions e.g. to timescales which should be considered?

For those affected by a flooding incident a month is too long. If the scheme is considered essential for prevention of social and financial suffering, then suitable priority must be given, and therefore in such cases there should be a mechanism that allows shorter delays to implementation that do not adversely affect those affected.

Option 2

Q18. Do you think that the option to rely on a local authority based process in a similar way as other local authority development activity should be taken forward?

This would be appropriate where the definition of the Option 1 method is not met.

Q19. What would be the appropriate timescales for notification and response?

They should be aligned to current planning application requirements. That way the whole could incorporate all planning requirements at the same time.

Q20. Would it be appropriate for such a process to carry deemed planning consent?

If both planning and flood management requirements are aligned and dealt with in the same time scale and incorporate the requirements of both, then YES

COMMUNITY COUNCIL of the ROYAL BURGH of PEEBLES and DISTRICT

Q21. How should the issue of technical expertise and capacity to ensure the necessary technical standards are observed, be addressed?

The national body dealing with Flood Management extracted from SEPA could have a central pool of expertise that would be available to the local authorities dealing with the scheme. Also each local authority should have a requisite level of technical expertise to deal with smaller schemes and advise on larger schemes in their region as appropriate.

Q22. Are there any additional alternatives to the options outlined above which would simplify procedures?

Once the decision that a flood prevention scheme is required has been taken, then planning and flood management should be one single process that incorporates the requirements of both.

Q23 Do you consider local authorities' powers are sufficient to take necessary action to avert danger to life and property?

At this time it is not possible to answer this, however as there seems to be doubt, it would certainly be worthwhile reviewing with each authority. That way if there are any scenarios other than those that they already have the powers to deal with, then decisions on dealing with those outside their powers to be made.

Q24. Do you agree that streamlining the CAR and flooding/planning processes can be managed through better guidance?

Whether by better guidance or making it a requirement, streamlining the processes so they work in tandem seems to be a constructive approach.

Q25. Do you think there is anything further SEPA, the Scottish Government or others should be doing to promote joined-up regulation?

Simplify and publicise.

Q26. Do you think that there is an alternative approach to simplifying the process of promoting flood measures to those discussed above which the Government should consider?

Simplify into one system that deals with all the requirements so that it can all be dealt with as efficiently, quickly and appropriately as possible, and not allow unnecessary red tape to throttle progress.

Q27. Do you agree that the form and content of the biennial reports should be more systematic, and subject to direction from Ministers?

Yes. They should also be simple enough so that the public can understand them.

Q28. Do consultees agree that the proposals as outlined will improve flood risk management and ensure Scotland is equipped to implement sustainable flood management?

Yes

Q29. Do consultees feel that this is enough to ensure that flood risk is addressed or should local authorities have a new duty to promote measures to alleviate flooding?

Local Authorities should have an obligation to promote measures to alleviate flooding and be supported by the national body. Whilst owners, including householders are responsible for their flood protection of their own property it seems that few, if any householders, are actually aware of this and in any case it can be very difficult to achieve anything without neighbour and local authority assistance, agreement, enforcement etc.

RESERVOIR SAFETY

Q30. Do you believe enforcement responsibilities under the Reservoirs Act 1975 should be transferred to a single national body?

Yes

Q31. If so, should it be SEPA or another as yet unidentified body?

A single national body yet to be identified so that it deals only with the required responsibilities and does not have the potential conflicts that SEPA currently has.

Q32. Are you content with the proposals for dealing with reservoir flood maps under the provisions of the Floods Directive, or do you think that there should be a statutory duty on reservoir undertakers to prepare reservoir inundation maps and plans, similar to the duty in the 2003 Water Act for England and Wales?

There should be a statutory duty for all reservoirs. Smaller reservoirs such as the angling ones mentioned in consultation document may be permitted to lesser requirements as deemed appropriate by the single national body.

Q33. Do you agree that enforcement powers be extended and post incident reporting included as an additional requirement?

Yes

Q34. Views on crown application and any other comments?

These must be included in requirements, as being a crown body does not necessarily imply equivalent or higher standards are voluntarily imposed.

022

23 Market Drive
New Elgin
Moray IV30 6DG

5th April 2008

Gordon Young,
Flooding Policy Team
Scottish Government
Victoria Quay
Edinburgh

Dear Mr Young,

Thank you for inviting me to the Public Meeting to be held in Rothes on 11th April.

Although I am sure it will be an interesting and hopefully productive meeting, I will not be able to attend.

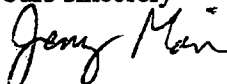
Although I am no expert in hydrodynamics I feel very strongly about certain aspects of flood risk management and I believe that recent developments in my own neighbourhood contributed directly to the flooding of my area. Consequently I feel that the precautionary principle should automatically apply when considering developments within areas of flood risk.

I have already made statements at the recent Parliamentary Inquiry held here in Elgin and I enclose a copy of the preliminary statement that I sent to that committee. In it there is a brief outline of some of the experiences undergone by just a few people in this immediate neighbourhood.

I would like to stress that I am not making my opinions known simply for my own benefit, but also on behalf of my friends and neighbours who have neither time or, in the case of several elderly neighbours, the capabilities of accessing the many facilities necessary to make their voices heard. It is not apathy that keeps so many voices silent - many find the prospect of tackling the system too daunting - and there is a perception that it is '*not worth making a fuss because no-one will do anything*'. .

Thank you for your concern and interest in this matter – it is appreciated.

Yours sincerely


Jenny Main

enc

FLOODING AND FLOOD MANAGEMENT INQUIRY

February 2008

Statement by
Jennifer Main, 23 Market Drive, New Elgin Moray IV30 6DG

Floods in 1997 did encroach upon my property and, while water covered the garden and bubbled up under my floorboards it did no real damage. This was due to the fact that, just before reaching what would have been danger levels for me, the River Lossie burst its banks and the water subsided.

However, I was a flood victim in November 2002 when the Moray floods caused a lot of havoc. I hope that this account may be of some use to the Inquiry.

On both these occasions, before water began to pour out of drains or to overflow from the nearby Tyock burn, (which drains into the river Lossie) water was seen bubbling up out of the ground at various points in my garden in areas where there was no drainage system.

Outline of local history and events

People who have lived in this area all their lives can testify that the water table is very near the surface. One neighbour recalls her father attempting to dig an air-raid shelter during WWII but being thwarted when the hole began to fill with water. Another aged local who, as small boy, lived within a few yards of my property, remembers the fun he and his friends would have when they dug holes in his garden and watched them speedily fill up with water.

After 1997 I witnessed a survey team engaged in test drilling in the Mart car park, adjacent to my property, and was told by the person in charge that the water table in this area was less than 2 metres below the surface. This is because many hundreds of years ago the whole area was once a loch. The survey team told me they had found evidence of the old loch bed. The loch eventually dried out leaving just the Tyock burn draining into the river Lossie, and left the area a wetland. The name of the main street leading from the town of Elgin to New Elgin is Moss Street, and on old maps it leads to the Moss of Strathcant. Old names such as Pond Park, and Springfield indicate the nature of the land.

Over the years there have been several floods in Elgin. Old photographs show the New Elgin road under a few inches of water – although the houses were not then flooded out. At the same time the nearby railway line was badly flooded and there are photographs of a troop train ploughing through several feet of water during the First World War.

I have lived in Market Drive since the houses were first built nearly thirty years ago and have never before seen any threat of flooding here – although the adjacent Mart Paddock has at times been ankle deep in water. I often noted that fields along nearby Edgar Road could be very sodden at times when the Tyock Burn was very full, but

not overflowing. It would seem that water would be backing up into the fields until it could drain through underground channels into the Tyock Burn.

A few years ago retail developments were undertaken in the fields along Edgar road. It is only since these developments that the houses on the New Elgin Road and in Market Drive have been subjected to serious flooding.

At the time when my home was being stripped and dried out, developers were planning to start work in the Mart and the Mart Paddock next to my property. Despite my letter-box being taped shut (with a notice attached redirecting mail) my letterbox was opened and notification of development was served. It was only thanks to an observant workman that this notification for building a retail development next door to my property was discovered amongst the debris in the solum. I was then able to effectively question development on the grounds of increased flood risk.

At the time of writing, the Moray Development Plan is in the process of preparation and large-scale development is once again proposed for the Mart Paddock. This is the last remaining field which has acted as a sponge in times of heavy rain. On June 1st this year a torrential deluge resulted in drains in Market Drive back-flowing – the one at the bottom of my drive spouted water up to a height of three feet. However, the nearby paddock was waterlogged, but did not overflow into adjoining properties. Had the Paddock been developed, the drainage system would have been even more overloaded and surface water drainage would also have contributed to the problem. Adjoining properties would have undoubtedly been flooded. As it was, the Paddock acted as a sponge absorbing and holding much of the deluge.

Response to questions from the Committee

Not being qualified in any form of environmental planning or management I am not able to give anything other than my personal opinions.

•1) I have read many serious and compelling articles about climate change (e.g. in The Scotsman, National Geographic etc.) and believe that it will eventually result in increased and more severe flooding episodes in Scotland, including in my local area. During recent years I have been aware of changes – there have been many more sudden torrential downpours here, with unprecedented amounts of water falling in a very short time – rain ‘stotting’ off the pavements with amazing ferocity, and episodes which can only be described as cloudbursts. Whilst short in duration, these episodes can be very severe.

•2) I feel very strongly that legislation should be changed in order to safeguard existing properties from being endangered by new developments which might possibly exacerbate flood risk. If there is any doubt about potential risk, such as on existing flood plains, then there should be a presumption against building.

Legislation could also be considered in order to enable emergency action to breach river banks where appropriate and allow flood water to spread over farmland instead of into areas of housing – obviously landowners should be properly compensated for this.

•3) Flood management should be the responsibility of an impartial department that is not subject to pressure from councils or developers. Despite the automatic claim of there never being enough funding for everything, flooding is an increasing drain on the public and government purse. Good government housekeepers should be able to divert funds from less essential areas in order to deal with a problem which will, if not quickly confronted, result in rapidly escalating costs. The costs will be not just financial, but will impact on business, health and welfare and upon the reputation of the management of this country.

•4) Sustainable flood management could oversee proposals for developments on areas of flood risk. They should co-ordinate and advise on local flood alleviation schemes as well as local emergency action plans.

•5) Land-use management, the planning system and building regulations must be co-ordinated and free from any commercial pressures when assessing flood risks.

Prevention is always better than cure and a combination of thorough research and common sense must dictate actions in mitigating the effects of flooding. In severely affected areas it would conceivably be both practical and eventually economical to purchase badly damaged properties, allowing residents to move elsewhere, and thereby creating safe holding areas for water in a flood event.

•6) The present flood warning systems in this area seems dependant upon residents being either near a phone or a computer. While local radio can play an important part in alerting people, not everyone is tuned in. In this area in 2002, while water could be seen encroaching nearby, it was not apparent until the last moment that residents in Market Drive would be flooded. Perhaps someone with an overview of the developing situation could have given us, or a nominated representative, a clearer warning.

•7) The response to the most recent severe flood of 2002 in this area was uneven. The emergency services and council workers worked hard to assist the flood victims in council-owned property and in more severely affected areas near the river Lossie.

However, there was no one to help in this area, despite helicopters flying overhead and obviously being aware of the situation. Everyone in this street had to fend for themselves as the water rose. I live in semi-detached bungalow which is the lowest lying property in the street. Other neighbours in flats and maisonettes were not so deeply flooded and were able to retreat upstairs. I have mobility problems and am widowed, but luckily had a friend with me at the time. Without the assistance of friends and a strong neighbour, I would have suffered a much greater loss. I was fortunate in having my mother living in an upstairs flat just a few doors away, which meant I had an immediate refuge during the night when flood water lay within my home and covered the road to a depth of almost three feet.

My octogenarian neighbours were also fortunate in having friends visiting at the time of the flood who were able to give them help. They needed assistance when they were eventually persuaded to leave their home and struggled in the dark through the flood water to higher ground and to sanctuary with a friend. Another octogenarian neighbour managed to flee her property and went to stay temporarily with relatives.

Neither at the time of the flood nor during the following days were we visited by any council officials or social workers to check on our welfare or offer impartial advice.

Using their initiative and lacking any experience in this situation, my neighbours hired a caravan as temporary accommodation, believing this would be for a short time only. They were unable to operate and empty the chemical toilet. Family members came up from distant homes as soon as they could and eventually managed to demand help from the council. My neighbours were then given temporary housing in Forres, 12 miles away, and for the next seven months, mostly in winter, travelled back daily to supervise the reconstruction of their home. It was interesting that no-one informed us about the possibility of our homes being contaminated until weeks later when my neighbours were told that anyone entering the house should be wearing protective suits. They had, until their move, been using facilities in their damaged home and had no idea about the possible danger of contamination.

After a few weeks sleeping on the floor in my mother's small flat, I was lucky to eventually find temporary accommodation with a friend, but there seemed no system in place to offer advice or to check on our welfare.

(This in spite of the fact that following the previous flood event of 1997, in recognition of the stress endured, local Council employees were given counselling to help them recover from the trauma they had suffered when dealing with the initial phone calls from distraught victims. The flood victims were not offered this counselling.)

The effect on the flood victims has been profound. The stress has exacerbated medical problems and this will have certainly resulted in an unquantifiable drain on the National Health services. Although it can never be proven conclusively, I am sure that the death of at least one near neighbour was a direct result of the trauma of being flooded out twice within five years and the health of his widow has deteriorated steadily.

It was not possible to return to normal immediately on return to our reconstructed homes. The loss of personal possessions and the changes within the houses – different furnishings, different creaks and draughts etc., left us all unsettled and disorientated for a long time. Following the flood event of a few hours our lives have been disrupted for several years. Only other flood victims appreciate the deep concern we now feel when there is any heavy rainfall.

Apart from obvious financial losses, the mental and physical damage inflicted by this incident has had a profound effect on all those directly involved and caused great disruption to lives and to normal community activities. The real costs are incalculable.

Flooding Consultation

QUESTION	RESPONSE BY PERTH & KINROSS COUNCIL
<p><i>Q1. Do you believe the definition of Sustainable Flood Management is helpful and of practical benefit to flood risk management?</i></p>	<p>This was considered a reasonable attempt, but several issues were raised regarding the definition. Without wishing to appear to be concerned over semantics, there was some concern over the word "fair". Although some explanation is provided later on, it may need some more clarification. It was thought consideration could be given to replacing "fair" with "equitable".</p>
<p><i>Q2. Do you think the definition is clear and simple to understand?</i></p>	<p>It is a reasonable attempt to define Sustainable Flood Management but it is not providing anything new. Between the definition and the indicators, it is possible to see a way forward. It may be better to replace "maximum" with "optimum" as local authorities may have other competing priorities and demands. Resources may not always be deployed to flooding priorities. See also comments above.</p>
<p><i>Q3. Do you agree with the conclusion as set out in paragraph 3.17?</i></p>	<p>The desirability of a single competent authority is accepted. However, it is important that the Directive is delivered appropriately but this bill is also looking at existing legislation and that needs also to be considered. It may be possible to identify a role for a single competent authority to implement the Floods Directive but the bill covers more than this and a dual competent authority may be unavoidable, with local authorities involved.</p> <p>There is a need to consider both the catchment and local levels of flood risk mitigation measures but these are not stand alone and require both the Local Authority and SEPA to collaborate closely together at both levels. The aim of the directive is to look at a much more holistic approach and that is what is required.</p> <p>It is clear that a partnership approach will be required to ensure successful implementation of this bill.</p>

<p>Q4. Do you agree that there should be a single competent authority with a national remit for implementing the Floods Directive, and that it should be SEPA?</p>	<p>Again, the desirability of a single competent authority is recognised. However, there will be difficulty in identifying SEPA as a stand alone competent authority as the Local Authorities will be required to input into all levels of the Preliminary Flood Risk Assessment and maps. Further to this they will be the authorities that implement the Flood Risk Management Plans at the local scale.</p> <p>It is clear that SEPA as a competent authority may fulfil the roles at a Strategic response level to the EU Directive and is a sensible place to hold and disseminate information from. However, this consultation is about more than the European floods Directive and is considering the future of long term flood risk management and that includes changing legislation, therefore a Local Authority must also be considered to be a competent partner.</p> <p>Clearly there is a need for a more collaborative approach to flood risk management with all the relevant players involved.</p>
<p>Q5. Do you agree that this is a sound basis for the development of Local Flood Risk Management Plans? If not what alternative do you propose?</p>	<p>We are content with this and welcome it being a collaborative process with neighbouring authorities and involving all levels of stakeholders and interested parties.</p> <p>We agree that Local Authorities are best placed to lead the Local Flood Risk Management Plan and provide co-ordination and the Strategic Environmental Assessment of the plans. Local Authorities can also provide the single point of contact for the public, to provide and receive information in relation to flooding issues.</p> <p>Local authorities are best placed to undertake flood risk management plans; they possess local knowledge and have established information gathering and biennial reporting systems. It is important that these plans are based on the most relevant and accurate information possible, to reduce wastage of resources and time. There is a requirement for a new 3rd generation of high definition flood maps to better inform the process.</p> <p>There will be issues regarding financial resources and the recruitment of specialised staff. It is essential that funding is made available to facilitate this.</p> <p>We require further definition for how Flood Risk is assessed and the term "Significant Risk" needs to be defined to allow a consistent approach across different catchments and sub-catchments, which will assist the development and construction industries.</p>

	<p>The ability to accommodate climate change needs to be considered through the process.</p>
<p>Q6. Should Ministers or SEPA have the power to designate a lead authority within a local area, or should it be left to the partners?</p>	<p>We agree that partners should be empowered to designate a Lead Authority however in the case of no agreement an arbitration process may be required and in that case we consider that Ministers are best placed to decide and it is assumed that a common approach across catchments will be achieved.</p> <p>We consider that SEPA needs to have duties placed upon it to operate, participate, and be party to a positive solution in a partnership approach, rather than in an autocratic role.</p> <p>It should be recognised that Local Authorities, in general, currently have limited expertise for designing flood defences in-house. They need to bring other expertise into place, not just engineers, but other professionals, such as hydrologists, geomorphologists, flood modellers and specialists in biodiversity, to effectively manage the appraisal of flood risk and selection of preferred measures. This will have resource implications.</p>
<p>Q7. Do you agree that Local Authorities, Scottish Water, the Forestry Commission, and SNH should be identified as responsible authorities?</p>	<p>Yes, however Local Authorities should be considered in a shared Competent Authority's role. Scottish Water in particular, needs to have duties placed upon it, to co-operate, participate and assist to deliver a positive solution.</p>
<p>Q8. Which other bodies should be identified as responsible authorities?</p>	<p>Additional responsible authorities to be considered are energy companies such as Scottish and Southern Energy as part of the flood management and attenuation of river systems through hydro electric schemes. Network Rail and British Waterways should be included along with emergency services as they respond to events as they happen. This should possibly extend to a wider forum including National Farmers Union (NFU) and Scottish Government Rural Payments and Inspections Directorate (formerly Scottish Executive Environmental Rural Affairs Department - SEERAD) as land owner representatives.</p>
<p>Q9. Do you agree that responsible authorities should have a duty to work</p>	<p>Given the importance of ensuring that all responsible authorities actively participate in the process the suggestion that they have a duty to work together is welcomed. However, it is considered essential that there is a mechanism</p>

<p><i>together within Flood Advisory Groups to produce plans?</i></p>	<p>for ensuring that where there is disagreement over the measures proposed in the Area Flood Risk Management Plan that an alternative can be submitted to Scottish Ministers. This would be similar to the mechanism in the Planning Act/Regulations for strategic city region plans.</p> <p>In terms of Local Flood Risk Management Plans it is considered that the existing Flood Liaison Advisory Groups (FLAGs) have an important role to play in their preparation. Again, the proposal to place a duty on responsible authorities to work together on these plans is welcomed as is the suggestion that local authorities lead that process. However, as many FLAGs have a wider stakeholder grouping it may not always be possible to reach agreement on the content of the plan(s) or the measures proposed. Consequently, it is suggested that there is a mechanism to allow alternative views to be expressed and taken into account in the finalisation of the plan(s).</p>
<p><i>Q10. Do you agree the proposals are sufficient to support wider stakeholder and community engagement in the flood risk management planning process?</i></p>	<p>The proposals to involve stakeholders and the wider community in the flood risk management process are welcomed for the reasons outlined in the consultation paper. It is considered necessary to have that stakeholder involvement at all levels of the process. The model provided by the River Basin Management Plans is considered to be an appropriate model to follow. That is there would be a stakeholder group at the national level comprising national bodies, for example COSLA would represent local authorities on that national stakeholder group and organisations like the Association of British Insurers. At the Area Flood Risk Management Plan level, the stakeholder group would involve those with a 'regional' responsibility, for example it would be the area NFUs or Fisheries Board on the group. Finally, at the local level stakeholders would be appropriate representatives of the local community.</p>
<p><i>Q11. Do you agree that the Bill should set out a process similar to that for River Basin Management Planning for the preparation by SEPA of area flood risk management plans?</i></p>	<p>It is considered essential that River Basin Management Planning and Flood Risk Management Planning are co-ordinated and integrated processes. Consequently, the proposal to use a similar process is welcomed as it will build on the experience gained through the River Basin Management Planning process. In any event to meet the requirements of the Strategic Environmental Assessment (SEA) Directive and Environmental Assessment (Scotland) Act 2005, it will be necessary to consider the effects of each plan on the other.</p>
<p><i>Q12. Do you agree that Ministers have</i></p>	<p>It is considered appropriate that Scottish Ministers have the power to approve, reject or modify Area Flood Risk</p>

<p><i>the power to approve, reject or modify Area Flood Risk Management Plans?</i></p>	<p>Management Plans. It is essential that when doing so Scottish Ministers provide justification for their proposed actions and provide the competent authority and others with an interest with the opportunity to comment on any proposed modifications.</p> <p>Given the importance of the Area Flood Risk Management Plans in delivering sustainable flood management it is essential that when approving the plan(s) there is adequate funding in place to implement the measures considered as essential in the plan(s).</p>
	<p><u>Additional Point: Ensuring Compliance with Flood Risk Management Plans</u></p> <p>There was no question relating to this issue covered in 3.41 and 3.42. There may be a difficulty in ensuring the success of a collaborative approach, if a local authority might later suffer from enforcement by the competent authority. It is possible that a local authority might be penalised in this way when it considers that it may have more important priorities to address from limited funding.</p>
	<p><u>Additional comment on Box 8: Proposed Roles and responsibilities for Flood Management in Scotland.</u></p> <p>It should be noted that in general terms, the Bellwin Scheme does not provide adequate assistance to local authorities. It provides only for assistance in coping with the immediate response, once a threshold has been reached and not for any permanent repairs to infrastructure which may be required subsequently.</p>
<p><i>Q13. Do you think that integrated urban drainage plans should be included as part of a Local Flood Risk Management Plan?</i></p>	<p>Integrated urban drainage plans should be included as part of a Local Flood Risk management Plan. It should be noted however, that the desired interaction between all relevant parties is not the norm. Experience shows that Scottish Water does not always co-operate with local authorities and other parties and there is concern over Scottish Water's commitment to interaction and its openness.</p>

<p>Q14. Should Flood Risk Management Plans inform the way that development plans are prepared, or should there be a stronger linkage such as a requirement on planning authorities to show that they have regard to the Flood Risk Management Plans?</p>	<p>There is a definite need to ensure that Flood Risk Management Plans are considered within the development plans. This would allow a more consistent approach and help ensure that these Flood Risk Management Plans are put into place on the ground. There should be a strong linkage to ensure this happens. These development plans should then be used to ensure that inappropriate development does not occur.</p>
<p>Q15. Do you think that the granting of deemed planning permission at the end of the statutory process for flood risk management will deliver a more streamlined approach to the delivery of flood risk management?</p>	<p>Yes, in respect of proposals which would require ministerial approval.</p>
<p>Q16. Should Ministerial confirmation be made necessary even where features of a scheme do not require planning permission?</p>	<p>If the scheme is so small that planning permission is not required, then it should not require ministerial confirmation.</p>
<p>Q17. Is the present procedure for Ministerial confirmation satisfactory for this new purpose or are there revisions e.g. to timescales which should be considered?</p>	<p>The current approvals process is too long and needs to be streamlined.</p>

<p>Q18. Do you think that the option to rely on a local authority based process in a similar way as other local authority development activity should be taken forward?</p>	<p>The Option 2 proposal for both scheme approval and planning consent for smaller schemes, beings devolved to local authorities is welcomed. Notification to ministers would still be required and ministers would only call in an application if they considered it to be significant, allowing minor schemes to be approved without their intervention. Were there to be an unresolved objection however, then the arrangements for Option 1 would be expected to apply.</p>
<p>Q19. What would be the appropriate timescales for notification and response?</p>	<p>There needs to be one timescale for all processes. If this were in line with the planning requirement for objections to be lodged within 21 days, for example, this would be satisfactory.</p>
<p>Q20. Would it be appropriate for such a process to carry deemed planning consent?</p>	<p>Yes, provided that there was safeguard for larger schemes by reference to Scottish Ministers or a Public Local Inquiry.</p>
<p>Q21. How should the issue of technical expertise and capacity to ensure the necessary technical standards are observed, be addressed?</p>	<p>It is considered that the development of technical expertise should be encouraged to develop through universities and employers. Unfortunately the creation of the Water Authorities in 1996, saw staff with expertise in flooding matters, transfer to these new authorities, whilst responsibility for flooding remained with local authorities, who were largely obliged to engage the services of consultants to plug the skills gap. The performance of consultants is varied to say the least. It has become clear that some consultants have failed to grasp the changing nature of flooding response, particularly the duty on local authorities to consider sustainable measures. Overall, the concept of shared expertise or shared services between local authorities is welcomed.</p> <p>Technical Standards and Guidance would be required to ensure a consistent approach.</p>
<p>Q22. Are there any additional alternatives to the options outlined above which would simplify procedures?</p>	<p>See comments above relating to differentiating between small scale and larger schemes.</p>

<p>Q23 Do you consider local authorities' powers are sufficient to take necessary action to avert danger to life and property?</p>	<p>No the Act is very limiting in what it empowers the authorities to do. Firstly the consideration is based on river and tidal flooding and other types of flooding need to be considered. The Act only considers the impacts of flooding on non-agricultural land. Without consideration of agricultural land, we do not have a holistic approach.</p> <p>Although there is mention of being able to remove blockages, dams, small access bridges or other works situated within or on watercourse this has proved difficult to achieve and a strengthening is required to the powers to facilitate this. Further to this should the authorities have to carry this out they should have a facility where they can re-charge the landowner/homeowner.</p> <p>Presently there is no provision to allow Local Authorities to make small scale improvements which could avert danger to life and property. Improvements such as increasing pipe size; re-aligning a system; installation of a pumping station; wall; bund; grid or manhole would require to be raised under a formal Flood Prevention Scheme. If minor works could be carried out to an agreed threshold this would assist.</p> <p>Problems associated where landowners/homeowners have failed to maintain their ground or placed restrictions on watercourses, are at present not addressed within the legislation. Notification to access land and facilities to remove any obstruction or address poor maintenance restricts the ability of Local Authorities to avert danger to life and property.</p> <p>It would assist the Local Authorities if the bye law facility was removed and offences created under the legislation along with significant penalties attached. It would help to ensure works necessary to mitigate risk, are undertaken.</p>
<p>Q24. Do you agree that streamlining the Controlled Activities Regulations and flooding/planning processes can be managed through better guidance?</p>	<p>While guidance would be helpful it is considered that it may be necessary to provide some legislative support either through new secondary legislation or by amending current secondary legislation to ensure that processes are not duplicated and therefore streamlined. For example, Environmental Impact Assessment will be required for both the Controlled Activities Regulations and planning processes and may also be necessary to allow the responsible/competent authority to undertake Appropriate Assessment under the Habitats Directive. All may currently have slightly different requirements but all are essentially seeking to ensure that the environment is protected from inappropriate developments or that the effects are mitigated. Consequently, it would seem desirable to have one process that delivers a single outcome.</p>

<p>Q25. Do you think there is anything further SEPA, the Scottish Government or others should be doing to promote joined-up regulation?</p>	<p>The Scottish Government should be taking the lead on the promotion of joined up regulation as it is the only body with the ability to ensure that all regulations are consistent. In addition, it is the only body with the power to change the regulatory regime to ensure a consistent approach across all sectors.</p> <p>There is also a need for a programme of awareness to focus landowners/home owners attention on the personal responsibilities they have in relation to flood alleviation.</p>
<p>Q26. Do you think that there is an alternative approach to simplifying the process of promoting flood measures to those discussed above which the Government should consider?</p>	<p>The approach suggested in the consultation document is welcomed. It is considered essential that in granting authorisation for flood risk measures that deemed planning consent and deemed Controlled Activities Regulations authorisation is also issued at the same time. This should reduce the amount of duplication in the system. It should also ensure that delays are minimised as it will not be necessary to wait for one authorisation before another is granted.</p>
<p>Q27. Do you agree that the form and content of the biennial reports should be more systematic, and subject to direction from Ministers?</p>	<p>Yes we do consider it should be more formalised, Professor Werritty of the University of Dundee produced a useful report which concluded that a more common format was required to enable information and trends to be identified on a national basis. It would be advantageous to see Professor Werritty's recommendations being implemented.</p>
<p>Q28. Do consultees agree that the proposals as outlined will improve flood risk management and ensure Scotland is equipped to implement sustainable flood management?</p>	<p>The proposals are a reasonable attempt to improve flood risk management within Scotland. However, a single competent authority will have difficulties fulfilling the remit of this bill. It is clear that the bill encompasses much more than the European Directive and includes a heavy reliance on Local Authorities to participate at all levels, therefore a dual competency is recommended to allow the bill to be fully implemented.</p> <p>A more flexible approach to what can be incorporated into flood mitigation proposals is welcomed but National Standards/guidance including Planning Advice Notes should be provided. This should also consider the issues of developers who choose to exploit loopholes within legislation in the quest to build properties in potential risk areas. There is also a need to strengthen building regulations to incorporate flood proofing techniques for properties, and to provide guidance to developers as well as existing property</p>

	<p>owners. This guidance should be extended to insurance companies who are repairing properties that have suffered flooding, to ensure they are flood proofed for the future.</p> <p>Sustainable flood management should also consider the removal of properties where protection cannot be supplied. Consideration should be given to including a provision within amended legislation, for removal and relocation of a property to constitute a flood prevention operation.</p> <p>There is a concern that as consideration is given to including agricultural land within the remit of Local Authorities that it should not become a duty for them to repair and maintain agricultural flood embankments. These should remain the responsibility of the relevant landowner. However, where works have to be undertaken to secure these banks, to assist sustainable flood management, a facility should be available for Local Authorities to re-charge the landowner. A database is required to establish the quality, protection and lifespan of these embankments as well as their role within sustainable flood management. There will also be a need for clear guidance on how these agricultural embankments are dealt with.</p>
<p><i>Q29. Do consultees feel that this is enough to ensure that flood risk is addressed or should local authorities have a new duty to promote measures to alleviate flooding?</i></p>	<p>First and foremost the primary duty for flood mitigation should remain with the relevant homeowner/landowner and more education is required to ensure they understand their duties and obligations.</p> <p>If primary duties are placed on the Local Authorities, this is likely to become a burden upon them to provide a service within existing resources. At present where appropriate measures are required, Local Authorities readily use the powers within the legislation to promote any schemes that may be required. Creating a duty may result in local authorities unnecessarily investigating options to solve an insoluble problem.</p> <p>A realistic view has to be taken that as people note the change in emphasis from a power to a duty, they are likely to consider that the local authority is failing them where a scheme cannot be provided and the pressure on the Local Authority to promote mitigation measures could become excessive. There is little to be gained from changing the power to a duty.</p>

RESERVOIR SAFETY	
Q30. Do you believe enforcement responsibilities under the Reservoirs Act 1975 should be transferred to a single national body?	<p>We have no problem with this approach however we are surprised at the assertion in paragraph 4.7 which states that the format of the Biennial Reports has never been prescribed. The format was standardised for the 2005 and 2007 reports and any further information required could have been easily accommodated.</p> <p>This route is likely to ensure better consistency across the country.</p>
Q31. If so, should it be SEPA or another as yet unidentified body?	<p>We have some concerns regards the current resourcing capability within SEPA to undertake this role and enforce when required, but if this issue were addressed, there is really no other sensible alternative.</p>
Q32. Are you content with the proposals for dealing with reservoir flood maps under the provisions of the Floods Directive, or do you think that there should be a statutory duty on reservoir undertakers to prepare reservoir inundation maps and plans, similar to the duty in the 2003 Water Act for England and Wales?	<p>Reservoir Flood Maps should be consistent across boundaries however Category A or B dams tend to be operated by large utility organisations such as Scottish Water and Scottish Southern Energy. It is appropriate for these organisations to have a duty to produce flood plans and maps in line with the risk their dams pose. However, it may be more appropriate to place duties on the lesser category dam undertakers to participate in the preparation of Plans and maps.</p> <p>A predetermined timescale needs to be identified and enforcement powers granted to ensure compliance.</p>
Q33. Do agree that enforcement powers be extended and post incident reporting included as an additional requirement?	<p>The collation of this information after such incidents should be forwarded to the Scottish Government for a national database.</p> <p>Reservoirs, smaller than those considered to be large raised reservoirs as defined in the act, need to be included in post incident reporting as these can, and have caused flooding previously. The trends of dam type and incident types can be better defined through this route.</p>
Q34. Views on crown application and any other comments?	<p>The Flood maps need to be accurate for the purpose intended regardless of reservoir owner therefore we consider that Crown Property maps and plans need to be included. There should be no exemptions.</p>

Tel. 01576 300793



024

7th April 2008

Michael Russell
Environment Minister
Scottish Parliament
Scottish Government
EDINBURGH

Dear Mr Russell

As you have stated that you are looking for views from members of the public in Dumfries & Galloway, to assist in the shaping of the future "flood prevention bill", I would like you to look into situations, like my own, where the threat of flooding has existed for many years due to archaic and unfair laws which must have existed since medieval times and which no politician, for what ever reason, has had the decency to repeal.

My property is situated at a crossroads and is bordered on 2 sides by a field owned by a farming neighbour. Surface water drains into the corner of this field next to my property where there is a small drain. In periods of "heavy" rainfall the drain is inadequate, surface water backs up creating a "pond" which drains down under my garden wall and accumulates around my property. Actually, the problem existed before I bought the property and had not been revealed. Some years ago I had a most upsetting exchange with this farmer who, when asked, refused to clear out this drain which contributed to the problem. In fact, his reaction was to tell me that as I lived at the bottom of the sloping fields, under the law I had to accept surface water from whatever direction.

As I was unable to reach any satisfactory and fair solution to the problem with this uncivilized farmer, I had to go to great expense to install an open grid-type flood drain around my property which seemed to deal with the problem reasonably satisfactorily. However, due to climate change and the heavier rainfalls we are now experiencing, the problem of surface water accumulating around my property, almost reaching the air-vents, has now re-surfaced.

"SEPA", who I have consulted on this matter, have not been very helpful, although I am informed that the law in Scotland on this type of problem needs urgent attention.

As we all know, the big influential landowners, who used to own all these farms, have had a lot of input into the legal system over the centuries to protect their interests and this is at the root of the problem.

As I live at a crossroads, there is no land where I can drain this farmer's surface water which he is happy to drain on to me. Mine is a residential property with no farming connection.

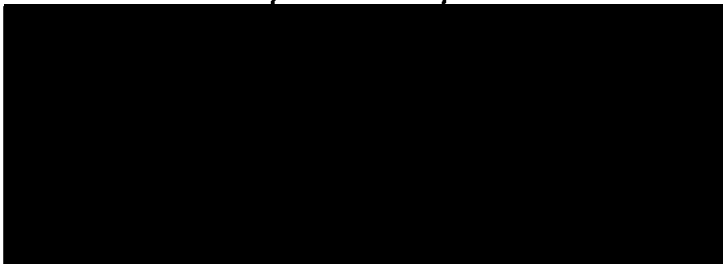
Farming is now the most feather-bedded and protected industry in the land. As a tax payer I am expected to contribute to their highly subsidized lifestyle. Surely, the least I can expect from them is civilized behaviour backed up by the law of the land.

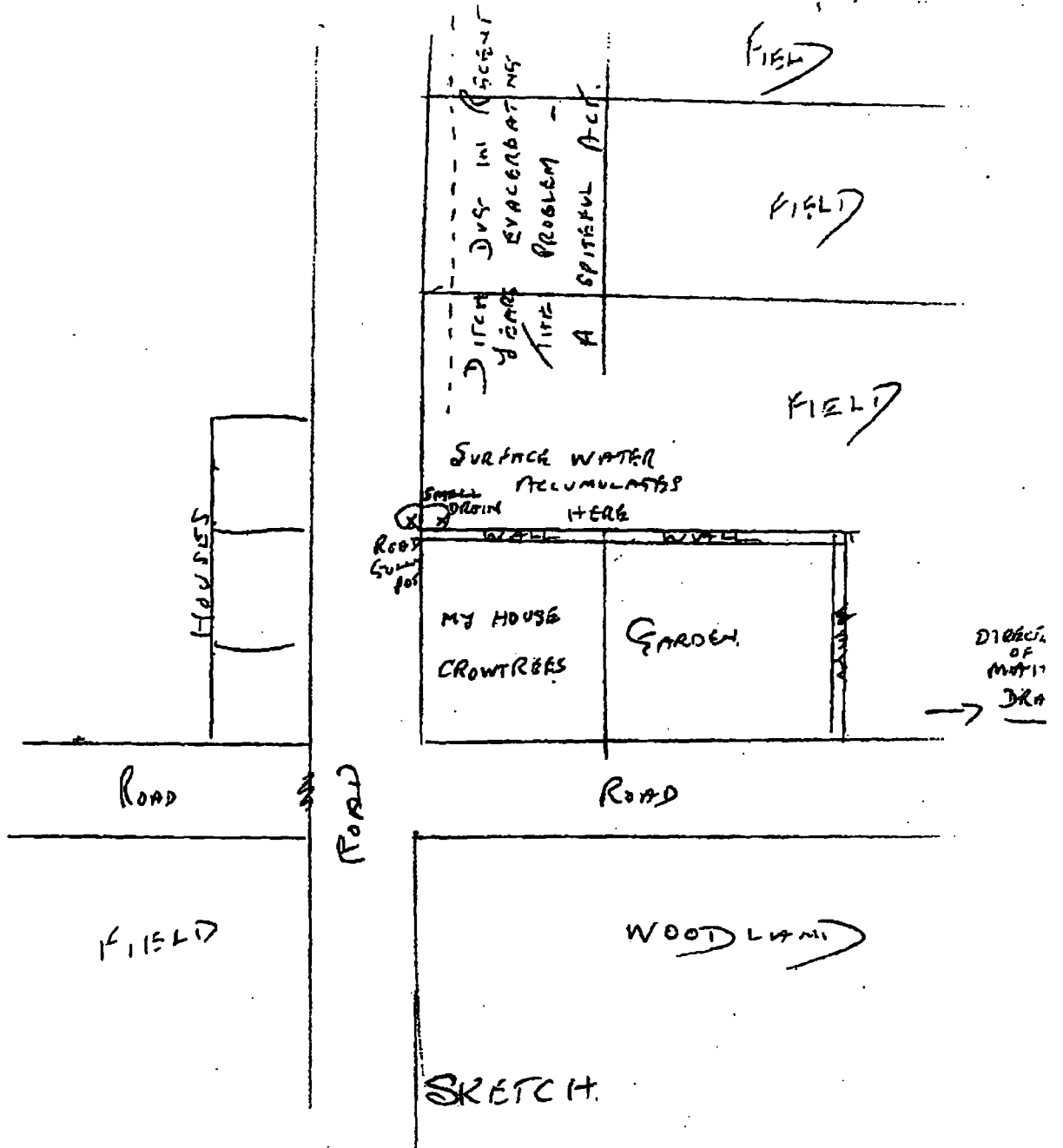
As I recently pointed out to an official from SEPA, were this farmer to restrict light to my premises due to say a tall Leylandii type hedge, because of a change in the law they could force him to rectify the situation by demolishing the hedge. This official agreed. Surface water with the real risk of flooding my home should be dealt with in the same manner. It is far more serious.

I sincerely trust you will appreciate the lunacy of the present situation and carry out urgent repeal of the existing law which is long overdue.

For your information, I enclose a rough sketch of my property to illustrate the problem.

Yours faithfully







Frances Conlan
 Water, Air, Soils and Flooding Division
 The Scottish Government
 1H North
 Victoria Quay
 EDINBURGH
 EH6 6QQ

Please ask for
 Direct line
 Our ref.
 Your ref.
 Date

G Potter

14/4/08

Dear Madam

THE FUTURE OF FLOOD RISK MANAGEMENT IN SCOTLAND

I refer to your recent consultation into Flood Risk Management in Scotland. This was considered by the Highland Council's TEC Services Committee on 10 April 2008 and the Council's formal response to your various questions is detailed below:

Q1. Do you believe the definition of SFM is helpful and of practical benefit to flood risk management?

The definition of Sustainable Flood Management is helpful but the practical benefits of the definition will be difficult to realise. The definition only includes a reference to resilience. Resilience means the ability to recover quickly and easily. The definition could be usefully extended to include prevention, avoidance and reduction of flooding.

Q2. Do you think the definition is clear and simple to understand?

The definition of Sustainable Flood Management depends on a footnote containing an explanation of the meaning of resilience, flooding and the 'four As' Awareness, Avoidance, Alleviation and Assistance. These footnotes should be included directly in the definition, in plain English.

Q3. Do you agree with the conclusion as set out in paragraph 3.17?

Yes, a single competent body with a national remit for implementing the Flood Directive is required. The approach does need to be underpinned by local co-ordination.

Q4. Do you agree that there should be a single competent authority with a national remit for implementing the Floods Directive, and that it should be SEPA?

The Council is content that SEPA is the single competent authority but SEPA must have a formal duty to consult responsible authorities and stakeholders.

Q5. Do you agree that this is a sound basis for the development of Local Flood Risk Management Plans? If not what alternative do you propose?

The Council agrees that this is a sound basis but all the elements in paragraph 3.27 (appraisal, measures, sustainable urban drainage plan, timetable, funding plan), must be included in the Local Flood Management Plan and this will need the input of all the responsible bodies. For example - an urban drainage plan cannot be carried out without the input of Scottish Water - a timetable cannot be implemented without identification of funding. The full spectrum of water sources must be included in the plan and all resources for implementation of the Plan must be identified along with timescales.

Q6. Should Ministers or SEPA have the power to designate a lead authority within a local area, or should it be left to the Partners?

Power to designate a lead authority may be delegated to Partners but Ministers will require the fall back powers to resolve any lack of agreement among Partners.

Q7. Do you agree that Local Authorities, Scottish Water, the Forestry Commission, and SNH should be identified as responsible authorities?

Yes

Q8. Which other bodies should be identified as responsible authorities?

Other bodies which should be identified are Hydro-Power generation companies, Canal and Waterways Authorities, Railway Operators, all Road Authorities and anyone with responsibility for substantial impoundments (weirs or reservoirs). For example, Scottish & Southern Electricity, Alcan, British Waterways (Scotland), Distilleries, Network Rail and the Trunk Road Authority.

Q9. Do you agree that responsible authorities should have a duty to work together within Flood Advisory Groups to produce plans?

Yes.

Q10. Do you agree the proposals are sufficient to support wider stakeholder and community engagement in the flood risk management planning process?

Yes, but some of the stakeholders may need support funding in order to fully contribute to the process.



0977

PROJECT DESIGN UNIT: Offices at Ales, Brora, Dingwall and Inverness
REPLY TO: Project Design Unit, Transport Environmental & Community Services,
Council Offices, Dingwall, IV15 9QN



Certification No 78 01291

Q11. Do you agree that the Bill should set out a process similar to that for River Basin Management Planning for the preparation by SEPA of area flood risk management plans?

Yes.

Q12. Do you agree that Ministers have the power to approve, reject or modify Area Flood Risk Management Plans?

Yes.

Q13. Do you think that integrated urban drainage plans should be included as part of a Local Flood Risk Management Plan?

Yes, successful Risk Management Plans must include an integrated urban drainage plan otherwise the risks of flooding from all sources cannot be addressed.

Q14. Should Flood Risk Management Plans inform the way that development plans are prepared, or should there be a stronger linkage such as a requirement on planning authorities to show that they have regard to the FRMPs?

Yes, there should be a stronger linkage for Development Plans to address flooding issues raised by the Flood Risk Management Plan process.

Q15. Do you think that the granting of deemed planning permission at the end of the statutory process for flood risk management will deliver a more streamlined approach to the delivery of flood risk management?

Yes. It will deliver a more streamlined and integrated approach. The Highland Council's experience suggests that objections to flood schemes on planning grounds were mainly duplicates of the objections to the Flood Prevention Order.

Q16. Should Ministerial confirmation be made necessary even where features of a scheme do not require planning permission?

Yes. Most flood schemes require planning consent. Therefore, the necessity for Ministerial approval will be only slightly greater.

Q17. Is the present procedure for Ministerial confirmation satisfactory for this new purpose or are there revisions e.g. to timescales which should be considered?

Yes. The present procedure is satisfactory. The timescales for advertisement and objection



0977

PROJECT DESIGN UNIT: Offices at Alness, Brora, Dingwall and Inverness
REPLY TO: Project Design Unit, Transport Environmental & Community Services,
Council Offices, Dingwall, IV15 9QN



Certificate No. FB 21191

could be radically reduced to a similar level for that required for planning applications.

Q18. Do you think that the option to rely on a local authority based process in a similar way as other local authority development activity should be taken forward?

The option to rely on local authorities could be reserved for minor schemes where agreement with landowners can be obtained. If a Compulsory Purchase Order is to be relied on then the timescale would increase for this option to the timescale currently needed for Flood Prevention Schemes, with no advantages. Also, if the local authority has to acquire the land then in many cases this would not be desirable from the local authority perspective or from the landowner's point of view. However, future maintenance of any such option would have to rely on a legal servitude agreement for access and operations.

Q19. What would be the appropriate timescales for notification and response?

Appropriate timescales should be equivalent to the current planning procedures.

Q20. Would it be appropriate for such a process to carry deemed planning consent?

Yes.

Q21. How should the issue of technical expertise and capacity to ensure the necessary technical standards are observed, be addressed?

There would be a problem over liability for the effect of any schemes. Any proposals would have to comply with the Flood Risk Management Plan. Technical standards could be set out through mandatory procedures and standards issued by Government. For example local roads are designed and constructed using national guidelines. Departures from Standard are subject to a verification and justification procedure. Guidance on whether a scheme should reduce flood risk to 1 in 25 years, 1 in 100 or 1 in 200 would have to be defined.

Q22. Are there any additional alternatives to the options outlined above which would simplify procedures?

Yes, minor schemes and universally accepted desirable schemes should be fast-tracked. Such schemes would need to be defined, but should be similar to permitted development. These schemes should not be subject to the full procedures required by the adopted options outlined in the consultation.



0977

PROJECT DESIGN UNIT: Offices at Alass, Brora, Dingwall and Inverness
REPLY TO: Project Design Unit, Transport Environmental & Community Services,
Council Offices, Dingwall, IV15 9QN



000
Certificate No. FR 01091

Q23 Do you consider local authorities' powers are sufficient to take necessary action to avert danger to life and property?

Yes.

Q24. Do you agree that streamlining the CAR and flooding/planning processes can be managed through better guidance?

Yes, better guidance would streamline the processes. The CAR procedure quite often considers the environmental effects to the detriment of the social cost, funding, urgency needs and benefits. A more balanced approach is required.

Q25. Do you think there is anything further SEPA, the Scottish Government or others should be doing to promote joined-up regulation?

Yes. The process would be assisted if the completed Flood Risk Management Plan is adopted as a statutory document by SEPA which must be complied with. The approach to CAR would then be aligned with the plan and CAR consent should then be a formality.

Q26. Do you think that there is an alternative approach to simplifying the process of promoting flood measures to those discussed above which the Government should consider?

Yes see the answer to Q22. Minor schemes should be exempt from most of the procedures.

Q27. Do you agree that the form and content of the biennial reports should be more systematic, and subject to direction from Ministers?

Yes, they should be based on a standard template.

Q28. Do consultees agree that the proposals as outlined will improve flood risk management and ensure Scotland is equipped to implement sustainable flood management?

Yes, subject to the comments above.

Q29. Do consultees feel that this is enough to ensure that flood risk is addressed or should local authorities have a new duty to promote measures to alleviate flooding?

If local authorities are given duties to promote measures to alleviate flooding then it would place them in a difficult position if such flood schemes cannot be delivered. Non-delivery may be due



0977

PROJECT DESIGN UNIT: Offices at Alness, Brora, Dingwall and Inverness
REPLY TO: Project Design Unit, Transport Environmental & Community Services,
Council Offices, Dingwall, IV15 9QN



Certificate No. 78 0199

to objections, timescales, funding or lack of powers. There are many reasons for flooding and local authorities cannot necessarily be made responsible for alleviating flooding arising from all causes.

RESERVOIR SAFETY

Q30. Do you believe enforcement responsibilities under the Reservoirs Act 1975 should be transferred to a single national body?

Yes.

Q31. If so, should it be SEPA or another as yet unidentified body?

This body may be SEPA. In any case reservoir owners should be designated as responsible authorities under any modified regulations.

Q32. Are you content with the proposals for dealing with reservoir flood maps under the provisions of the Floods Directive, or do you think that there should be a statutory duty on reservoir undertakers to prepare reservoir inundation maps and plans, similar to the duty in the 2003 Water Act for England and Wales?

Inundation maps are a necessary requirement if all hazards and risks are to be identified.

Q33. Do you agree that enforcement powers be extended and post incident reporting included as an additional requirement?

Yes

Q34. Views on Crown applications and any other comments?

Crown bodies should not be exempt from any new flood legislation.

Other Comments

1 Sustainable flood management will often result in a detrimental effect to some landowners and householders to the benefit of others. Adequate compensation and powers have to be included in the legislation for this sustainable approach to be effective. Natural flood management may require some areas to be flooded for attenuation.

2 Sewerage systems and the standards to which they are built are very important components of flood risk and need to be integrated into the Plans.



0977

PROJECT DESIGN UNIT: Offices at AIness, Brora, Dingwall and Inverness
REPLY TO: Project Design Unit, Transport Environmental & Community Services,
Council Offices, Dingwall, IV15 9QN



Certificate No. FE 01191

3 Resources along with expert knowledge and skill will be required by all the bodies involved. Training schemes and support will be needed to ensure that this is available to prepare and deliver effective and efficient Flood Management Plans.

4 The current flood risk maps are a broad brush and will need further refinement to increase their accuracy and relevance in critical areas. There are anomalies and omissions in the current flood maps which need to be addressed. Examples are: the accuracy of the flood outlines, consideration of constrictions and structures and also small catchments are excluded. Flood Risk Management Plans will need more accurate data, and the inclusion of these currently excluded effects if they are to be representative of the actual situation.

Yours faithfully



Geoff Potter
Project Design Unit Manager



0977

PROJECT DESIGN UNIT: Offices at Alness, Brora, Dingwall and Inverness
REPLY TO: Project Design Unit, Transport Environmental & Community Services,
Council Offices, Dingwall, IV15 9QN



Certificate No. 78 01191

026

Balerno Community Council (BCC)

Dr. K. D. Stephen BSc, PhD, (rtd Euro Ing, FIEE, FISMM, CEng)

Northfield,

Community Council Web Site:-

550 Lanark Road West,

www.balerno-communitycouncil.org.uk

Balerno. EH14 7BW

Telephone: [REDACTED]

e mail: [REDACTED]

Freedom of Information Act

Frances Conlan,
Water, Air, Soils and Flooding Division,
The Scottish Government, 1 H North,
Victoria Quay,
Edinburgh. EH6 6QQ

Our Ref: Scot Gov, F. Conlan.
Your Ref: 2008/0011875OR
Copies: KS, TA, DMcC.
Date: 16th April 2008

Dear Frances Conlan,
The Future of Flood Risk Management in Scotland – Consultation Document February 2008.

I have been asked by Balerno Community Council to respond to the above consultation on their behalf. With reference to Annex D of the Consultation Document, I am responding on behalf of Balerno Community Council; the official name and address of Balerno Community Council is:-

Mrs. T. Allan, Secretary, Balerno Community Council,
6 Lovedale Avenue, Balerno. EH14 7DT

The content of our response is to be made available. I am content for the Scottish Government to contact me again in the future in relation to this consultation response.

In the light of our research on this subject, we offer the following in response to Questions 22, 25, 26 & 34.

Enclosed copy of our Research Paper V11-15th April 08, related letter, copies of the first pages of the 9 Sections of the Report entitled "The global water crisis and the commodification of the world's water supply" (Introduction; The Crisis; The Impact of Globalization; The Water Privateers; The Global Trade in Water; The Failure of Governments; The Threat of International Trade and Investment Agreements; The Need for Common Principles; Conclusion) issued by the International Forum on Globalization (IFG).

Based on the above and our communications with Defra, the EA, CEH and the FEH and various others in this country and overseas, and our experience in determining forward looking policies on the basis of history, facts, threats, opportunities, objectives, and unintended consequences, we find it difficult to understand why you think it necessary to treat our rivers as a threat rather than an opportunity and to answer any of the other Questions except with "No".

It would appear from the Consultation Document that the Scottish Government has failed to undertake a rigorous and careful analysis in either a management, scientific or global context of the potential for Scottish Rivers themselves to make a significant contribution to "creating a more successful country, with opportunities for all of Scotland to flourish, through increasing sustainable economic growth."

In this context we request a copy, Under the Freedom of Information Act, of the information presented to the Scottish Ministers relating to this Consultation Document. We understand that although this type of information might not have been available in the past, due to a number of recent cases, it will now be available under the FIA.

Yours sincerely,

[REDACTED]

Dr. Kenneth D. Stephen
Balerno Community Councillor.

Eliminating River Flooding **by Active Reservoir Management**

Blue Gold - How to design a safe, cost effective River Flood **Prevention and Hydro Power Scheme**

"The need to stop wasting water is urgent" IFG Spring 2001

*In the UK we spend hundreds of millions of pounds every year on Flood Prevention
Yet every succeeding year we seem to be less successful at Preventing Flooding
Are we spending taxpayer's money wisely?*

What people whose property is currently at risk of flooding want, is not a Flood Prevention Scheme which will not prevent flooding; or a flood risk map; or warnings when flooding is imminent; or the fitting of temporary flood barriers; or a supply of sandbags; or rescuing from a house they will never feel the same about again and which they will not be able to sell or insure; or excuses; but the complete elimination of the threat of flooding to their property and land in any foreseeable or unforeseeable circumstances, so that they can feel safe and secure in their own homes and sleep peacefully in their beds at night.

Our predecessors built many flood storage reservoirs around the country specifically to hold sudden high volumes of rainwater to prevent flooding of property. These do not appear to have been modified or increased in number to cope with the increasingly severe weather we are now experiencing.

**This Research Paper is being prepared by
Dr. Kenneth D. Stephen BSc PhD, Balerno Community Councillor,
for Balerno Community Council
<http://www.balerno-communitycouncil.org.uk>**

Version 11 – 15th April 2008

Eliminating River Flooding by Active Reservoir Management

Being prepared by Dr. Kenneth D. Stephen for Balerno Community Council.

Copyright

Copyright © 2008 Dr. Kenneth D. Stephen for Balerno Community Council. This Research Paper is published under the terms of the *Creative Commons Attribution-Share Alike 2.5 UK: Scotland Licence*. In summary, you are free to copy, distribute, display, and perform the work and to make derivative works under the following conditions: you must give the original author credit; if you alter, transform, or build upon this work, you must distribute the resulting work only under a licence identical to this one; for any reuse or distribution, you must make clear to others the licence terms of this work. Any of these conditions can be waived if you get permission from the copyright holder. Nothing in this license impairs or restricts the author's moral rights. For the full licence, see <http://creativecommons.org/licenses/by-sa/2.5/scotland/legalcode>.

Version History

<i>No</i>	<i>Date</i>	<i>Notes</i>
7	1 st March 2008	Circulated for review by Balerno Community Council
8	6 th April 2008	Formatted for publication in pdf

Disclaimer

Balerno Community Council (BCC) is not able to warrant the accuracy of the data in this paper and neither BCC nor any of its members has any responsibility for determining the fitness of the data, calculations or methodology for their intended use by the user. The provision of such data, calculations or methodology carries no liability for their accuracy or reliability or any omissions and we cannot be held accountable for any loss, damage, injury, death, or personal injury or any other occurrence arising from the use of this data, calculations or methodology.

Our entire liability in respect of any tort or breach of our duties, statutory or otherwise, whether or not attributable to our negligence, is limited to the fee paid for this paper and the data, calculations or methodology contained therein. It must be recognised that raw data may be transcribed, or may be acquired and processed using automated techniques.

Although such processing is undertaken as accurately and reliably as possible, some data may be subject to processing without human intervention with the result that errors may be undetected.

Acknowledgements

The author wishes to acknowledge the support of Balerno Community Council and all its members and those members of the Edinburgh Flood Prevention Group, past and present, without whose encouragement this paper could not have been produced. He also wishes to acknowledge the support, encouragement, tolerance and patience of the Councillors and Staff of the City of Edinburgh Council, the elected Members of the British and Scottish Parliaments for Balerno and their Civil Servants and the staff of Scottish Water, the MET Office, the Babbie Group, ARUP, DEFRA and the Environment Agency. Particular thanks is due to Dr. C. Clark of the Chardon Hill Research Station, the staff of the Centre for Ecology & Hydrology and for the information given on their website relating to the Flood Estimation Handbook, Encyclopaedia Britannica, the New Scientist, the International Forum on Globalization (IFG) Committee on the Globalization of Water, various websites including that of, Waterpower Magazine and the many other individuals in the United States, mainland Europe, Southern Africa and Australasia who have unstintingly offered advice and support.

Table of Contents

Summary	5
Introduction	6
<i>Every drop of water is precious</i>	6
<i>Our flood storage reservoirs are no longer "Fit For Purpose"</i>	8
<i>Treat the disease not the symptoms</i>	8
<i>Downstream flooding does not exist on rivers with upstream hydroelectric dams because if it did it would reduce the profits of the companies which operate these hydroelectric schemes</i>	8
<i>If there is a sudden big increase in the flow of water in a river, or a surge which looks like a wave, the most probable cause is the overflowing of an upstream flood storage reservoir which was "specifically intended to hold sudden high volumes of rainwater to prevent flooding of property."</i>	8
Explanation of the Active Reservoir Management method of flood prevention in simple, everyday, familiar terms	10
<i>If a bath is overflowing you do not put sandbags round the bath rim, you turn the tap off</i>	11
<i>If severe rainfall is held where it falls, upstream, obviously it can not cause flooding downstream</i>	11
Part 1. Traditional Walls and Embankment Flood Prevention Methods Do Not Prevent Flooding	12
<i>"To many the defence against flooding is the construction of engineering structures such as walls and barriers to prevent floodwaters inundating those areas we have chosen to develop. However attractive this may appear, total application of this solution with limited resources is impractical, uneconomic and unsustainable."</i> ²	12
<i>"Those that fail to learn from history, are doomed to repeat it" Winston Churchill</i>	12
<i>It is illogical to use a non-flexible solution, like a traditional wall and embankment flood prevention scheme, to deal with a variable and predicted to be increasingly severe problem. The traditional method of designing flood walls and embankment flood prevention schemes is not appropriate for the exceptional events which cause severe flooding in the UK</i>	12
<i>We have been treating the consequences of the problem (the symptoms), overflowing rivers, rather than the problem itself (the disease), too much water entering our rivers in the first place</i>	15
<i>It is patently obvious that if rainfall in a catchment area is stored upstream in reservoirs it can not at the same time flow downstream in the rivers fed by these reservoirs, and cause flooding</i>	15
Part 2. Reservoir Storage – a success story; a new, dramatically cost effective and Active Management Method of Flood Prevention; Do it yourself Flood Prevention Design. April 2008	16
<i>Obviously if you store all the flood water upstream it can not at the same time cause flooding Downstream</i>	16
<i>It is claimed that the method of Active Management of Reservoir Storage, as illustrated in the following example, is exceptionally cost effective, is both elegant and simple, and is not prone to the miscalculations which can occur in Computer Modelling</i>	17
<i>Water Balance the concept underlying all the Hydrologic Sciences</i>	19
<i>Annual Rainfall and Average Annual Flow for the Water of Leith – Illustration No 1</i>	20
<i>Illustration No 2 - Surely it is only logical that the part of the total Water of Leith catchment area which contributes most to the flood risk, the Hillside Catchment Area, should be the part which gets most attention, rather than as in the CEC Scheme – the part that gets least attention</i>	21
<i>Increasing the Water of Leith Reservoirs Flood Prevention Potential</i>	22
<i>Active Reservoir Management – Illustration No 3</i>	22
<i>The Water of Leith Rural Catchment Area Calculations</i>	23
<i>The Need for New Reservoirs</i>	23
<i>Answers to some objections</i>	24
Part 3. Hydro Energy – Do it yourself Hydro Electric Design – April 2008.....	25
<i>In 2006 a new hydroelectric plant on the river Thames started supplying power to Windsor Castle</i>	25
<i>Inverness Council is considering reopening a small hydroelectric plant to power some of its electricity needs</i>	25
<i>The DTI's Enviro Report 2005 indicates the UK has the potential to provide 11,300 GWh new</i>	25

<i>Hydro Power</i>	26
Part 4. Environmental Issue. April 2008.....	27
References	28
Illustration No 1	29
Flow Diagram No 1	30
Illustration No 2.....	31
Flow Diagram No 2.....	32
Illustration No 3.....	33
Flow Diagram NO 3	34
Schematic Representation.....	35

Summary

A Flood Prevention Scheme which will not prevent flooding is obviously "Not Fit For Purpose"!
CEC admitted in their Summary Precognitions at the Public Local Inquiry (see para 5.3 of their Precognitions) that their Scheme would not prevent flooding.

The method of fluvial (river) flood prevention - walls and embankments - on which the UK is spending hundreds of millions of pounds every year, invariably fail, and in a number of different ways and for a number of different reasons. The paper describes in simple terms, and in accordance with the concept of water balance, which underlies all the hydrologic sciences, the method of flood prevention used by our predecessors - reservoir storage - which is dramatically superior to the walls and embankments method in every way. Storing rainfall in reservoirs obviously also helps relieve drought conditions. The paper then demonstrates, in readily understood terms, that the same level of flood mitigation of the City of Edinburgh Council (CEC) Water of Leith Flood Prevention Scheme, of 10,300 metres of walls and embankments through a World Heritage Site, could be achieved, at a cost of only £6m - a saving of £46m on the CEC Scheme, see para 2.10 of this paper, just by marginally increasing the heights of the existing reservoir dams. Since these upstream reservoirs now belong to CEC, raising the dam heights by this marginal amount should be possible well within the time scale of the CEC Scheme. The paper goes on to illustrate how, much greater levels of flood prevention can be achieved by adopting the method of *Active Reservoir Management*. The CEC Scheme has been used to illustrate the differences between the two methods, because in its upper reaches the Water of Leith flows through Balerno and consequently the authors have local knowledge and residents of Balerno would not be protected by the CEC Scheme.

When water is stored in upstream reservoirs it is also only logical to use it to generate electricity, and the paper indicates how this may be optimised both to produce renewable electrical power in a most advantageous way and at the same time improve the environment and reduce Global Warming. The DTI's *Enviros Report 2005* indicates that the currently untapped exploitable hydro capacity in the UK from our rivers is 11,300 GWh or £1,130m per year at 10p/unit. This represents nearly 6 times the UK's total renewables generation from wind, wave and solar power in 2004 and hydro power is storeable - that means it can be used when it is needed and not just when the wind blows within the right speed range, not too slow or too fast, or when there are waves or when the sun shines. The £1m scheme on the river Thames at Romney weir, completed in 2006 by Npower Renewables, generates 200KW of renewable electricity for Windsor Castle. It has been estimated the relatively insignificant, in terms of annual rainfall, Water of Leith could generate £2m per year in renewable electricity

In Part 4 the paper deals with the wider economic, political and environmental issues including the declining availability of freshwater. "All but one of England's 33 major rivers are suffering: some are now less than a third of their average depth. The Thames is threatening to run dry and already larger ships are having to restrict their movements to high tides."²⁸ First there was 'Black Gold' - Oil, now there is 'Blue Gold' - Fresh Water. Both are in decline on a world wide basis, increasing in value and subject to commercial exploitation. In their booklet "Blue Gold - The global water crisis and the commodification of the world's water supply" Maude Barlow, National Chairperson of the International Forum on Globalization (IFG) Committee on the Globalization of Water stated "If present trends persist, the water in all river basins on every continent could steadily be depleted. Global consumption of water is doubling every 20 years, more than twice the rate of human population growth. According to the United Nations, more than one billion people on earth already lack access to fresh drinking water. If current trends persist, by 2025 the demand for freshwater is expected to rise to 56 percent above the amount that is currently available." As Ismail Serageldin, vice president of the World Bank said "The wars of the next century will be about water."²⁸ *Yet we in the UK are discarding vast quantities of our precious rainfall, during severe weather flooding conditions, mixing it with effluents and our valuable top soil and channelling it via traditional flood wall and embankment flood defences into the sea.*

these more severe floods. For whatever reason, from the fact that these flood storage reservoirs are no longer able "to hold sudden high volumes of rainwater to prevent flooding of property" they are obviously, at present no longer "fit for purpose" which is one of the main reasons why we have been experiencing dramatic increases in downstream flooding.

Treat the disease not the symptoms.

There has been a lot of nonsense talked about the downstream flooding problem. For example because we have built, or built too many, houses on flood plains and the solution being offered is to build ever higher walls along the banks of our rivers to channel the flood water elsewhere. We have always built on floodplains, for obvious reasons. Downstream flooding is the symptom of the problem, not the problem itself. The problem is that, when river flooding occurs, there is too much water flowing down our rivers from the sources of our rivers, the hillsides, where the rainfall is heaviest, sometimes several times heavier than on the flood plains. We must re-learn the lessons learnt and acted upon by of our predecessors, treat the problem – too much water entering our rivers from the hillsides, not the consequences – rivers overflowing their banks downstream. Similarly now, because we are covering up our gardens with concrete to take our cars, which our Councils will not allow us to park on the street, and built houses on what used to be fields, the drains which used to be adequate to take away the surface water rainfall are no longer "fit for purpose". Either the drains will have to be replaced with larger drains or we will have to use techniques to let the rain soak away into the land or be stored for flushing toilets etc.

Downstream flooding does not exist on rivers with upstream hydroelectric dams because if it did it would reduce the profits of the companies which operate these hydroelectric schemes.

The average annual rainfall on Ben Nevis (the highest mountain in Britain located to the North West of Scotland) is 4,350 mm, or more than 14 ft, per year which is more than twice the rainfall at Fort William, the town at the foot of Ben Nevis, which is at sea level. This compares with the average annual rainfall of 676 mm for the Water of Leith which flows through Edinburgh, on the East Coast of Scotland, only about 16% of the annual rainfall on Ben Nevis. Why does flooding in Scotland not occur in the North West of Scotland where the rainfall is highest? Could it be because the Hydro Generating Schemes in Scotland, with their associated very large dams, are mainly built where the rainfall is greatest and the companies which operate these hydroelectric schemes try to ensure all the water collected behind the dams goes through the turbines, as any water which overflows the dams does not go through the turbines to generate electricity, and is wasted as far as these companies are concerned, which reduces their profits. In fact in some hydroelectric schemes in the UK, called 'Pump Storage Schemes', the water flows through the turbines generating electricity at peak load periods when it commands a premium price, and is pumped back up again to the reservoirs when energy is much less expensive, at night, so that it can go through the turbines to produce energy again at the next peak time. The Tanygrisiau hydro-electric pump storage scheme at Ffestiniog in Wales was the first to be completed in Britain in 1963. There are some 14 Pump Storage Schemes in Scotland with an annual output of 1,544.5 GWh. They are highly profitable, very flexible and may have as many as ten thousand stop-starts in a year²⁶.

If there is a sudden big increase in the flow of water in a river, or a surge which looks like a wave, the most probable cause is the overflowing of an upstream flood storage reservoir which was "specifically intended to hold sudden high volumes of rainwater to prevent flooding of property."

We should, like our predecessors, the Victorians who new a thing or two, treat the problem not the symptoms and modernise our upstream reservoirs, and/or build new ones, so that they will hold much greater sudden volumes of rainwater, in order that they will be able to prevent flooding of property downstream and be "fit for purpose". An interesting proof of the fact that we have not increased our reservoir capacities to cope with the increased severity of our rainfall can be seen when a wave of water flows downstream during a period of heavy rainfall. Where do the citizens, who wait nervously to see if

this wave of water will flood their property, think it comes from? This wave of water occurs when the reservoirs upstream overflow their dams, as this suddenly effectively increases the river catchment area, by the catchment area of the reservoirs, and hence suddenly increases the flow of water in the river.

These upstream reservoirs can be used to generate renewable hydro electric power. The potential energy they can produce in Scotland alone is about equivalent to that of a Nuclear Power station and, unlike wind or tidal renewable energy, they can provide electricity when it is required rather than just when the wind blows at the right speed – not too fast and not too slow – or when the tide changes. As far as renewable energy is concerned a combination of energy sources is desirable, but the most reliable source of renewable energy is hydro energy because it is the only one which can store large quantities of renewable energy, and unlike fossil fuel fired or nuclear power stations this energy is available within seconds. Moreover hydro power stations have a very long working life, and they produce no pollution or waste. No renewable system can operate without a storable energy component.

Explanation of the Active Reservoir Management method of Flood Prevention in simple, everyday, familiar terms.

In our experience most people find it difficult to understand basic Hydrology and (water) Catchment Areas and yet if they are going to discuss Flood Prevention with the Authorities it is important that they do understand these concepts which sometimes the Authorities themselves do not understand. The following explanation has been couched in simple, everyday, familiar terms to help the uninitiated understand what they mean. To keep the explanations as simple as possible complications such as run-off, transpiration, sub-soil flow etc which in severe flood conditions make no difference anyway, have been ignored but can be added later if required.

Water Balance is the concept underlying all the Hydrologic Sciences. Basically for any area, the amount of water entering the area must equal, or balance, the amount of water leaving it. For example if one considers a simple, straightforward, normal, conventional bath with one tap and one drain. For Water Balance, that is stable conditions with the water level in the bath neither rising nor falling, the amount of water entering the bath through the tap must equal the amount of water leaving the bath through the drain.

A water Catchment Area is a drainage basin where rainfall collects. Rainfall collects in every specific Catchment Area because at every point in that area, the ground slopes down, usually to a river. Most catchment areas are surrounded by other catchment areas. Ultimately these rivers flow into other rivers or lakes or the sea

Any one Catchment Area can for convenience be subdivided into a number of smaller Catchment Areas. For example the Water of Leith Catchment Area of 117.3 sq km (see Schematic Representation of the Water of Leith Catchment Area, Water Flow Modeller tables and Catchment Area Diagrams) is, for convenience, subdivided into four Catchment Areas, the Hillside Catchment Area 34.1 sq km (above the reservoirs), the Rural Catchment Area 49.8 sq km (between the reservoirs and Colinton), the Upper Urban Catchment Area 23.2 sq km (between Colinton and the flow gauge at Murrayfield), and the Lower Urban Catchment Area 10.2 sq km (between the flow gauge at Murrayfield and the sea at Leith).

Consider a normal conventional domestic bath with an overhead shower, two conventional taps and a plug-hole drain. In general terms the bath represents the local catchment area, the shower represents the rainfall in the local catchment area, the first tap represents the flow of water into the local catchment area from the upstream area, usually the river upstream, and the plug-hole drain represents the drain from the local catchment area downstream, usually to the river downstream. The second tap represents any other sources of water flowing into the local catchment area from another catchment area – but more about that later.

Let us assume the local catchment area we wish to consider, the bath, is that part of the Water of Leith Catchment Area between Colinton and Murrayfield, known as the Upper Urban Catchment Area of Edinburgh. During normal weather conditions, on a dry day the only water entering the Upper Urban Catchment Area is the water flowing down the Water of Leith from the adjacent Rural Catchment Area, between Colinton and the Reservoirs, out of the first tap. When rain is falling, additionally water will enter the Upper Urban Catchment Area, the bath, from the shower representing rainfall from the heavens. In both instances the water leaving the Upper Urban Catchment Area, the bath, will go down the plug hole drain, that is in the Water of Leith out of the Upper Urban Area passing the flow gauge at Murrayfield into the adjacent Lower Urban Area. If all the water flowing in the Water of Leith in the Hillside and Rural Areas is held behind upstream dams, there will be no water entering the Upper Urban Area, the first tap will be turned off, and the only water entering the Upper Urban Area will be rainfall, from the shower, and all this water will leave the Upper Urban Area passing the flow gauge at Murrayfield, through the plug hole drain, into the Lower Urban Area.

If the first tap is turned on, water from the Water of Leith Rural Area plug hole drain will flow into the Upper Urban Area and so on.

If the water entering any catchment area (bath) from its own rainfall (shower) and from other upstream catchment areas (the taps) flows into the bath faster than it flows out through the drain, the bath will eventually overflow (exceed the full bank flow) and start flooding the bathroom around the bath.

If a bath is overflowing you do not put sandbags round the bath rim, you turn the tap off.

Relating the above illustration to the water in a river which is at risk of flooding, the bath represents the river at one specific location – say Tewksbury, the tap represents the water flowing into the river from upstream (from the rainfall in the upstream catchment areas of the rivers Severn and Avon and their tributaries), the drain represents the water flowing downstream – into the river below Tewksbury. On the 18th January 2008, the river at Tewksbury had again overflowed its banks and the residents were waiting helplessly to see what would happen when the surge of flood water flowing down the rivers Severn and Avon arrived from upstream. Whether the flooding increases or decreases at Tewksbury depends on whether the flows of water from the upstream rivers (from the taps) is greater than or less than the flow of water downstream (out through the drain). There can be absolutely no doubt that if there was no flow of water at all from the rivers Severn and Avon above Tewksbury, that is if the upstream taps were turned off, the flow in the river at Tewksbury, due to the rainfall in the countryside around Tewksbury which drains into the river at Tewksbury, would have been a mere trickle along the river bed. All that we need to be able to do, to prevent flooding, is be able to turn the taps off.

If severe rainfall is held where it falls, upstream, obviously it can not cause flooding downstream.

In its simplest form this method of flood prevention is quite straightforward. If flooding is forecast for say the Tewksbury area, and the upstream taps are turned off so that no water flows in the river at Tewksbury from upstream – the threat of flooding at Tewksbury will be eliminated. The only water entering the river at Tewksbury would be from rainfall in the countryside around Tewksbury, from the shower, as the river downstream, the drain, can easily cope with this flow without overflowing the river banks. Once the threat of flooding has past the upstream taps can be opened again in a controlled manner to allow the water to flow downstream at a rate which will not cause the river to overflow its banks.

For this method to work all that is necessary is to be able to store upstream rainfall in on-line and/or off-line flood storage reservoirs as required. According to Joss Wallace of defra “The Environment Agency has 180 existing flood storage reservoirs around the country *specifically intended to hold sudden high volumes of rainwater to prevent flooding of property* and they will continue to consider this option where it might provide a practical and cost-effective solution in other locations.” From the fact that in 2007 we did get flooding at Tewksbury we assume that there are no flood storage reservoirs in the upstream catchment areas of the rivers Severn and Avon and their tributaries, or that there are not enough of them, or that they are “not fit for purpose”. From the recent incidence of flooding in England and Wales it would appear that most of these 180 existing flood storage reservoirs, often built by the Victorians, may no longer be fit for purpose in our increasingly severe rainfall situations - see references ^{22, 23, 24} These flood storage reservoirs are obviously “not fit for purpose” if they overflow during a severe rainfall event as this, at a stroke, immediately and dramatically increases the effective catchment area of the river, resulting in a surge or wave of water which is often what causes severe flooding downstream, rather like turning on an additional tap feeding additional large quantities of water into a bath which is already overflowing. In fact if a river experiences a surge or wave of water it is a reliable sign that there are upstream storage reservoirs in its catchment and these are “not fit for purpose”. However, as we shall show in this paper, these flood storage reservoirs could be modified inexpensively to provide dramatically improved flood prevention and of course drought prevention, and at the same time, produce very significant quantities of renewable hydroelectric energy to provide revenue and help reduce Global Warming.

Part 1. Traditional Walls and Embankment Flood Prevention Methods Do Not Prevent Flooding.

“To many the defence against flooding is the construction of engineering structures such as walls and barriers to prevent floodwaters inundating those areas we have chosen to develop. However attractive this may appear, total application of this solution with limited resources is impractical, uneconomic and unsustainable.”² see section 2.3 of the Final Report of the Institution of Civil Engineers’ Presidential Commission on Technical Aspects of Flood Risk Management in England and Wales.

The authors suggest that if the reader accepts that the above statement and Title of this Part of the paper are correct, the reader skips this part of the paper as it only demonstrates that these statements are correct and that Traditional Walls and Embankment flood prevention should never be used if there is any possibility of using an alternative.

“Those that fail to learn from history, are doomed to repeat it” Winston Churchill.

1.1 That a new method of flood prevention is required followed from observations at the Public Local Inquiry for the City of Edinburgh Council’s Water of Leith Flood Prevention Scheme and observations of floods and catastrophic failures of traditional methods of flood prevention – flood walls, embankments, dykes and levees - specifically at the Mississippi and Los Angeles in the United States, the Rhine at Dresden, the Vitava at Prague, the Rhone in France etc and locally the more recently the failure, just three months after completion, of the new Milnathort Flood Prevention Scheme in Scotland in December 2006 due to overtopping of the walls and erosion of the embankments, and in June and July 2007 the floods at Sheffield in the East Midlands, at Hull in South Yorkshire, in the West Midlands and South of England, and before the actual flood event - the proposed Flood Prevention Scheme for Boscastle in 2004.

As Pearce stated in his paper ‘We can’t hold back the water any more’ *with walls and embankments* “whenever we close off more flood plain, the river’s flow farther downstream becomes more violent and uncontrollable. Dykes are only as good as their weakest link – and water will unerringly find it. By trying to turn the complex hydrology of rivers into the simple mechanics of a water pipe, engineers have often created danger where they promised safety, and intensified the floods they meant to end”¹. Flood Risk Assessment is far from being an exact science. How can one specify with any degree of confidence a completely unpredictable design storm, which requires specifying the duration of the design storm (in hours), the return period of the design rain/flood (in years), the Seasonal Correction Factor, the revitalised FSR/FEH rainfall-runoff etc. Apparently the flooding at Boscastle was due to a severe rainfall event which stationed itself over Boscastle, and did not move. Colin Clark in his paper Flood Risk Assessment explains how flood risk assessment could be improved.⁴ The CEC Water of Leith Flood Prevention Scheme is based on data from the Environment Agency and the Flood Estimation Handbook (FEH). Colin Clark shows that for the catchment area under consideration in his paper, the Probable Maximum Flood (PMF) is more than double the value obtained from the FEH. If Colin Clark is right, and similar conclusions can be applied to the Water of Leith, the walls and embankments along the Water of Leith will be overtopped by flood water well below the CEC design flood of a 200 year return period flood event.

1.2 ***It is illogical to use a non-flexible solution, like a traditional wall and embankment flood prevention scheme, to deal with a variable and predicted to be increasingly severe problem. The traditional method of designing flood walls and embankment flood prevention schemes is not appropriate for the exceptional events which cause severe flooding in the UK.***

The City of Edinburgh Scheme, basically of flood walls and embankments, but incorporating some upstream reservoirs supposedly “to help mitigate the effects of flooding”, was designed using hydrological analysis and a hydrological model to cope with the current standard, a 200 year return period flood event, over its life of 60 years. This technical jargon helps prevent the uninitiated asking awkward questions, but as a rough approximation it is equivalent to a maximum rainfall rate of about 4 inches or 102 mm in 24 hours. Is this a reasonable standard? Readers will judge for themselves. It is

less than the 108 mm of rainfall at Wittering in Cambridgeshire in July 2004; the 150 mm at Elgin in November 2002; the 152 mm at Carlisle in January 2005; the 203 mm at Boscastle in August 2004. It is also less than the supposedly exceptional events such as the 50.8 mm in 5 hours at Glastonbury in June 2005; the 127 mm in 6 hours at Swanage in September 2002; and the 70 mm in 3 hours at the North York Moors in June 2005. This supports CEC's opinion as stated in their Precognition for the PLI ²¹, that 'The Scheme' will not prevent flooding. Would it prevent flooding in any one of the above events? - of course not. Moreover due to Global Warming the predictions are that our weather is going to get more severe. 'The Scheme' was not designed to cope with the sort of flood events we have recently experienced in the UK or are likely to experience in the future. Regrettably it is not as rare as it used to be for a project to be found to be "not fit for purpose" after it has been completed. It does seem irrational however to start work on a Scheme knowing it is "not fit for purpose" before it is started.

1.3 It is not one of the aims of this paper to investigate why the traditional walls and embankment method of flood prevention fails, but it is abundantly clear that it does, and perhaps DEFRA or the Research Councils should consider funding research into why these traditional schemes fail. Some indication may be obtained from the Technical Reporter's comments on the Hydrological Design of the CEC Scheme at the Public Local Inquiry (PLI) ²¹. For example in sections 1.14 'the unusual nature of the Water of Leith catchment'; 1.15 'standard hydrological analysis is unlikely to suffice'; 1.16 'lacking significant detail in many respects'; 1.17 'The method adopted to define the rainfall surface does not comply with any recognised method'; 1.18 'there is considerable doubt as to the reliability of all subsequent data.'; 1.19 'the reduction is an arbitrary device employed to improve the match between recorded and modelled hydrographs'; 1.20 'that caveat was apparently ignored in subsequent analysis.'; 1.21 'A key assumption made bears little resemblance to any actual storm profile'; 1.23 'that interpretation has never been scientifically, or statistically, confirmed.'; 1.24 'What *appears* to have been done is to run the model with FSR rainfall and then plot the resulting flood estimates at lower return periods to represent the Flood Estimation Handbook (FEH) rainfall flood estimates.'; 1.25 'then the shape of the flood frequency curve using rainfall-runoff model outputs will be incorrect.' 1.27 'If that was not done, as appears to be the case, then the estimated peak flow at Murrayfield for the reservoir storage option cannot be correct.'; 1.40 'There is a strong possibility that the true critical design event remains unidentified.' In view of these comments alone it is difficult to comprehend why in the Reporter's report, PLI WYF 3E/55/1 section 6.9 it should state '.... the hydraulic model is generally satisfactory

On a more general basis, the main reasons why engineering designs fail is because they were designed incorrectly, or the tasks they had to undertake were incorrectly specified. Traditional flood prevention schemes of walls and embankments are normally designed by hydrologists using the FEH methodologies and hydrodynamic computer models to calculate the details. This may not be appropriate for exceptional events which result in extensive and damaging flooding. Computer models can only produce reliable results when input data is correct and when the models are used within the limiting parameters of their design, and for the purposes for which they were designed. An all too frequent scenario for those with inadequate experience of computer modelling is RIRO "rubbish in rubbish out". When computer modelling is being considered it should be standard practice to undertake the initial calculations by hand, to a first approximation, based on fundamental scientific principles and accurate measurements. This practice arose when designs were calculated using a slide rule as it was vitally important to place the decimal points in the mathematical formulae at the right place. Computer models should only be used to refine results, already correctly predicted by hand, and where used correctly, in circumstances where many accurate measurements can be taken, these models are invaluable tools for accurate design. They are absolutely essential tools for example for the design of electrical machines and aero engines. Normally when based on accurate data and fundamental scientific principles, hand calculations are remarkably accurate. It is this method of hand calculation that is the basis for the results in Part 2.

Unfortunately for traditional walls and embankment schemes the accuracy of the hydrological data and the design method are both suspect and the design itself is time dependent. For example in the CEC Scheme it is assumed that the peak of the hydrograph from the Rural Catchment arrives later than the peaks of the downstream sub-catchment hydrographs. The flooding at Carlisle in 2005 occurred apparently because the peaks of the hydrographs from the catchments of the two rivers above Carlisle

arrived at the same time. The flooding which isolated Tewksbury in 2007 was aggravated because the peak hydrograph from the Welsh hills arrived before the peak from the Avon had passed.

1.4 In the litigious environment we now find ourselves there are also legal liability questions which will become much more important when insurance companies start to refuse to insure properties at risk. For example according to current benefit cost ratio policy in the UK, traditional flood walls and embankments can only be funded where the cost of constructing them is less than the cost of the damage flooding will cause. This appears to be grossly unfair to those whose property is in areas where the benefit cost ratio policy is such as to rule out any possibility of provision of traditional flood defences, such as Balerno, particularly where a scheme upstream or downstream has aggravated the flood risk. Then there are consequential costs. Walls and embankments restrict the flow and so increase the height of the river level upstream, and as they reduce the amount of flood plain available where they are constructed, they also increase the flood threat downstream. Professor Edmund Penning-Rowsell, Director of the Flood Hazard Research Centre, in his paper to The Royal Society of Edinburgh in 2007 in the Natural Disaster Series – Earth, Wind, Fire & Water: Floods stated in the section of his paper on Social Justice – The present method of basing flood defence decisions on economic criteria results in different standards of protection for different communities. Why should this be? Social justice is better served if resources are targeted on the most vulnerable rather than on where the most damage occurs. A new approach is required to determine policies based on equality that account for the needs of the old and vulnerable. Those whose property is damaged due to such effects may feel they have grounds for litigation under European Convention of Human Rights (ECHR) Legislation. Also flooding is normally preceded by overflow of reservoirs upstream where these exist. Are those responsible for managing these upstream reservoirs being irresponsible in not drawing down the water levels in these reservoirs prior to the flood event, so that they will contain any severe rainfall above the reservoirs and so not overflow?

1.5 Anyone who experienced directly or saw film of the torrent of flood water flowing through Boscastle in 2004 or Carlisle in 2005 or the floods which surrounded Tewksbury in 2007, will readily appreciate that flood walls and embankments might have to be higher than the Berlin or Jerusalem Walls if they were ever to prevent rivers flooding property, and even if they did prevent flooding by overtopping the wall, they would inevitably fail due to sub-soil flow as occurred on the Rhine at Dresden or one of the three other reasons for failure, impact, bad design and poor maintenance. However many people in influential positions now have vested interests in the design and construction of these traditional flood prevention schemes and it may need a catastrophic disaster, similar to that which occurred on the Mississippi, to bring about a change. The question then is who will be held responsible?

1.6 The Traditional Flood Prevention Method of Walls and Embankments has failed repeatedly in the UK and worldwide, and yet we still spend millions of pounds every year on flood prevention in the UK - £800m in 2007/8 although not all of this is on fluvial flooding. The governments answer so far has been to build more and higher walls. Do we really want all our rivers hemmed in by miles and miles of high walls of concrete which everyone knows, even the professionals, will not prevent flooding? Penalty Clauses in contracts for these schemes would show how little faith the authorities and professionals have in them. Why traditional schemes are Fundamentally Flawed has been known and reported in Professional Journals for many years. The question is why is it still Government Policy in the UK and why are we still spending £ms every year on them? In some fields of engineering, failure results in an inquiry, refund of costs and compensation payments at the authorities and/or contractor's insurance company's expense, not at the customer's expense – why is this not the case for failure of Flood Prevention Schemes in the UK?

As we quoted above, in Section 2.3 of the Final Report of the Institution of Civil Engineers' Presidential Commission on Technical Aspects of Flood Risk Management in England and Wales states:-

“To many the defence against flooding is the construction of engineering structures such as walls and barriers to prevent floodwaters inundating those areas we have chosen to develop. However attractive this may appear, total application of this solution with limited resources is impractical, uneconomic and unsustainable.”²

We have been treating the consequences of the problem (the symptoms), overflowing rivers, rather than the problem itself (the disease), too much water entering our rivers in the first place.

Even the professionals, local authorities and government departments admit these traditional methods will not prevent flooding. We do not know why anyone ever thought they would, as they just try to treat the consequences of the problem rather than the problem itself, which is too much water flowing into our rivers. If the water is not allowed to enter the rivers, they will not flood.

This is just commonsense. and is dramatically illustrated at the River Garry in Scotland, which in spite of the heavy rainfall in the Scottish Highlands, has for years been reduced from a famous salmon river to a salmon-less trickle, all year round, because the water which used to flow in it has been stored upstream for hydro generation,. There can no longer be any doubt whatsoever that in the UK flood walls and embankment schemes, which do nothing to restrict the amount of water entering our rivers will never prevent flooding unless they are impractical, uneconomic and unsustainable. Recognising this fact some authorities have started to mitigate flood risk by combining traditional methods of flood prevention with upstream storage similar to that now being adopted for the Mississippi in the United States and for the White Cart Water in Scotland. This may be an improvement but will still not prevent flooding.

1.7 The contributions BCC has made is to show, in a way which can readily be understood by people with a basic understanding of school level science and mathematics, how flood risk may be eliminated entirely in most rivers using Reservoirs alone, and that this obviously also reduces drought risk and that these same reservoirs can be used to store energy for hydro-generation when required, and not just when the wind blows within specific speed limits or the tide flows, and form a new and invaluable environmental and recreational resource.

It is patently obvious that if rainfall in a catchment area is stored upstream in reservoirs it can not at the same time flow downstream in the rivers fed by these reservoirs, and cause flooding.

It is also patently obvious that the only way to prevent rivers overflowing their banks and flooding property is to prevent water entering rivers in such quantities as would cause them to overflow their banks. That is the problem. Everything else proposed for flood prevention is just dealing with the consequences of the problem and can be unrealistically expensive. An example of unrealistic expenditure dealing with consequences is to construct all our new houses built on flood plains such that they will float when rivers flood, and connect them to services and moorings with umbilicals as they are now doing at one location in Holland. If one eliminates the problem one does not have to deal with the consequences and it is dramatically less expensive.

1.8 One can not control the flow into the reservoirs, unless they are fed by other reservoirs. The clever bit is to control the flow out of the reservoirs so that it generates power, keeps the rivers and fish healthy, and at the same time eliminate flooding once and for all. As the world's supply of economically extractable oil runs out ¹⁷ we will increasingly have to develop hydroelectric schemes in the UK and we might as well do it at the same time as eliminate flooding. As will be demonstrated in Part 2, using reservoirs as the sole method of flood prevention, is elegantly simple, dramatically more cost effective, and dramatically safer than any other method. Consequently we are confident that the Scottish Ministers' decision to approve the CEC Scheme, in this instance, will be proved to be incorrect, probably sooner rather than later.

1.9 It has been suggested to us that BCC produces a paper for its website explaining in simple terms, which can readily be understood by a schoolchild or "the man in the street", how to design an Effective Flood Prevention and Hydroelectric Scheme for their own area. The intention is that this paper, based on fundamental scientific principles and the latest ideas on active flood prevention, should enable those subject to flood risk to discuss schemes for their area in meaningful terms with Government, Local Authority and Contractor's staff. Part 2 of this paper is intended to make this possible.

Part 2. Reservoir Storage – A success story; A new, dramatically cost effective and Active Management Method of Flood Prevention; Do it yourself Flood Prevention Design. April 2008.

Currently there are 2,070 reservoirs in England and Wales subject to the Reservoirs Act 1975, which means they were designed to hold or are capable of holding at least 25,000 cubic metres of water above natural ground level. Of these 1,473 are impounding reservoirs and 180 of these impounding reservoirs are flood storage reservoirs. DEFRA states these flood storage reservoirs are “specifically intended to hold sudden high volumes of rainwater to prevent flooding of property” whereas the Environment Agency says flood storage reservoirs are specifically designed to store and attenuate flood flows (i.e. they are empty for most of the year). The authors are attempting to determine the reservoir situation in Scotland.

According to the August 2007 Environment Agency Briefing, “all impounding reservoirs will reduce the impact of flood flows – by storage if they are partially full and – by attenuation and controlled overflow when they are full. The extent to which a reservoir can attenuate flood flows when full, is dependent upon catchment characteristics, the spillway design and mode of operation of any control structures.”

Obviously if you store all the flood water upstream it can not at the same time cause flooding downstream

2.1 In the United States two thirds of all national disasters between 1965 and 1985 were due to river flooding. In the UK we do not call river flooding a national disaster - yet, although it clearly is a disaster for a great many people and organisations. In the United States in spite of repeatedly raising the 4,500 km Mississippi walls and embankments (levees) heights, reinforcing them and fitting ever larger pumps (to pump the flood water back into the Mississippi after the floods had overflowed the levees and passed by) these schemes still fail and so now they are trying a different method, *Upstream Storage*.

Upstream storage is beginning to gain favour again in the UK, but unlike when upstream storage facilities were constructed by our predecessors, at present they only appear to be being adopted on a partial basis. For example upstream storage has been partially adopted for the White Cart Water scheme near Glasgow, the Water of Leith Scheme in Edinburgh, and more generally for Sustainable Urban Drainage Systems (SUDS). It should be appreciated that partial adoption of upstream storage can not prevent flooding as when flooding is at its peak, and at its greatest threat, partial storage schemes will inevitably be completely overwhelmed and become useless. The argument that they will delay the peak flow is irrelevant as if the peak flow occurs at all, it will cause flooding in a flood risk area. For Adoption sewerage systems should not discharge in a 30-year event whereas flood protection now demands protection against a 200 year event.

Good examples of complete adoption of Upstream Storage are the Hoover Dam on the Colorado River and the Gariep and Vanderkloof dams on the Orange River, South Africa's major river, but the classic example is the Aswan High Dam in Egypt. All of these are hydroelectric dams. The Nile overflowed its banks every year before the Aswan High Dam was built in 1971 and has never once overflowed its banks since it was built. In fact Egypt is now in dispute with Uganda because Egypt does not get enough water to fill the Aswan High Dam since Uganda built a hydroelectric dam upstream of it, and now Uganda is planning to build two more hydroelectric dams which will make matters worse for Egypt and reduce their water flow and hydroelectric production, as they have no control over the management operations of dams in Uganda. It has been suggested that Nations may soon go to war with one another over water, but there can be no doubt that correctly designed dams ensure that those living downstream are no longer at the mercy of their unpredictable rivers, as complete adoption of Upstream Storage stabilise river flow. If authorities in the UK opted for complete adoption of Upstream Storage and co-operate with each other where they share catchment areas, disputes should not arise. The Balerno Community Council (BCC) area is located in the upper reaches of the Water of Leith, and although perhaps not seriously at risk of flooding itself, has been advocating upstream storage for a number of years and is now advocating *Active*

Management of Reservoir Storage and Hydroelectric Power Generation. The snow and glaciers in for example the Alps are a natural form of active reservoir storage and management.

2.2 In order to be able to undertake calculations for Upstream Storage some measurements are required. Although most of these can be obtained from Ordnance Survey Maps etc., BCC was fortunate in that most of the measurements used in the following calculations were kindly provided by the City of Edinburgh Council (CEC) in the Babbie Group 2001 Report to the CEC; during the Public Local Inquiry (PLI) on the Water of Leith Flood Prevention Scheme; by ARUP in 2004; and very kindly in writing by CEC and Scottish Water. For other catchment areas in the UK, BCC is trying to obtain information from DEFRA and the EA, but similar information can probably be obtained under the "Freedom of Information Act 2000" from appropriate authorities or to a first approximation be estimated by anyone who can read an Ordnance Survey Map and has school level mathematics.

It is claimed that the method of Active Management of Reservoir Storage, as illustrated in the following example, is exceptionally cost effective, is both elegant and simple, and is not prone to the miscalculations which can occur in Computer Modelling.

2.3 The Scottish Ministers laid down a challenge to Balerno Community Council (BCC) when they said in their decision dated 15 March 2007, on the submission by the City of Edinburgh Council for confirmation of the water of Leith Flood Prevention Scheme, Annex B20:-

"the Scottish Ministers consider that no evidence was presented to the Inquiry by the objectors to indicate that the alternative proposals would have a significant impact in major flood events or that these would significantly reduce the need for walls/embankments within the city. They consider that additional storage sites had been investigated and modelled by the Council but the evidence presented to the Inquiry demonstrated that reductions in the defence heights would have been marginal and any savings in wall construction within the city would have been considerably outweighed by the additional costs of developing the reservoirs in the rural areas and were likely to provide a less cost effective scheme."

In their PLI closing submission to the Scottish Ministers of the 10th December 2004²⁵, BCC disagreed with the Scottish Minister's opinion and in the remainder of this part of this paper BCC endeavours to demonstrate why. In fact BCC maintains not only that their alternative proposal to raise the reservoir dam heights alone, by a small amount and at a marginal cost, would make the need for the CEC walls/embankments flood prevention scheme within the city completely superfluous, and would have significant other advantages. To some extent the BCC method was proposed by various other people including the Babbie Group and the Scottish Government's own Inquiry Reporters Unit in their April 2005 Conclusions and Recommendations 6.10 and 6.11 to the Scottish Ministers²¹. Why the Scottish Ministers chose to ignore the advice of their own Reporters is a mystery.

2.4 The initial idea of using reservoirs to mitigate flooding was brought to BCC's attention in the Water of Leith Flood Study Report submitted to the City of Edinburgh Council (CEC) by the Babbie Group in 2001. It occurred to BCC that a much better approach might be to *use reservoirs alone* to prevent flooding. After all where super dams have been used on rivers they have eliminated flooding altogether (see 2.1 above). However whereas super dams prevent downstream flooding due to their enormous capacity, for much smaller dams, such as BCC is advocating *Active Reservoir Storage Management* is recommended. This new, simple, safe, active, flexible, dramatically superior and cost-effective method of flood prevention has been made viable by the increasing accuracy and time scale of MET Office Forecasts in the UK. It is claimed that with their latest computers the MET Office can now predict rainfall for as small an area as 1 metre square and 5 days in advance. In the past we have used historical records to estimate the flood risk over their next 60 year life and built walls along our rivers to contain these floods and then passively hoped that they will. Invariably they don't! With *Active Reservoir Storage Management* we create a holding area for the forecast severe rainfall, so that it stays in the reservoir and does not overflow into the river. *After the severe rainfall event has passed*

surplus water in the reservoir is allowed to enter slowly into the river, in such a way as to eliminate flooding entirely.

Following advice in the Babbie Group Report to CEC on the Water of Leith Flood Prevention Scheme, and some persistent persuasion by the Edinburgh Flood Prevention Group (EFPG) and BCC, CEC now manage the Water of Leith reservoirs within their current limitations fairly responsibly and 'draw down' the level of water behind the three Water of Leith reservoir dams by an average of about one metre below the dam overflow level, and maintain it at this level irrespective of the catchment rainfall. CEC was able to do this as they recently purchased these reservoirs from Scottish Water. This was probably done in the past by the resident 'Water Keepers', although if they did their efforts were probably only appreciated by the water mill owners who built the reservoirs. When the water mills ceased operation, the services of these 'Water Keepers' were gradually dispensed with. Is this why we started to experience flooding?

To maintain the water level at or below the 'draw down' level involves adjusting the reservoir outflow valves as required. These can be remotely controlled. Level and flow readings are taken regularly by CEC and monitored by the EFPG and BCC. To date, in spite of the rainfall in June and July 2007, these dams have not overflowed and there has been no recurrence of downstream flooding and damage to property, as has occurred in the past. For computer modelling large numbers of accurate readings are required over extended periods and widely varying and severe rainfall conditions. Normally these do not exist in this field. For the 24 – 26 April 2000 Water of Leith flooding event apparently the only readings available were a flow at Murrayfield of 73 – 82 cumecs, for a rainfall at Blackford Hill, which is not even in the Water of Leith Catchment Area, of 0.112 metres in 48 hours. The only other reading apparently available was for the 14th August 1966 flooding event of 76.6 cumecs at Murrayfield for a rainfall of 0.060 metres at Blackford Hill ref the Babbie Report. Computer models, based on mathematical formulae, are used extensively in engineering design but where they are used successfully, the mathematical formulae are always based on a larger number of readings, in some cases hundreds of readings.

Of course Upstream Storage is not new in the UK. In a letter BCC received from the Department for Environment Food and Rural Affairs (DEFRA) dated 8th October 2007, Joss Wallace stated "The Environment Agency has 180 existing flood storage reservoirs around the country (presumably England and Wales) specifically intended to hold sudden high volumes of rainwater to prevent flooding of property and they will continue to consider this option where it might provide a practical and cost-effective solution in other locations." In an attempt to ascertain why these flood storage reservoirs were apparently "Not Fit for Purpose" during the floods of 2007, BCC has written to the Environmental Agency requesting details of the flood storage capacity of these reservoirs under the Freedom of Information Act. BCC suspects that these reservoirs were mainly constructed by the Victorians and that they have not been maintained and modified "to hold sudden high volumes of rainwater to prevent flooding of property" in the more severe weather conditions we are now experiencing due to Global Warming.

2.5 Under the new BCC *Active Reservoir Storage Management* method, the appropriate authority notes the forecast severity of the threat up to five days prior to its occurrence, as predicted by the MET Office, and actively makes provision by responsible management to drawdown the reservoirs in the catchment area to contain the predicted flood, so that the reservoirs do not overflow and so pose no threat to property downstream. Although most of the more than 2,000 reservoir dams in the UK were built over a century ago, none of them has failed for over eighty years. This is because they were well built, and because reservoirs of over 25,000 m³ capacity are covered by the Reservoirs Act 1975 which ensures they are designed to withstand a 10,000 year return period flood, and they are robustly inspected and maintained to a very high standard. The basic structures of these dams are still sound, often well over a century later, unlike walls and embankments, but the pipes and valves are corroding and will soon need to be replaced. *When they are replaced this should be with pipes and valves capable of being controlled remotely and able to carry much larger flows so the reservoirs can be drawn down at Full River Bank Flow in a matter of hours.* Compared with dams, flood walls and embankments which are not covered by any maintenance and safety legislation and currently, if built

within the last year or so, only have to meet a 200 year return period flood event, and have a life expectancy of just 60 years, and consequently are very much less safe, reliable and cost effective.

Water Balance the concept underlying all the Hydrologic Sciences

2.6 If walls and embankments and upstream storage on land set aside for this purpose such as wet lands will not prevent flooding then what will? Of course the basic answer has been staring us in the face for centuries in terraced fields on hillsides, and more recently in reservoirs and hydro schemes, but we at BCC are taking this to the next stage – *Active Reservoir Management*.

In this section, by way of illustration, we are going to concentrate on the existing Hillside, Rural, and Upper Urban catchment areas of the Water of Leith. The water of Leith Reservoirs are all fed by the Hillside Catchment Area. The capacity of these 'In Line' reservoirs to contain large volumes of water is relatively enormous and we should use them to contain "Severe Rainfall", rather than allowing this rainfall to flow, completely out of control, in a destructive torrent down stream damaging property and possibly killing people on the way. By comparison the volume of water which overflows our river banks due to Deluges, Cloudbursts, Torrential Rain, Flash Floods, and Unprecedented Weather (which we shall group together and call *Severe Rainfall*) is quite small and completely out of proportion to the havoc it causes. All we need to do is manage our On-Line and/or Off-Line Reservoirs, and enlarge them or construct more if necessary to contain this *Severe Rainfall* we are likely to experience, and which the Met Office forecasts up to 5 days in advance. We do this by drawing off some of the water in the reservoir, called drawdown, until the predicted *Severe Rainfall* can be contained safely in the reservoir without overflowing. Off-Line reservoirs are as their name suggests not in line with the river. We can also have downstream on-line reservoirs. According to Defra, "the Leigh Barrier in Kent controls one of the largest on-line flood storage reservoirs in the country and can hold some 6 million tonnes of water (or 6 million cubic metres of water, since 1 cubic metre of water weighs 1 tonne). It was filled and emptied three times in a month in the Autumn 2000 floods. If it had not been emptied promptly there would have been nowhere to store the later floods with consequent implications for flooded towns." This is a simple example of Active Reservoir Management.

As is well known (e.g. from the Encyclopaedia Britannica), underlying all the hydrologic sciences is the concept of water balance. In a simple form this may be expressed as:-

$$E = X - F - V - Z$$

Where **E** is the change in water storage in the storage area (reservoirs) over a given period,

X is the precipitation input during that time period,

F is the stream discharge from the area,

V is the total evaporation and transpiration to the atmosphere from the area, and

Z is the subsurface flow.

In the Water of Leith catchment area there is a substantial input of drinking water from the Tweed Catchment Area from reservoirs owned by Scottish Water but as most of this goes into the sewers, for the purposes of these calculations it can be ignored.

To a first approximation and for a worst case scenario we can assume that for steady state conditions there will be no change in water storage i.e. $E = 0$; that there is no evaporation and transpiration (evaporation of water e.g. from plants and leaves of trees) i.e. $V = 0$; and there is no subsurface flow into aquifers etc. i.e. $Z = 0$ and the ground in the catchment areas is fully saturated before the event.

This leaves the equation:-

X the precipitation in the catchment area = F the stream flow from the catchment area, or

The rainfall X in metres per 24 hours times the catchment area A in square metres = the flow from the catchment area in 24 hours in cubic metres per 24 hours.

Rainfall is normally specified in inches or millimetres in 24 hours even though it may only be raining for part or parts of those 24 hours because the rain gauges are only read daily.

This leaves us with the basic fundamental scientific hydrological equation which we shall use in the following illustrations:-

(Rainfall X in millimetres per 24 hours / (1000 x 24 x 60 x 60)) x (Catchment Area A in square Kilometres times 10^6)

= Flow from the Catchment Area F in cubic metres per second or cumecs or

$$F = A \times X \times 10^6 / 24 \times 60 \times 60 \text{ cumecs}$$

2.7 To a *first approximation* and to illustrate the simplicity of the *Active Reservoir Management Method*, which should be able to be used by school children with a basic understanding of mathematics and science, we will use examples for the Water of Leith Catchment Area in Edinburgh which has now operated Reservoir Storage for about four years and last experienced significant flooding in the Edinburgh Urban Area two years before that, in April and November 2000.

An overriding advantage of reservoir storage compared with traditional walls and embankments for Flood Prevention is that it is not "time sensitive". This means it does not matter if the rain falls in 24 hours or as a cloudburst in 24 minutes, or even 24 seconds for that matter, or the speed and direction the rainfall is carried across the catchment area by the prevailing wind, the reservoir will still contain the rainfall if appropriate capacity is available, without overflowing, and so prevent flooding downstream. Another overriding advantage is the colossal amount of water which can be stored in reservoirs. There are actually three reservoirs feeding the Water of Leith - Harlaw, Threipmuir and Harperrig. It should be mentioned that care has to be taken as rapid changes in water level behind clay dams may cause problems but this is not a problem for modern dam designs. The following calculations are carried out to more figures than the data accuracy warrants but this is useful in the illustration for indicating where the figures come from.

Annual Rainfall and Average Annual Flow for the Water of Leith – Illustration No 1

2.8 Referring to Illustration No 1 from the Water Flow Modeller, copy enclosed, the Met Office records indicate that the Average Annual Rainfall for Edinburgh is 676 mm per year, or 676/365 mm per 24 hours. The Chart shows that the total system average annual flow is 2.51 cumecs. At the Murrayfield Flow Gauge, between the Upper and Lower Urban Areas the average annual flow is 2.51 - 0.219 = 2.291 cumecs.

Note:- It should be possible for individual members of the public to obtain the values for the Areas etc for their own locations, if necessary under the Freedom of Information Act, from the appropriate authority such as their local council, the MET Office or they can be estimated from Ordinance Survey Maps etc.

This illustrates the first ludicrous aspect of the Traditional Walls and Embankment Scheme as proposed by the City of Edinburgh Council and approved by the Scottish Executive. It is designed to cope with a flow of 121 cumecs, or 95 cumecs with some drawdown at the reservoirs. This means that on average during the year there will appear to be only a trickle of water, 2.291 cumecs, flowing along the river bed between the tall walls able to contain 95 cumecs, 38 times as much.

Who would construct a 95 lane motorway for an event which only occurs once in 200 years when for the other 199 years 2.291 lanes would suffice?

The river walls running through Vienna, illustrate the unfortunate consequences of this method. There must be a better way to prevent flooding – and of course there is.

The Water of Leith Reservoir Catchment Area Peak Flow Calculations

2.9 When we are considering reservoir catchment, if the reservoirs do not overflow, which is the aim of drawdown, as almost all downstream flooding is preceded by reservoir or lake overflow, in the Water Balance equation, see 2.6 above, $F = 0$. Also if *we only consider the "Worst Case Scenario"* which is the one that causes serious flooding, that is saturated ground, rainfall continuously at the peak

of the skewed normal distribution curve, and no evaporation V or subsurface flow Z, for any particular catchment area we are left with the simple equation as shown above:-

$$F = A \times X \times 10^6 / 24 \times 60 \times 60 \text{ cumecs}$$

Illustration No 2

Referring to Illustration No 2 from the Water Flow Modeller, copy enclosed, the flow at the Murrayfield Gauge specified for a 1 in 200 year return period flood event is 121 cumecs. Feeding this value into the equation gives an average rainfall over the catchment area of 0.09761 metres in 24 hours. To prevent flooding the reservoirs levels are periodically drawn down by CEC to the values given in the Chart. This results in a Draw Down Capacity (DDC) as shown in the Chart for each of the 3 reservoirs, which has a Rainfall Equivalent again as shown in the Chart, and a time to fill this DDC for each reservoir of 11.99, 6.53, and 19.53 hours. This appears to be illogical and calls into question how the specified Draw Down levels were determined.

Surely it is only logical that the part of the total Water of Leith catchment area which contributes most to the flood risk, the Hillside Catchment Area, should be the part which gets most attention, rather than as in the CEC Scheme – the part that gets least attention.

The question then is how much would the dam heights have to be raised to prevent the dams overflowing for a 1 in 200 year return period flood event?

Note:- It is appreciated that reservoirs do not have vertical sides. However because they have such a large surface area, assuming that they do have vertical sides is reasonable to a first approximation and gives remarkably accurate results. However on relatively level ground if the dam heights are raised, this often dramatically increases the potential surface area and could then be taken into account.

The Chart shows the dam heights would only have to be increased by 0.902, 1.607, and 0.206 metres respectively and that as a consequence the flow at Murrayfield would be reduced to 82.47 metres. According to the information given at the PLI Mr. W. McBain of ARUP, there would be no problem from an engineering point of view in raising the dam heights by this amount and CEC estimated it would only cost on average £3m per dam.

However these calculations were based on the assumption that rainfall over the total catchment area is uniform at 0.09761m for 24 hours whereas the CEC stated that rainfall in the hillside catchment areas was twice that at the coast and Scottish Water stated that 75% of the rainfall in the Urban areas would be carried away in the sewers. Taking these factors into account, obvious the rainfall changes and from the Chart we see that for a 1 in 200 year flood event the flow rates from the reservoirs increase and the flow rates from the Rural and Urban Areas decrease, but if the reservoir dam heights were raised to contain this greater rainfall, by 2.22, 3.22 and 1.01 meters above their present levels, the flow at the Murrayfield Gauge is reduced to 54.34 cumecs. As the Full Bank Flow for the Water of Leith at the Murrayfield Gauge is 59 cumecs this means that by raising the dam heights alone at a cost of £9m the CEC Walls and Embankment Scheme at a cost of £52m would be completely superfluous.

This calls into question the statement given in section 2.3 above:-

“the Scottish Ministers consider that no evidence was presented to the Inquiry by the objectors to indicate that the alternative proposals would have a significant impact in major flood events or that these would significantly reduce the need for walls/embankments within the city. They consider that additional storage sites had been investigated and modelled by the Council but the evidence presented to the Inquiry demonstrated that reductions in the defence heights would have been marginal and any savings in wall construction within the city would have been considerably outweighed by the additional costs of developing the reservoirs in the rural areas and were likely to provide a less cost effective scheme.”

It also calls into question a statement made at the PLI by a senior hydrologist who said according to the design model building dams to retain all the rainfall above the City Bypass (effectively all the rainfall in the Hillside and Rural Areas) would only reduce the flow from 95 cumecs to 91 cumecs. Either the design model is fundamentally wrong, the senior hydrologist misunderstood the question or we misunderstood his answer but neither CEC nor the Reporters nor the Scottish Executive picked up on this dramatic and critical difference. This calls into question the whole concept of Walls and Embankments as a sensible method of flood prevention. Of course so far we have only dealt with calculations to a first approximation and more accurate calculations may result in marginal adjustments, but these would be no where near enough to invalidate the thesis, that Reservoir Storage is a dramatically superior and cheaper method of flood prevention than Walls and Embankments. In fact according to the Chart the flow at the Murrayfield Gauge under these conditions would only be that from the Upper Urban Area 5.67 cumecs, or just over 6% of the senior hydrologists figure of 91 cumecs.

Increasing the Water of Leith Reservoirs Flood Prevention Potential

2.10 As we saw above, 3.84 inches of rainfall in 24 hours is equivalent to a 200 year return period flood event for the Water of Leith and is the basis on which the City of Edinburgh Council designed their Water of Leith Flood Prevention Scheme. In view of the flood events in England in June and July 2007, BCC consider this to be an inadequate level of protection and suggest a 50% margin of safety should be added, equivalent to a 300 year return period flood event as was experienced in parts of England in Jun/July 2007, with the facility to increase this still further quickly, within 5 days, by *Active Reservoir Management* if the MET Office predict it should be required.

However to achieve this level of safety for the whole length of the river as far as the Murrayfield Gauge, additional reservoirs might be required in the rural and urban areas below the reservoirs, but these would be required in any case to optimise the production of electricity – see 2.12 and there is adequate space to store this water along the Water of Leith and its tributaries.

Active Reservoir Management

2.11 So far we have only considered adjusting the outlet valves on the reservoirs periodically to maintain specified draw downs. Active Reservoir Management is much more proactive than this as it involves obtaining notification when a severe rainfall is likely to occur in the catchment area from DEFRA, EA, SEPA and/or the MET Office and when it will occur, for how long and the total predicted rainfall; and drawing down the levels in the reservoirs so they will contain this severe rainfall event. For this one needs to know how quickly one can reduce the level of water in the reservoirs to the appropriate depth. A useful indication is how long it would take to drain the reservoirs at full bank flow, that is the flow rate at which the river will not overflow its banks. According to CEC the safe Full Bank Flow rate for the Water of Leith is 59 cumecs.

Illustration No 3

Referring to Illustration No 3 from the Water Flow Modeller, copy enclosed, although the flow from each reservoir should be able to be controlled, in this illustration it has been assumed it is proportional to rainfall in its catchment area, but the maximum flow to empty the reservoirs must not exceed the full bank flow of 59 cumecs at Murrayfield. As shown in the Illustration this is from 0.83 to 2.33 days, well inside the 5 day forecast period.

Although it is not envisaged that these reservoirs would ever need to be emptied, except for maintenance, it is interesting to note that they have the potential to contain 6.65 to 19.97 inches of rainfall with Active Reservoir Management. This should be compared with the CEC Design Rainfall for a 1 in 200 year return period flood event of 3.84 inches of rainfall. Obviously this would only be

considered in extreme conditions, much greater than currently envisaged by government, and would only last for the period of extreme rainfall, probably just once for a few hours in 200 years.

By Active Reservoir Management the reservoirs we can contain on average about three times the rainfall the City of Edinburgh Council's Water of Leith Flood Prevention Scheme has been designed for, or better than a 600 year return period flood. Those at risk of flooding do not want to be warned when their property is at risk of flooding, or to be told free sandbags will be made available, they want to be able to sleep soundly in their beds confident in the knowledge that their property is not at risk of flooding. Active Reservoir Management could achieve this.

The skill in optimum reservoir level management is drawing down the level sufficiently to contain the forecast severe rainfall event such that the level is back up to the "optimum" level, whatever that may be, after the severe event has passed, without ever overflowing. This becomes complicated where the reservoir is used for a fresh water supply, for hydro generation and where it is just one of a number of "In-Line" and "Off-Line" reservoirs. The days when we could allow any reservoir to overflow are over.

The Water of Leith Rural Catchment Area Calculations

2. 12 So far our calculations have only involved the reservoirs in the Hillside Area (29% of the total Water of Leith Catchment Area or 54% of its effective area) where, as we have seen for a cost of just £9m, rainfall on average over 12 inches can be retained in the existing reservoirs with slight modifications. This is normally the most important area as it is the area where the average rainfall is highest, normally about twice that in the Lower Urban Area.

However the Rural Area (42% of the total Water of Leith Catchment Area or 39% of its effective area) is a significant area and consequently rainfall in this area could cause flooding on its own, even if the Reservoirs do not overflow. *From the attached Table and Pi-Charts for the "Water of Leith Sub-Catchment Areas" the Rural Area is 49.8 sq km. For the CEC design rainfall of 3.84 inches in 24 hours, reservoirs in this area designed to contain this rainfall would be required to contain $49.8 \times 10^6 \times 3.84 \times 2.54 / 100 = 4.86 \times 10^6 \text{ m}^3$ of water in 24 hours or 56.2 cumecs, which is less than the full bank flow of 59 cumecs so there would be no need for any walls and embankments as the Water of Leith would not overflow its banks. It should be remembered that all the above calculations are based on a "Worst Case Scenario"*

THIS IS QUITE EXTRAORDINARY AS IT PROVES THAT THERE IS NO NEED FOR ANY WALLS AND EMBANKMENTS OR ADDITIONAL RESERVOIRS IF THE EXISTING RESERVOIRS ARE MODIFIED AND USED PROPERLY FOR FLOOD PREVENTION.

The Reporters at the PLI may have had this in mind when they said in their Report "The CEC Flood Prevention Scheme is unlikely to optimise the flood storage capacity of the reservoirs. There may be the potential to increase the compensation flow and the amount of dedicated storage in the reservoirs. The option of raising the reservoir dams to increase the volume of storage does not appear to have been examined in detail."²¹

The Need for New Reservoirs

2.13 In 2.10, 2.11 and 2.12 we saw that there was no need for flood walls and embankments or new reservoirs to prevent flooding for a 200 year return period flood event if certain low cost modifications were made to the existing reservoirs. However BCC does not think this is an adequate level of protection for those at risk of flooding. The Water of Leith used to be a working river and should be again.

Before the introduction of steam and electric power, the power produced by the Water of Leith at its Water Mills had a major influence on the growth and prosperity of Edinburgh. In the Statistical Account of Scotland of 1791 there were said to be *76 mills along the 23 miles of the Water of Leith*. The Water of Leith was a very valuable source of energy. However in the past under flooding

conditions most of the potential energy which could have been generated by these mills overflowed the weirs and was lost. Designing a Mini Hydroelectric Generating Scheme for the Water of Leith should maximise use of all the available energy and ensure that as much water as possible flows through each Water Turbine in succession on its way downstream, and is not lost over weirs. It has been estimated that at present day prices, and energy prices are set to rise for the foreseeable future, ***the Water of Leith could generate renewable hydroelectric power to the value of £2 million per year, and the Water of Leith is just one of the rivers in the area.***

The aim of this part of the paper was to show, based on the fundamental principles of hydrology, that BCC's objections to the Scottish Ministers decision dated 15th March 2007, see para 2.3, were fully justified. We believe we have demonstrated that they were, and that:-

1. Our alternative proposals would have a significant impact in major flood events;
2. That they would not only significantly reduce the need for walls/embankments within the city but would make them completely unnecessary, at a saving to the taxpayer of £46m;
3. That additional storage sites had not been investigated and modelled properly by the Council;
4. That reduction in defence heights would have been 100%;
5. That our objections, if accepted, would have resulted in a 100% saving in wall construction within the city, and would have provided a dramatically more cost effective flood prevention scheme.

Answers to Some Objections

(1) If the East Midland Becks do not have dams – build them, leave them normally empty and incorporate flow restriction weirs so the flow downstream can never exceed the full bank flow;

(2) Reservoirs are built for a number of different reasons e.g. By the Water Authorities to supply safe drinking water, by Hydro Power Authorities to supply electricity, by Local Authorities and Agencies to prevent flooding, to protect certain habitats by maintaining water levels at a particular level (e.g. RSPB, Historic Scotland, and Scottish Natural Heritage if the area is a designated Site of Special Scientific Interest) and by private landowners in regulation of water levels. It may be unreasonable to expect small reservoirs not covered by the 1975 Reservoirs Act, that is less than 25,000 cubic metres capacity, or built below ground level, to be used for flood prevention and power generation, but flooding and power generation are, or will become so serious issues that it may be necessary to consider them on a case by case basis. However if those responsible for reservoirs covered by the Act object to managing their reservoirs responsibly and lowering reservoir levels to prevent downstream flooding, we should investigate if they are open to prosecution for malpractice and damages for causing flooding downstream, or change the law so that in the event such a thing happens again they can be held liable;

(3) If the "Severe Rainfall Containment Capacity" in a given catchment area is not sufficient, based on 5 day Met Office rainfall forecasts, initiate accelerated draw down procedures 5 days in advance to increase the "Severe Rainfall Containment Capacity" in time to meet the predicted severe rainfall – the "full bank flow" for the Water of Leith is 59 cubic metres of water per second (cumecs) so the reservoirs could be drained from full in just over a day.

(4) If draw down pipe work is too small to draw down the water level quickly enough, increase it;

(5) If there is still not enough "Severe Rainfall Containment Capacity" lower the **Severe Rainfall Containment Level** still further or empty the reservoirs. For environmental reasons Edinburgh has not been permitted so far, by SEPA, Environmentalists and Anglers, to lower the **Severe Rainfall Containment Level** more than about 1 metre as the reservoirs are considered to provide a valuable amenity and habitat. Those subject to flood risk may have something to say about this.

(6) If there is still not enough "Severe Rainfall Containment Capacity" build more reservoirs both above and below the existing reservoirs. Where this is difficult, changing agricultural and farming practice may go some way to ease any problems.

(7) If anyone still thinks Walls and Embankments are the answer they should look at the video of the Ulley reservoir dam near Rotherham on the 25th/26th June 2007 where the spillway became a raging torrent and broke through the spillway wall and washed away a section of the dam itself thereby making it unsafe, necessitating the evacuation of occupants of houses downstream and closure of a motorway. These dams are built to withstand a 1 in 10,000 year flood without sustaining damage and are required to conform to very stringent safety conditions in compliance with the Reservoir Act. Currently the latest traditional Walls and Embankments schemes are only required to withstand a 1 in 200 year flood and are not required to meet any legal safety conditions. It was failure of the wall which caused the erosion damage. Turbulent flowing water is very difficult to control.

Part 3. Hydro Energy – Do it yourself Hydro Electric Design – March 2008

Her Majesty Queen Elizabeth II has set us all a good example. In 2006 a hydroelectric plant on the river Thames started supplying power to Windsor Castle. The £1m scheme which supplies up to 200kw of electricity, about one third of the castle's needs was developed by Npower Renewables. The generators are driven by four turbines built into Romney weir about 800 metres from the castle. The generators will supply about a third of the castle's needs, maintenance is minimal and life expectancy is 100 years. (This compares with 25 years for a wind turbine.)

Inverness Council is considering reopening a small hydroelectric plant to power some of its electricity needs.

3.1 It would appear that the world's extractable supplies of oil and gas are coming to an end, so ending our supply of cheap energy^{6,8}. According to James Howard Kunstler's book "The Long Emergency – surviving the converging catastrophes of the twenty-first century"¹⁷, oil discovery peaked forty years ago and has been declining steadily ever since. Also according to Hubbert's model, and assuming current levels of world oil consumption at 27 billion barrels a year, the world has only about 37 years of oil left and because much of that oil will be too expensive to pump out of the ground, requiring the energy of more than a barrel of oil to pump a barrel of oil out of the ground, and oil consumption in China and India is still increasing, we will not be able to use oil as a source of energy long before 37 years are up. Probably a more realistic time scale will be 25 years. We have tried to find someone at a senior level in government and academia who could direct us to any professionally respected authoritative sources which refute the facts and/or basic thesis of this book, so far without success. If anyone can direct us to such a source we would be grateful, otherwise we have to assume Kunstler is right. Against this background and similar situations with other fossil fuels, and the industries and chemicals which depend on them, as Kunstler says in the title of the first chapter of his book we are "Sleepwalking into the Future", and very soon we will recognise that we have to exploit other, and preferably renewable sources of energy and hydro electricity has many advantages over the alternatives.

3.2 Our main concerns at this stage are with Micro and Small Hydro Power Schemes, associated with existing reservoirs and rivers. Four of the advantages of river based hydro power are that, unlike wind farm power i) they provide power when its needed and not just when the wind blows at the right speed; ii) they have a much longer life, 100 years rather than just 25 years; iii) they provide power close to the demand and so do not require long overhead lines; iv) they enhance the environment; and v) maintenance costs are negligible¹⁹.

3.3 The Implementation Plan of World Summit on Sustainable Development in Johannesburg in 2002 states that hydro power of all scales should be included in the drive to increase the contribution of renewable energy throughout the world. Hydro can be the a cornerstone of sustainable energy systems as it: allows greater utilisation of other renewable energy options; is reliable, flexible and efficient; does not consume finite resources; has a high energy payback ratio; has long-lasting infrastructure; and often provides multiple use benefits such as reservoirs particularly through increased availability, reliability and quality of fresh water supplies and reduced flood risk. There is a need to recognise entitlements and share benefits with directly affected people²⁰.

3.4 Water stored behind the reservoirs upstream can of course and should be used to generate carbon free renewable energy and help reduce the UK's dependency on energy from other countries, our Carbon Footprint and Global Warming. Micro and Small Hydro Power Schemes have very high Load Factors and are ideal for helping to meet Peak Load demand as they can supply energy when it is needed and not just when the wind blows at the right speed or the tide changes. To put quantities in perspective the DTI's Enviro Report 2005 indicates the exploitable hydro capacity for Micro Hydro Power (up to 1.25 MW) in England, Scotland, Wales and Northern Ireland is 750 MW; for Small Hydro Power (1.25 – 20 MW) is 900MW; and for Large Hydro (more than 20 MW) excluding Pumped Storage is 350MW providing a Potential Generation of 3,500 GWh, 4,400 GWh and 3,400

GWh respectively, **a total of 11,300 GWh or £1,139m/yr @ 10 p/unit** nearly twice the 6,440 GWh of energy generated at all the Locks along the Danube. According to the DTI's Sub National Electricity Figures this represents 3% of the Total UK Generation by fuel, or 63% of Scotland's Nuclear Power generation, or nearly 6 times the UK's total generation from wind, wave and solar power in 2004.

However these figures may be unduly pessimistic as Hungary ⁷, which is about a third the area of the UK, and has significantly less annual rainfall, has a theoretical hydropower potential of 1,400MW or 7,480 GWh/a, and this excludes the main river the Danube because of its topography.

We in the UK have been blessed with large quantities of cheap oil and gas from the North Sea but this source of cheap energy is coming to an end. Meanwhile in Germany for example, because they were not so blessed, they have been progressing much more rapidly than we have in making use of energy sources we have, up to now, ignored. The Ritz-Atro a company in Nuremberg sells devices capable of generating anything from 1 KW upwards from flows of just 70 litres per second (0.07 cumecs) which can be used where flows are too low for other micro generators, such as waste outflows from small industrial plants. Because we had cheap energy, we in the UK have so far failed to exploit this valuable source of carbon free renewable energy. We need to start exploiting this Hydro Energy source of renewable energy.

Unfortunately at present the construction of hydro-electric schemes is not within the powers available to local authorities in Scotland under the Flood Prevention (Scotland) Act 1961 so it is up to our civil servants and politicians to change this if they really are serious about reducing our carbon footprint and global warming.

An informative Small Hydro Power Guide can be found on the Leonardo Energy web site ¹⁸

To be continued.

Part 4. Environmental Issues. March 2008

A series of environmental jewels in the necklace of the Water of Leith, safe recreational areas, safe environmental habitats;

Fish Ladders - SEPA specify that the Compensation Flow to keep the Water of Leith clean and fresh must not be less than 34.4 million litres per day. As there are 1000 litres in a cubic metre this is 34,400 cubic metres per day or 0.4 cumecs. It is envisaged that the fish ladders will carry this flow;

Environmental habitats are regularly washed away during periods of severe rainfall with conventional flood prevention measures;

Unlike Wind Power Schemes which normally require unsightly overhead lines to take the energy to urban areas, it will normally be economically viable to run Micro and Small Hydro Power Lines underground, as rivers are normally reasonably close to urban load areas.

Canoe races can be held when the reservoirs are being drawn down rapidly to contain a predicted severe rainfall event.

In salmon rivers the salmon deposit their eggs in gravel beds, where the eggs are fertilised in depressions in the gravel cut out by the females tail. The eggs hatch releasing young known as alevins, still nourished by the remains of the yolk sac. They remain in the safety of stones on the river bed until they emerge to feed on insect larvae and other small animals until they grow to become parr. Unfortunately a great many of them die when the gravel in the river dries out as the rainfall declines and the weather warms up. Renewing the weirs which used to operate on our rivers and making more of them should reduce the number of deaths and increase the number of pools for fishing.

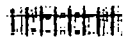




Most people in the UK now accept that we have a Global Warming problem and that there is a need to recycle. So far few people have even heard of the Global Water Crisis or what it will mean to us all. "A number of key research and environmental organizations such as Worldwatch Institute, World Resources Institute and the United Nations Environment Program have been sounding the alarm for well over a decade." "If water usage continues to increase at current rates, the result will be devastating for the earth and its inhabitants." "Local communities must be the watchdogs of our waterways and must establish principles that oversee the use of this precious resource." "Already, corporations have started to sue governments in order to gain access to domestic water sources." "By the year 2025, as much as two-thirds of the world's population – predicted to have expanded by an additional 2.6 billion people – will be living in conditions of serious water shortage and one-third will be living in conditions of absolute water scarcity." "In 1972 the yellow river failed to reach the sea for the first time in history." "In the malquiladora zones of Mexico clean water is so scarce that babies and children drink Coca-Cola and Pepsi instead." "The Nile, the Ganges the Yellow River and the Colorado river in America are among the major rivers that are so dammed, diverted, or overtapped that little or no freshwater reaches its final destination for significant stretches of time." "The need to stop wasting water is urgent." ²⁸

To be continued

References

1. Pearce F. New Scientist 10 January 2004
2. November 2001 Final Report of the Institution of Civil Engineers' Presidential Commission To Review the Technical Aspects of Flood Risk Management in England and Wales.
3. http://en.wikipedia.org/wiki/June_2007_United_Kingdom_floods
4. www.waterpowermagazine.com/story.asp?sectionCode=46&storyCode=2043071
5. New reports demonstrate success of pioneering method for managing floods
www.wwf.org.uk/news/scotland/n_000003597.asp
6. Bracing the world for the day when the oil runs out
http://news.independent.co.uk/business/analysis_and_features/article339347.ece
7. www.aquamedia.at/templates/index.cfm/id/7538
8. World oil supplies are set to run out faster than expected, warn scientists
http://news.independent.co.uk/sci_tech/article2656034.ece
9. www.aquamedia.at/templates/index.cfm/id/220
10. www.german-renewable-energy.com/Renewables/Navigation?English/root.html
11. www.scotland.gov.uk/Topics/Statistics/Browse/Environment/TrendElectricity
12. <http://news.bbc.co.uk/1/hi/uk/6239828.stm>
13. www.nerc-wallingford.ac.uk/ih/feh/
14. <http://freespace.virgin.net/bank.help/Facts/documents/7236.html>
15. www.scotland.gov.uk/Publications/2005/04/19110405/04130/Q/Zoom/125/cou...
16. <http://gis2.esri.com/library/userconf/proc97/proc97/to200/pap164/p164.htm>
17. Kunstler J. H. "The Long Emergency – surviving the converging catastrophes of the twenty-first century" Atlantic Books, London 2005
18. www.leonardo-energy.org/drupal/files/sh.pdf?download
19. New Scientist 21 January 2006
20. International Water Power & Dam Construction, April 2004.
21. Brian T., McKenna E. PLI Report to The Scottish Ministers April 2005 WYF 3E/55/1 para 6.10 and 6.11
22. Letter from defra dated 8 October 2007, CCU Ref: DWO45498.
23. Letter of response from BCC to letter 22 above dated 19th November 2007.
24. Letter from defra dated 17 January 2008, CCU Ref DWOE62664.
25. Letter from BCC and CCC to the Scottish Ministers dated 10 Dec 2004.
26. www.esru.strath.ac.uk/EandE/Web_sites/03-04/wind/content/storage%20available.html-21k
27. www.Chanel4.com/news/articles/dispatches "How The Banks Bet Your Money" 8pm Monday 18 February 2008
28. <http://www.thirdworldtraveler.com/Water/Introduction> or see 'Blue Gold' on Google

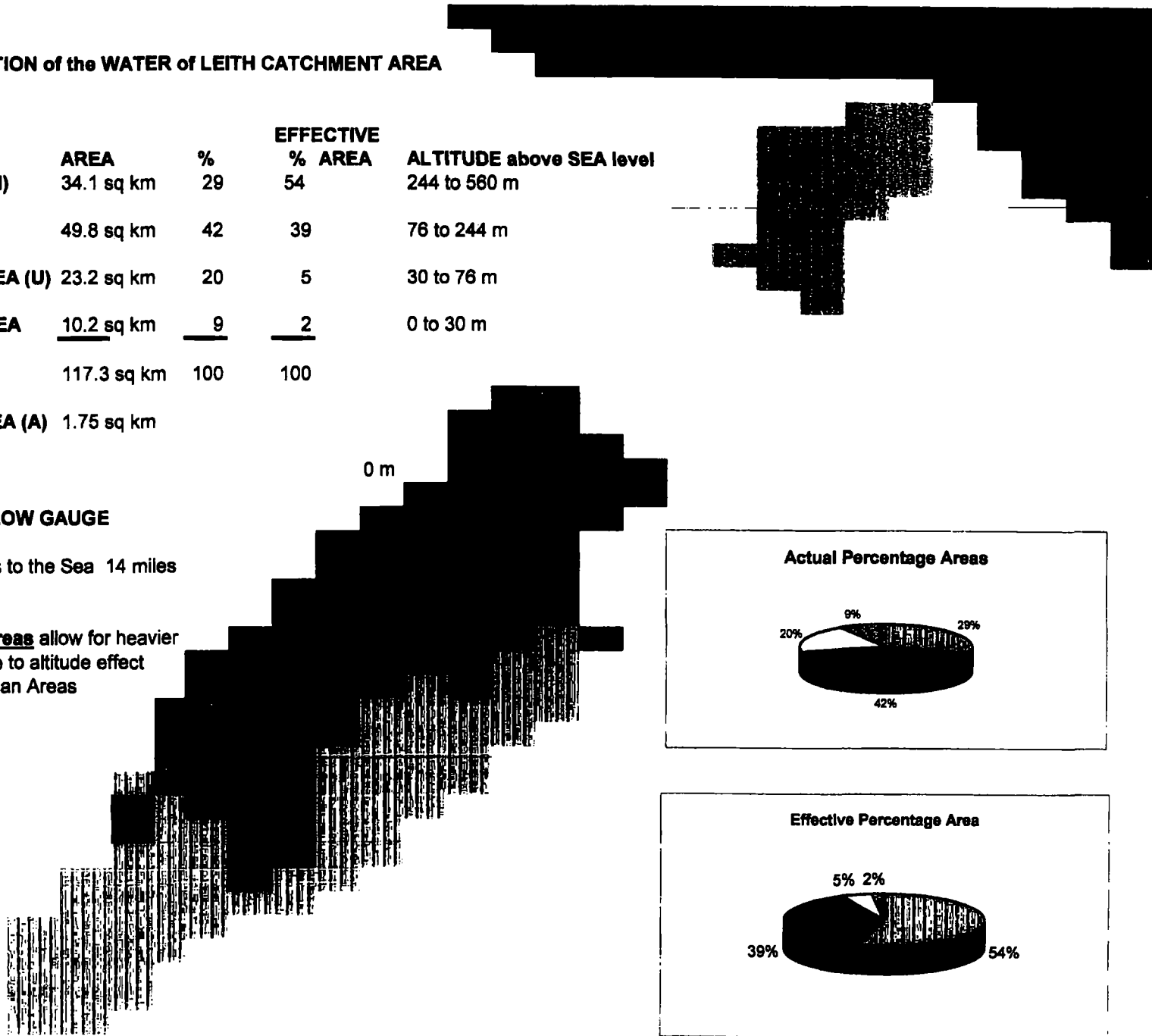
SCHEMATIC REPRESENTATION of the WATER of LEITH CATCHMENT AREA

	AREA	%	EFFECTIVE % AREA	ALTITUDE above SEA level
 HILLSIDE AREA (H)	34.1 sq km	29	54	244 to 560 m
 RURAL AREA (R)	49.8 sq km	42	39	76 to 244 m
Upper URBAN AREA (U)	23.2 sq km	20	5	30 to 76 m
 Lower URBAN AREA	<u>10.2 sq km</u>	<u>9</u>	<u>2</u>	0 to 30 m
TOTAL CATCHMENT AREA	117.3 sq km	100	100	
 RESERVOIRS AREA (A)	1.75 sq km			
 FIRTH of FORTH				

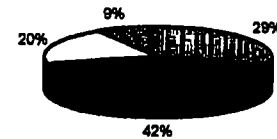
X MURRAYFIELD FLOW GAUGE

Max Distance from Reservoirs to the Sea 14 miles

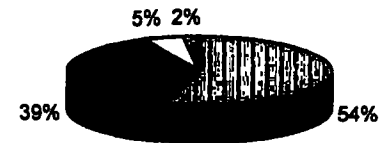
N.B. **Effective Percentage Areas** allow for heavier rainfall in the Hillside Area due to altitude effect and drainage to sewers in Urban Areas



Actual Percentage Areas



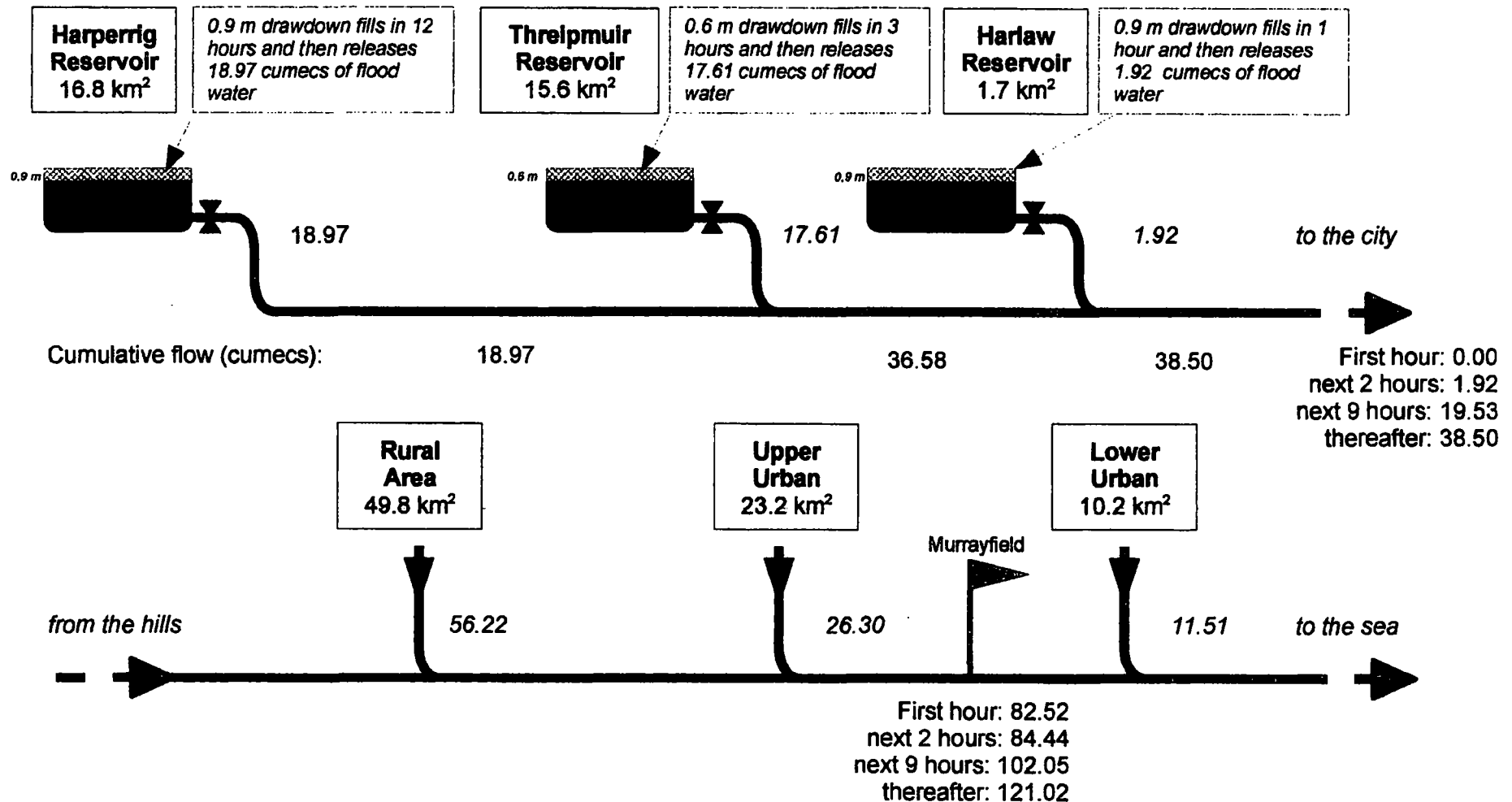
Effective Percentage Area



Being Revised!

What will the City of Edinburgh Council's proposed flood defences do?

The City of Edinburgh Council's (CEC's) Flood Prevention Scheme is designed to cope with 3.84 inches of rain in a 24 hour period. Left unchecked, this would result in a flow of 121 cumecs past the Murrayfield flow gauge. Today, the maximum safe flow at this point is only 59 cumecs. CEC's proposal is to use the reservoirs to absorb some of the excess rainfall, and build barriers to enable the Water of Leith to take 95 cumecs without overflowing.



WATER FLOW MODELLER

Illustration No 1

Average Annual Precipitation

Based on Readings for 30 years at 55° 55' N 3° 11' W Altitude 134m

EDINBURGH

Average Annual Precipitation = 676 mm

	mm	mm	
Jan	57	July	83
Feb	39	Aug	77
Mar	39	Sept	57
Apr	39	Oct	66
May	54	Nov	62
June	47	Dec	57
Totals	275	401	Annual 676

Average Annual Rainfall		X =	0.676	m	26.61	inches					
Description		Formula	Harperrig	Threipmuir	Harlaw	Hillside	Rural	Upper Urban	Lower Urban	Total System	Units
Catchment Area	A	Given	16.8	15.6	1.7	34.1	49.8	23.2	10.2	117.3	sq km
Surface Area	B	Given	0.91	0.69	0.15	1.75					sq km
Draw Down	C	Given	0.9	0.6	0.9						m
Full Capacity	D	Given	4.047	2.359	0.727	7.133					10 ⁶ m ³
Draw Down Capacity	E	BxC	0.819	0.414	0.135	1.368					10 ⁶ m ³
For Uniform Rainfall Across all Catchment Areas											
Average Annual Flow	F	Ax Xx10 ⁶ /365x24x60x60	0.360	0.334	0.036	0.731	1.068	0.497	0.219	2.51	cumecs

This Average Annual Flow of 2.296 cumecs at Murrayfield (between the Upper and Lower Urban Catchment Areas ie 2.51 - 0.219) compares with a Peak Flow of 121 cumecs for a 200 year return period flood event and the minimum 'compensation' flow of 0.398 cumecs (34.4 x 10⁶ litres /day) specified by the Regulating Authority SEPA

Illustration No 2

WATER OF LEITH - WATER FLOW MODELLER

Peak flows from all catchment areas for a 1 in 200 year return period flood event and 121 cumecs at the Murrayfield Gauge except when the dam heights are raised and the dam weirs do not overflow

If the dam heights are raised to contain a 1 in 200 year return period flood event the flow at the Murrayfield Gauge is reduced from 121 to 82.47 cumecs.

If allowance is made for increased rainfall with altitude and rainfall taken away in the sewers in the Urban Areas and the dam heights are raised to contain a 1 in 200 year return period flood event at a cost of £9 the flow at the Murrayfield Gauge would be reduced from 121 to 54.34 cumecs well below the Full Bank Flow of 59 cumecs at which downstream flooding occurs making the CEC Flood Walls and Embankments Scheme at a cost of £52m unnecessary. The addition of one new reservoir in the Rural Area would dramatically reduce the need to raise the heights of the reservoir dams.

Item						Total		Upper	Flow At	Lower	Total	
Description		Formula	Harperrig	Threplmulr	Harlaw	Hillside	Rural	Urban	Murrayfield	Urban	System	Units
Rainfall see note 1 below	X	For 121 cumecs	0.09761	0.09761	0.09761	0.09761	0.09761	0.09761		0.09761	0.09761	m
Rainfall in inches	X		3.84	3.84	3.84	3.84	3.84	3.84		3.84	3.84	inches
Catchment Area	A	Given	16.8	15.6	1.7	34.1	49.8	23.2		10.2	117.3	sq km
Surface Area	B	Given	0.91	0.89	0.15	1.75						sq km
Draw Down	C	Given	0.9	0.6	0.9							m
Full Capacity	D	Given	4.047	2.359	0.727	7.133						10 ⁶ m ³
Draw Down Capacity (DDC)	E	BxC	0.819	0.414	0.135	1.368						10 ⁶ m ³
DDC Rainfall Equivalent	E _R	E/A	0.049	0.027	0.079							m
DDC Rainfall Equivalent	E _R	E _R x 100 / 2.54	1.92	1.04	3.13							inches
Flow for Each Catchment	F	A x X x 10 ⁶ / 24 x 60 x 60	18.98	17.62	1.92	38.52	56.26	26.21	121.00	11.52	132.52	cumecs
Time for Reservoirs to reach overflow from Draw Down level												
Time to Fill Reservoirs	G	E x 24 / A x X	11.99	6.53	19.53							hours
Increase in Dam Height to Contain Flood Event without overflowing												
Increase in Dam Height	H	((A x X) / B) - C	0.902	1.607	0.206							
As F but with Flood Event Contained in Reservoirs						0.00	56.26	26.21	82.47	11.52	93.99	cumecs
Rainfall see note 2 below	J		0.16889	0.16889	0.16889	0.16889	0.08445	0.08445		0.08445		m
Rainfall Factor to maintain Total Flow At Murrayfield at 121 cumecs is												
As F but allowing for Altitude and Sewers see Note 2 Below												
Flow see note 2 below	K		32.84	30.49	3.32	66.66	48.67	5.67	121.00	2.49	123.49	cumecs
As J but with Flood Event Contained in Reservoirs												
Flow see note 2 below	K					0.00	48.67	5.67	54.34	2.49	56.84	cumecs
Increase in Dam Height for K		((A x J) / B) - C	2.22	3.22	1.01							

NOTE 1 Maximum flow at the Murrayfield Gauge is 121 cumecs = Catchment Area above Murrayfield x Rainfall x 10⁶ / 24 x 60 x 60 or Rainfall for 121 cumecs at the Murrayfield Gauge = 121 x 24 x 60 x 60 / Catchment Area above Murrayfield 10⁶ = 0.09761

NOTE 2 Rainfall in hillside is twice that at sea level and 75% of rainfall in urban areas is taken by sewers but total flow at Murrayfield is still 121 cumecs Therefore 121 = 200% X at sea level x hillside area + say 150% X x rural area + 25% upper urban area or 121 = 2 X x hillside area + 1.5X x rural area + 1/4 X x Upper urban area; therefore X = 121 / (2 x 34.1 + 1.5 x 49.8 + .25 x 23.2) 10⁶

Illustration No 3

WATER OF LEITH - WATER FLOW MODELLER

Full Potential of Active Reservoir Management with Raised Dam Heights to contain a 1 in 200 year return period flood event

Item						Total		Upper	Flow At	Lower	Total	
Description		Formula	Harperrig	Threipmuir	Harlaw	Hillside	Rural	Urban	Murrayfield	Urban	System	Units
Rainfall see note 1 below	X	For 59 cumecs	0.1495	0.1495	0.1495	0.1495	0.1495	0.1495		0.1495	0.1495	m
Rainfall in Inches	X		5.87	5.89	5.89	5.89	5.89	5.89		5.89	5.89	inches
Catchment Area	A	Given	16.8	15.6	1.7	34.1	49.8	23.2		10.2	117.3	sq km
Surface Area	B	Given	0.91	0.69	0.15	1.75						sq km
Draw Down	C	Given	0.9	0.6	0.9							m
Full Capacity	D	Given	4.047	2.359	0.727	7.133						10 ⁸ m ³
Draw Down Capacity (DDC)	E	BxC	0.819	0.414	0.135	1.368						10 ⁸ m ³
DDC Rainfall Equivalent	E _R	E/A	0.049	0.027	0.079							m
DDC Rainfall Equivalent	E _R	E _R x 100 / 2.54	1.92	1.04	3.13							inches
Flow for Each Reservoir	F	A x X x 10 ⁶ / 24x60x60	29.07	26.99	2.94	59.00			59.00			cumecs
Time to empty reservoirs from draw down level												
Time to Empty Reservoirs	L	(D-E)x10 ⁶ / Fx24x60x60	1.29	0.83	2.33							days
Rainfall to fill reservoirs from empty with raised dams			0.290	0.169	0.507							m
Rainfall to fill reservoirs from empty with raised dams			11.408	6.652	19.970							ins
Times CEC Design Rainfall for 1 in 200 yr return period			3.0	1.7	5.2							

NOTE

We do not know how quickly the reservoirs can be drained but assuming they can be drained as quickly as they can be filled and this is equivalent to the full bank flow of 59 cumecs, as shown they can be drained in less than the 5 days weather forecast. As shown they could then contain between 1.7 and 5.2 times the CEC Design Rainfall for a 1 in 200 year return period event.

We expect the drains will have to be replaced soon due to rust damage. When this is planned the drains should be designed to drain the reservoirs as effectively as possible, within the full bank flow limits.

Balerno Community Council (BCC)

Dr. K. D. Stephen BSc, PhD, (rtd Euro Ing, FIEE, FISMM, CEng)
Northfield,

Community Council Web Site:-
www.balerno-communitycouncil.org.uk

550 Lanark Road West,
Balerno. EH14 7BW

Telephone:- 0131 449 7011 Ex Dir
e mail:- kds@balerno15.freereserve.co.uk

Mr. R. Black, Auditor General for Scotland,
Audit Scotland,
110 George Street,
Edinburgh.
EH2 4LH

Your Ref: 04-g-41
Our Ref: R. Black, Auditor General
Copies: KS
Date: 26th February 2008

Dear Mr. Black,

IMPROPER and IRRESPONSIBLE EXPENDITURE of PUBLIC FUNDS **On Flood Prevention Schemes**

I wrote to you on this subject on the 29th July 2003. In his reply Jim Martin said "The Auditor General has powers under Section 23 of the Public Finance and Accountability Act 2000 to carry out audits of the economy, efficiency and effectiveness with which certain public bodies use their resources." and "I will write to you again shortly when I have gathered this further information." To date I have not received a reply to my letter.

Since my letter in July 2003, on one such scheme alone, the City of Edinburgh Council (CEC) Water of Leith Flood Prevention Scheme, according to Bob McCafferty's letter of the 23 October 2007, *copy No 1 enclosed*, against an original budget of £31.7m, £5.8m of taxpayer's money has already been spent and a further £45m will be spent to completion, a total of £50.8m, mainly paid by the Scottish Government. We note from the media that another scheme, the £21m Rothes in Moray scheme has just been given the green light.

In the UK we spend hundreds of millions of pounds on flood prevention schemes every year. At present almost all of these schemes in the UK exacerbate world problems, whereas there are alternative schemes which are more cost effective, provide renewable energy, increase food production and reduce Global Warming.

THE CEC SCHEME IS NOT FIT FOR PURPOSE

In their closing submissions to the Public Local Inquiry(PLI), para 5.3, CEC freely admit their Scheme will not prevent flooding.

As stated in the Balerno and Currie Community Council's letter of the 10th December 2004 to the Scottish Ministers, *copy No 2 enclosed*, and demonstrated in Version 6 of our Draft Web Page, *copy No 3 enclosed*, the CEC Scheme is Fundamentally Flawed.

In Chapter 6 - Conclusions and Recommendations, of their Report on the PLI to the Scottish Ministers ref WYF 3E/55/1 dated April 2005, *copy No 6 enclosed*, Timothy Brian, Principal Reporter, and Edward McKenna Reporter give examples of technical problems with the CEC Scheme, 6.7; 6.8; 6.9 and in 6.10 and 6.11 they state "There has been no detailed investigation of any potential alternative flood protection scheme, and undue reliance has been placed on a 1980s study when considering the potential for alternative flood storage locations" and "The Flood Prevention Scheme is unlikely to optimise the flood storage capacity of the reservoirs. There may be potential to increase the compensation flow and the amount of dedicated storage in the reservoirs.