National Infrastructure Commission
National infrastructure assessment call for evidence

Background to CIWEM

CIWEM is the leading independent Chartered professional body for water and environmental professionals, promoting excellence within the sector. The Institution provides independent comment on a wide range of issues related to water and environmental management, environmental resilience and sustainable development.

CIWEM welcomes the opportunity to respond to the National Infrastructure Commission on its call for evidence. This response has been formulated with the assistance of our Technical Panels who have a wealth of experience in the water and environment sector. We have tackled the questions that are in the areas most relevant to the Institution and its members.

Response to consultation questions

Energy

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved? Note: the "zero carbon power sector" includes the generation, transmission and distribution processes.

There is no such thing as a zero carbon power sector as any power generation system needs capital works which have embedded carbon. A power sector as close to zero carbon as possibly would have a diverse mix of renewable forms of generation, allied to significant storage and carbon capture. Nuclear is also likely to be part of this mix.

Demand for power varies during the day and between days, sometimes by a factor of about two. This gap is generally covered by fossil fuel. To minimise fossil fuel use it would be appropriate to store renewable energy for use in peak times and when renewable energy is insufficient. CIWEM considers there needs to be far greater emphasis on the more efficient use of energy through insulation, efficiency and demand management, alongside dispersed storage across the grid to mitigate peak electrical loads.

Whilst we support the development of solar and wind power, but issues with their intermittency are well understood. In contrast tidal energy does have gaps between tides which, for tidal lagoons and tidal barrages with modern ebb/flood generation, would be only about three hours. This gap can be covered by storage, particularly pumped storage. Traditionally this has been done by hydro pumped storage with schemes such as Dinorwig in North Wales storing about 9 GWh. Such schemes can last for 100 years, Dinorwig having been in use for about 35 years without significant renewal. Currently lithium ion batteries are being developed but so far these have relatively minimal output and relatively short life. However they can be distributed around the country. Consideration needs to be given to greater electrical storage systems.

The UK is blessed with large tidal ranges and there has been significant progress recently developing the science and technology of tidal lagoons. CIWEM believes that, providing they are sensitively designed and located with appropriate regard for the environment, they offer significant potential to

harness this natural resource. Assuming the Swansea lagoon goes ahead, the hydrological and ecological impacts should be monitored in detail. This can then be used to review the Severn Barrage scheme in light of new technological development since the time of the last review, which may significantly mitigate environmental impacts on intertidal habitats.

Vehicles could be part of the storage system by storing electricity in the batteries of electric cars. However there are several potential problems with this. At times when the grid would want to withdraw the energy to meet peak demand, generally in the evening, the cars may not be connected to the grid and most electrical loads in houses and businesses occur when people arrive (often having just exited a vehicle), so the process that gives rise to demand is not coincident with the need to charge vehicles. This needs careful thought on how it could be implemented. There has been a concern that charging will overload the grid. This is false; provided charging is staggered and synchronised it is entirely possible to charge with little impact on peak demand.

Water and wastewater (drainage and sewerage)

22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute? Note: "demand" includes domestic, commercial, power generation and other major sources of demand.

In general climate change, demographic change, economics and environmental legislation all necessitate a more integrated approach to the management of water in the UK. In the UK our institutional arrangements for managing water have developed and remain in 'silos'. We also have an underlying problem in that we continue to develop in the south east where water availability issues are greatest.

Most of our sustainable groundwater is already fully committed, and during droughts there is little water in some of the rivers that is not required to maintain a healthy environment. Supply side solutions, including new sources and water transfers should be used alongside demand management approaches. On the supply side, encouraging indirect potable reuse schemes, e.g. aquifer recharge with wastewater effluent and encouraging better interconnectivity between the supply networks of adjacent water companies.

Water efficiency and demand management offers an area where incremental changes can be made towards more resilient systems (e.g. increased metering alongside tariff responses to water availability and use, reducing demand through improved customer behaviour). A big challenge in this area is communicating the risks around water scarcity when it is not seen more widely as a big societal risk. Raising customer awareness of the water they use can only help serve this and will improve the willingness to pay for improved resilience. There is a need to understand the value of water in different contexts and locations as currently water is undervalued.

Much of the water we use for non-potable purposes such as industrial applications, toilet flushing and irrigation, is unnecessarily treated to potable-water standards (we only need 3% of our water to be potable in the domestic context). Opportunities for increasing non-potable water use will translate into energy saving too, with efficiency on treatment process power and pumping.

Leakage

The industry average leakage level is about 20% of the amount put into supply. Several overseas suppliers have a much lower level. Current water company water resources management plans show little further reduction in leakage which for some companies is over 25%. Water companies should be encouraged to lower leakage significantly further.

Leakage reduction is a fundamental part of demand management and depends critically on water companies 'doing their bit' (and being able to demonstrate that they are doing so against easily understood targets). Good data are essential to understand current rates of consumption, to forecast consumption and to evaluate the cost-effectiveness of water efficiency, water balance, consumption, leakage and conservation interventions. We recommend greater consistency in measuring and estimating consumption and leakage and greater sharing of data, particularly between water companies, where there are clear financial and statistical benefits from working at scale.

Company ownership of supply pipes will also help identify leaks. Water UK state that around 30% of leakage is estimated to arise from customer-owned water supply pipes[1].

Metering

Households that are metered use about 10% less water than unmetered households. Southern Water found metering reduced consumption by 16%. Current meter penetration is about 55%, with Southern about 85%. Water companies should be encouraged to substantially increase metering penetration.

Getting full metering (or as close as technically practical) is critical. Whilst offering companies the mechanism to compulsorily meter is useful, the customer base is often suspicious of why this would be done, especially where the area is not perceived to have water resources 'problems'. Regulators and government put the emphasis on the water companies to promote metering, however we consider this should be driven by strong policy as the benefits are recognised.

CIWEM supports a move to smart metering which has extensive benefits beyond 'dumb' metering and intermediate options such as automatic meter reading (AMR). Thames Water are installing smart meters on households and thus obtaining real time information of flows. Thus, once sufficient meter penetration has been achieved, Thames should be able to identify leakage and wastage much more quickly and efficiently. Thus these should reduce significantly.

Compulsory metering would help with unmeasured consumption and smart metering would go some way to helping with data.

Initiatives such as the Green Deal had the potential to integrate water and energy efficiency and a 2012 UKWIR project demonstrated the quantitative and qualitative benefits of such programmes. However national programmes seem unlikely without a significant change in government policy and local programmes have more potential in the short term. Most water using appliances in a home are long lasting. New houses should be required to be to a lower water use standard than currently.[2]

Waste water reuse

Currently significant indirect reuse of wastewater occurs. As an example, Oxford's treated wastewater is diluted in the River Thames and some pumped out to be stored and treated to become part of London's water supply. The great advantage of waste water reuse is that the source is largely there throughout any drought of whatever length and severity. Greater use should be made of reused wastewater, especially when it would otherwise be discharged directly to the sea. Already the Langford scheme in Essex treats wastewater from Chelmsford that would otherwise be discharged into the tidal Blackwater, treats it to a higher standard and puts it into the Chelmer and thence into Hanningfield reservoir for public supply. Thames Water have a proposal to take Mogden STW effluent, treat it further and then use it to be part of the Teddington residual flow, thus releasing the same amount of

[1] For more information please see CIWEM's policy statement: http://www.ciwem.org/wp-content/uploads/2016/04/Water-supply-pipes.pdf

[2] For further information see CIWEM's 2016 report: *Water Efficiency helping customers to use less water in their homes* http://www.ciwem.org/wp-content/uploads/2016/02/Water-Efficiency.compressed.pdf

river water. Southern Water has plans to recirculate wastewater that has been treated further. Where security of public water supply quality can be maintained, such action should be encouraged.

Water UK have recently produced a long term water resources strategy. As part of this United Utilities would divert water from Vyrnwy reservoir, which currently supplies Liverpool and Manchester, to flow down the Severn to near Gloucester and then be pumped over the Cotswold to flow down the Thames to London. United Utilities would have had a substantial drop in demand for industrial water and would take the remaining balance from the Lake District. Thus, for limited new investment, London would effectively be supplied from the Lake District.

23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand? Note: this can include, but is not necessarily limited to, governance frameworks across the country.

The most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand are to:

1. Keep surface water from new developments out of combined systems and separating surface water out wherever opportunities arise.
2. To create overland flood exceedance routes in to minimise damage where systems capacity is exceeded.

Progressive surface water separation has been used extensively in Switzerland to manage capacity. Removal of a relatively small proportion of surface water from a combined system can give capacity to admit a significant increase in foul flows from new developments.

Increasing green space in urban areas can increase natural infiltration and reduce run-off helping to reduce flood risk and the transportation of pollutants. Urban layout and landscape should be carefully designed to allow the space for flood water to pass freely along pathways. Roads and streets constitute up to 70% of impervious areas in urban areas and as such they act as major conveyors of storm water and an important flow path when the drains beneath them are full to capacity.

Sustainable drainage systems (SuDS)

SuDS help to reduce urban diffuse pollution. They minimise surface water runoff with permeable surfaces, filters, storage areas, wetlands and balancing ponds. This helps to protect water quality and provide a habitat for wildlife in urban watercourses. SuDS reduce water treatment costs by improving water quality at the source rather than 'end of pipe'. The collective benefits of SuDS schemes provide a more cost effective solution and offer numerous benefits compared with traditional systems.

The Victorians pioneered the drainage system that we take for granted today but, as we build more developments, this approach needs to be used alongside modern, more sustainable options that work with nature. Ofwat estimates that about half of average annual flooding incidents are a result of the capacity of the drainage system being exceeded.

Well-designed SuDS can be built affordably and without delay in nearly all kinds of development as well as retrofitted in established developments. Arguments for not delivering SuDS on the basis of site constraints may be overstated and the range of options available means it is nearly always possible to incorporate some measures. SuDS are a cost effective alternative to conventional drainage when included early in the planning process and it is the failure to consider SuDS from the very start of a development's design that is a significant barrier to efficient delivery. They are far from the brake on development they may be portrayed as, given the diversity of options and techniques available.

The implementation of Schedule 3 of the Flood and Water Management Act 2010 was shelved by Government. A revised approach was announced based on 'strengthening' the planning system

(through the National Planning Policy Framework), to create an 'expectation' that major planning applications (i.e. those of ten dwellings or more) would include SuDS. Yet our research[3] published in February indicates that the vast majority involved in delivering SuDS consider current policy is ineffective with many new homes built without the full benefit of SuDS.

The main barrier to wide scale retrofit SuDS implementation in the UK is institutional, not technical. A policy that demands SuDS to be considered from the outset would ensure that they are well designed and implemented, delivering cost savings and so much more: Amenity, biodiversity and water quantity and quality benefits. The Government is reviewing the law and policy in England that requires SuDS to be included in new developments. Significantly greater effort should be invested in delivering sustainable drainage and green infrastructure both in new and existing developments than is currently the case. We urge the NIC to look further at SuDS should the government's review not result in change to policy or standards.

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

This question should also include the use of the catchment for food and energy production. Catchments have so much more in the way of benefits (e.g. ecosystem services) and should not just be looked at through the lens of water and flooding. Although the catchment based approach started as a water quality initiative, the wider benefits of this approach for water resources, biodiversity and flood management are obvious, and further integration of activities and funding to achieve diverse outcomes should be strongly encouraged. The establishment of catchment partnerships in each catchment is key to achieving benefits for water and land use management. Schemes which engage with water polluters, e.g. farmers, pesticide industry will be far more effective.

There is a need to consider the full (ecosystem service) values associated with catchment management in order to make effective decisions. Both of these require effective economic analyses. At the UK Water Economics Forum those present agreed the most important economic issue facing UK water companies over the next 12 months was identified as taking on board natural capital accounting.

There is recognition amongst water economics professionals that in order to improve strategic planning in relation to water use there are some fundamental issues that need to be addressed:

1. adoption of the natural capital / ecosystem services approach,
2. improving business planning via economic valuation,
3. water pricing and the value of water (and the implications for abstraction).

There is beginning to be a more positive approach and dialogue towards the way that agricultural land is considered in flood risk management. The catchment based approach and payment for ecosystem services could assist in paying farmers to flood farmland where it is better used to store water to protect communities downstream.

[3] For more information please see CIWEM's 2017 report: *A place for SuDS?* www.ciwem.org/suds

Flood risk management

25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

There is no strategic plan for managing flood risk in England. Responsibility for managing flood risk lies with many different agencies, often working to different standards of protection and this makes managing and funding flood mitigation measures a challenging process.

The Government's intention is to reduce risk by around five percent by 2021 and reduce expected annual damages by 12 per cent to 2050. This is to provide the optimum return on investment as beyond this point it becomes increasingly expensive to lower the risk further. However there is limited understanding of this with a perception from many that they are owed full protection from flooding and the public purse will pay for it. There is also a reality that sometimes we simply live in places that are no longer appropriate. Some places in the Somerset Levels or communities on rapidly eroding coasts for instance are cases for migration.

The Government is under no legal duty to provide flood risk management or provide protection to a certain standard. It is however under increasing pressure to adequately manage flood risk for both the societal and economic costs it can cause. Since the majority of funding is provided by the Government, every taxpayer pays towards flood risk management under the current arrangements. The approach in the UK is often compared to the Netherlands, where there is a legal commitment to flood safety standards. The UK's hydrology and geology is far more complex so it is comparably more expensive to lower flood risk. In the Netherlands there is a lot more political and public support for FCERM measures and this may be because two thirds of the land area is at risk, compared to around 15 per cent in the UK.

In recent years national funding to meet national priorities has shifted to one that is now based on both national and local funding and more local choice (the partnership funding era from 2012). CIWEM supports the emphasis on partnership funding as it aims to increase the number of schemes being supported, increases local choice and should lead to an increase in external contributions. It introduces the concept that beneficiaries should contribute towards schemes from which they derive gain, which would not otherwise go ahead.

CIWEM considers that the current priorities for allocating funds for flood defence schemes are appropriate, however partnership funding needs to be monitored to ensure it is delivering enough schemes and helping the most vulnerable. There is still some confusion in the general public and media as to how the new funding framework operates and who is responsible for managing residual flood risk. There needs to be a national conversation about what level of flood risk is acceptable and at what public cost. For a full discussion of flood funding and priorities please see CIWEM 2015.[4]

Setting of an acceptable return period is difficult because of the increasingly extreme climate we will be encountering. Even existing defences will not provide the planned 1:100 year protection if the statistical chance of such heavy rainfall in any given year has doubled. The latest climate science[5] suggests that future extreme rainfall may be higher than existing UK climate change allowances for rainfall intensity, largely due to summer convective storms such as those experienced in 2007 and

[4] CIWEM. 2015. Breaking the bank? Funding for FCERM in England, which assesses both the amount of funding and its prioritisation http://www.ciwem.org/wp-content/uploads/2016/02/Breaking-the-Bank.compressed-1.pdf

[5] Dale, Luck, Fowler et al. New climate change rainfall estimates for sustainable drainage. Engineering Sustainability. Part of UK Water Industry Research's programme of climate change related projects. https://www.researchgate.net/publication/284546535_New_climate_change_rainfall_estimates_for_sustainable_drainage

2012. Sub-daily intensities are likely to increase at a higher rate than daily intensities because of the impact of phenomena such as intense convective cells. Picking a numerically convenient notional return period will be arbitrary and subject to challenge when flooding occurs more frequently than the statistics say is likely. The vocabulary around levels of protection will need to change because many do not understand the risk or the need to take action.

Similarly the level of acceptable damage will also be a function of preparedness and the durability of the assets at risk. So the consequence of the flood rather than the blanket expectation of avoidance needs to be factored in.

There is a tension between high-level policy for flood risk management and the public expectation for flood protection, between policies that rely on "resistance" rather than "resilience". There needs to be a focus on increasing the resilience of communities that benefit from defences and those living in flood risk areas to also change attitudes and take self-help measures.

Measures to enable a house to resist flooding have been developed. Existing householders in flood risk areas must be encouraged to obtain appropriate measures to be put in place when warning of flooding has been issued, especially given that at the end of Flood RE risk reflective pricing will come back into force in 2039. Defra should ensure that Flood RE has an explicit aim to build awareness of risk with those receiving assistance. It must incentivise owners to implement property level protection to increase their flood resilience so that they are insurable once the scheme ends.

Property Level Flood Protection (PLP) measures are those where the whole fabric of the building is addressed to minimise water ingress (e.g. flood doors, door barriers, self-closing airbricks, pumps). This provides an affordable and effective first line of defence in mitigating against internal flooding of property. The other is Property Level Resilience (PLR) measures which reduce the amount of damage and clean-up time should a property be flooded (e.g. tiled concrete floors, water resistant plaster, raised electrics).

Short term post-event Government repair funding is inadvertently creating a lack of trust in the industry, whereby opportunists are selling certified products but potentially not installing them properly or not factoring in the whole property's vulnerability, leading to potentially inadequate protection. Often solutions are marketed at a price which reflects the size of recovery grant available. This situation can actually hinder the sustainable growth of the industry by distorting market conditions to the detriment of more responsible providers.

There is a need to make people confident enough in the industry to act and install equipment and measures. Resilient repair is equally needed alongside PLP so that people can get back to normal as soon as possible after a flood. In July 2016 CIWEM convened a round-table discussion attended by senior figures from the industry and communities to debate these issues. What was common to all aspects of this discussion however was the need for a recognised standard of survey, inspection and certification during the PLP/PLR process to give the underlying confidence to property owners and insurers alike that the measures being put in place are as effective as they can possibly be.

New developments should not be allowed to add to flood risk, by not adding pressure to the drainage system and putting in place SuDS (see answer to question 23). Policies or funding streams should not incentivise building in the floodplain unless effective mitigation and resilience measures are included and the development in question is appropriate for its location.

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk? Note: "innovative technologies and practices" can include, but is not necessarily limited to, property level resistance and resilience, temporary defences, advances in predictive asset maintenance and innovative construction materials.

When flood mitigation measures are progressed, affordability often limits the scale of measures that can be put in place, leaving a residual flood risk in extreme events. This can only be overcome by adopting innovative approaches to flood mitigation as part of catchment-wide planning, and ultimately preventing damaging and expensive water ingress to properties through PLP and PLR.

No strategy can eliminate flood risk. Natural flood management (NFM) measures are designed to manage risk by allowing identified areas to flood in order to decrease the flood risk elsewhere. These methods reduce the severity of flooding by gradually lowering the flood peak as it passes along a river.

NFM can reduce low return period floods. However flood damage is caused by long return period floods and NFM has limited, if any, mitigation of these. At Holnicote, modelling has clearly demonstrated a 25% reduction in 5 year return period flows, but minimal benefit in floods greater than about 25 year return period, i.e. the ones that cause the damage. Having said this there are a host of additional reasons for understanding improved land management and building more green infrastructure such as reducing soil erosion, improving biodiversity, water quality, soil fertility and amenity.

Good land management practices (agricultural soil management, sediment retention, floodplain reconnection, slowing surface water runoff, river restoration and re-planting) should be encouraged. Whilst these NFM methods are supported by evidence, there is a lack of empirical data at a catchment scale (i.e. their effectiveness is unique to the catchment). This has meant that it is difficult for schemes to attract national funding on the basis of current funding allocations through cost benefit assessments.

Similarly SuDS will not prevent major floods, but complement more catchment-wide thinking that promotes diffuse "networks" of flood response, rather than single large flood defence schemes. SuDS can reduce the pressure on conventional drainage systems that are often over-stretched, reducing sewer overflows (where surface water and sewer systems are combined) and additional costs. SuDS can be delivered in a variety of urban and rural contexts including housing, schools, community buildings, parks, public open spaces and highways. SuDS have far greater benefits beyond flood risk that are currently not being valued or assessed. See more in our report A Place for SuDS?[6]

See also the answer to question 25 for a discussion of property level protection.

Solid waste

28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be? Note: A "circular economy" is an alternative to a traditional 'linear economy' (i.e. make, use, dispose) in which products are designed and packaged to minimise waste, and resources are kept in use for as long as possible, e.g. through re-use, recycling and greater recovery of materials through the waste management process

The government has recognised the value and contribution a more circular economy (i.e. recent statements from Defra) but has chosen to leave it to the market to resolve, opting to step back from waste policy. In 2011 CIWEM published a report[7] on moving towards a circular economy and little progress has been made since.

[6] CIWEM. 2017. *A place for SuDS?* www.ciwem.org/suds

[7] CIWEM. 2011. Less is more: waste prevention and resource optimisation across a lifecycle. http://www.ciwem.org/policy/waste-resources/

Nearly all of the recommendations are still relevant today such as: setting up a commission type structure or Office for Resource Management within government to monitor the impact of polices on resource use, changing the activities that VAT is charged upon and pricing externalities into decision making, extending producer responsibility to drive more measures up the waste hierarchy and introducing various incentive structures such as minimum standards, dynamic standards, voluntary labels and procurement standards. We consider it is very much within the power of the government to be able to drive the circular economy alongside businesses.

The EU has been leading on the circular economy and it is not yet known if the UK will adopt the Circular Economy package into domestic law before and whilst leaving the EU. Proposals within the Circular Economy package include an increased recycling target of 65% by 2030 as well as plans to harmonise definitions of recycling across EU Member States. Increases in targets for packaging recycling have also been proposed.