Ireland at Risk – Water Supply

by

Michael Phillips, Dublin City Engineer

INTRODUCTION

Water is the key to the survival of all human, animal and plant life. In antiquity it was considered so precious that variations on the theme of water as the source of life have been written about in virtually every religion. (Black M).

To day, those of us who live in water rich lands take it for granted. The dissection by modern day science of the chemical properties of liquids has taken from us the fascination of the composition of this flavourless, odourless and colourless liquid. The power to mix with other substances, to corrode others, to operate in three states of vapour, liquid or solid and at the same time have extraordinary self cleaning properties are all but forgotten by the present day generation.

CLIMATE CHANGE

When you consider that the world population will increase from the current 6.5 Billion to 8.0 billion in 2020 and 13 billion by 2100 (UNEP; IS92a). Future greenhouse gas emissions will depend on global population, economic, technological and social trends. The link to population is clearest: the more people there are, the higher emissions are likely to be. The link to economic development is less clear. While rich countries emit more than poor countries the emission rates are very different and depend on many variables. The bulk of emissions to date have come from industrialised nations. However, most future growth is likely to come from emerging economies where economic and population growth is fastest – and for which projections are most uncertain.

While the quantity of future emissions is uncertain the "Do-nothing" scenario indicates a doubling of pre industrial carbon emissions by 2030 and a trebling by 2100.The proposal by industrialised nations to return their greenhouse gas emissions to 1990 levels only postpones the above 2030 date by less than five years. (UNEP)

This means that the rate of climate change is greater than it has been for over the last 400 years and the question to be answered is how will the island of Ireland adapt to changes over which it will have very little control. The impact of climate change on people's water resources is a critical issue for people's lives and the respective economies. Even if the emissions of CO_2 were stabilized today it is recognised that temperature increases and water availability issues will continue for some decades. The latest Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2007) projects that global average temperatures in 2100 will be between

1.8 – 4.0 degrees higher than the 1980 – 2000 average. These global trends will have implications for Ireland and it is prudent that we should plan in anticipation of the expected changes.

Global Climate Models are used to forecast the expected climate change. These are not suitable for regional forecasting so downscaling has been carried out (J.Sweeny et al, 2000) to predict the potential changes in Ireland. The following estimates are the result

a) Current mean temperatures will increase by 1.5 degree by 2050 and 0.5 – 1.0 degrees by 2075.

b) The mean January temperature, along south and southwest coasts will be 7.5 – 8.0 degrees.

c) July mean temperatures will increase by 2.5 degrees by 2055 and a further 1.0 degrees by 2075.

d) Overall increases of 11% in precipitation are predicted for the winter months.

e) Marked decreases of between 25% to 40% in precipitation are predicted for the summer and early autumn months.

WATER – CURRENT STATUS

"Drought continues across Western Europe

The dry weather conditions we have been experiencing in southern England are also affecting other parts of Europe.

Portugal is facing its worst drought for 300 years. In **Spain** there are water restrictions on non-essential use arising from their worst for 60 years. In **France** there are garden watering and agricultural irrigation restrictions in place in Loire, Brittany and the Calais area as well as some parts on the south.

These droughts are due to the very low rainfall experienced since November and have led to poor recharge of natural underground water storage. In northern Europe this means the chalk, which provides most of the public water supply for southeast England and northeast France.

In **England** the drought is beginning to bring restrictions on the use of sprinklers and unattended hosepipes in local areas of the South East. This is an early stage in the formal drought planning process, which we, unlike many other European countries, have had in place for some years.

Water companies draw up detailed drought contingency plans in partnership with government and the Environment Agency. As water becomes scarcer the companies take necessary measures as outlined in the plans.

Similar procedures are in place in Scotland, Northern Ireland and Wales.

Ends "

(Water UK update on water resources, 01/06/05)

This is not a hypothetical scenario from some unknown date in the future but an actual press release from Water UK (2005). This is currently considered an extreme condition but with climate change now accepted as a normal environmental effect, then these extreme conditions will become more the norm in the future. As a result it is not just a simple problem of finding new sources of water or developing new technology to create water but the holistic issue of quantity, quality and the impact of achieving those demands has to be taken into consideration. This latter demand will be the most difficult to fulfil because in meeting this demand compromises, perceived or actual, in environmental issues will have to be made and the acceptance by the public of these decisions will be critical to planning the way forward.

Pamela Taylor (CEO, Water UK) further stated at Berlin (2007)

"This is the situation: we are in the front line of climate change, but at the same time we are already suffering its effects. Droughts and floods are a reality. Sewer design, water supply, infrastructure maintenance, in fact every aspect of our business is affected.

So it is clear we must also adapt to maintain water and sewerage services. How should we react? We could just pump more water out of the ground to meet supply needs and build more treatment plants and bigger sewers to deal with more intense rainfall events. But this alone is not an option. Obviously we must also account for the secondary effects of our actions on our social and environmental duties.

Is it possible for us to adapt and mitigate simultaneously whilst protecting the aquatic environment? Let us look in more detail at the impacts of our different industry responsibilities. Higher temperatures, more intense rainfall events and rising sea levels will have a major effect on all areas of operation from security of supply and water quality to sewer capacity and the maintenance of assets"

Planning the way forward is very difficult given the lack of information available and particularly the uncertainty in the rate of climate change over the period 2050 to 2100 and

beyond. What we do know though is that, while we can minimise our carbon emissions during the next 100 years, the actual rate of climate change will be determined by what occurs on other continents, particularly Asia and America.

When you consider that the implementation of public infrastructure projects and their design lives are much longer than for commercial or private investments you can understand that the public do not generally take an active interest unless it directly impacts on them. The alternative arguments to implementing public infrastructure are usually presented by NGO organisations that have a dedicated focus on a particular issue. This means that the case for the "greater common good" is promoted by the government agency or is championed in the media by the promoting agency. In future planning the influence of the micro on the macro will have to be appropriately balanced and the fact that people have to adapt to the changing climate recognised in the decision making process. Will the current decision making processes be sufficiently robust to manage these changes?

In the current social and economic climate in Ireland this type of planning will present many problems. From approximately 1800 to 1970 Ireland's economy virtually existed at subsistence level. The reasons for this are manifold and in the 20th century were mainly externally sourced. The rapid growth in affluence, increased ratio of young people as a proportion of the population and education in recent years has created standards and expectations, which may not be sustainable in the future. Standards and norms on the continent of Europe have evolved over years and the population accept the principal of the "greater good". Ireland has moved from a rural community set of standards to a high-density urban set of standards in effectively two generations. This introduces totally different levels of understanding and contribution when planning for the future. The fact that global travel, while detrimental to climate change, is economically possible for everyone today it may assist in making a very positive contribution from the viewpoint of the decision making process.

We live today in a constantly changing environment whether social, environmental or economical. One of the major issues that will confront Ireland in 2100 is providing for the population of the day. The present forecasts by the CSO/DEHLG is that by 2020 the population for the Country will be 5.3 million of which 2 million will be resident in the Greater Dublin Area and 1.46 million in the City of Dublin .It is estimated that by 2036 the population will be 5.8 million based on the higher scenario derived by CSO. If this is the case then a population of 8 million for 2100 has to be considered a possibility and that approximately 40% of the people will reside in the Greater Dublin Area. The National Spatial strategy currently sets out where people

should reside. The strategy to cater for growth to 8 million may have to be of a totally different nature.

Ireland because of its size will economically always have to be export orientated in order to ensure economic growth. This means that the demand on the available resources and in particular water will have to include sufficient flexibility to cater for the uncertainty that global trade introduces to the situation.

The provision of water for such a population and economic growth will present many challenges. In this context meeting the demand has to be considered in conjunction with the "sustainable use" of water, which includes some of the following – sustainability, conservation and leak detection; demand forecasting, water reuse, soil aquifer treatment, aquifer storage and recovery and desalination (AWWA). Sustainability involves both sides of the supply and demand equation where sources, treatment, storage, delivery and service have to be considered in conjunction with influencing demand and end uses. The three sources of potable water are

a) Surface abstraction from rivers and lakes,

b) Ground water abstraction and

c) Sea or estuary abstraction.

SURFACE ABSTRACTION

Ireland is very fortunate to have a good rainfall profile and an abundance of rivers. In recent years the demands and threats to the rivers have grown dramatically. The competing interests between urban dweller and farming community are ever present. The introduction of EU directives and their incorporation into national legislation has focused both parties on minimising damage to the environment. The agricultural industry is adapting to the regulations on an ongoing basis so that in general the dispersed form of pollution, which emanates from land run off can be controlled. The urban areas consist of two constituents, namely industry and the domestic dweller. The effluent from urban areas is now beginning to receive appropriate treatment so as to minimise pollution from point sources. In relation to abstraction detailed studies and environmental impact statements now identify the available quantities and the competing interests. The DEHLG carried out a National Water Survey in 2000, which involved 91 schemes each of which supplied more than 5,000 consumers. This report highlighted the inadequacy of current data gathering aspects of water supply and stressed the importance of data for future planning. The Water Framework Directive requires the adoption of a comprehensive integrated basin–based approach to water management i.e. to include surface waters, ground

waters, transitional and coastal waters. It will assist over time in defining the appropriate limits and reducing threats to catchments. Surface Abstraction for water supply is the most prevalent in Ireland with over 80% of the population receiving its supply from such sources.

The population growth, increasing densities, and farming intensification with the possibility of crop changes due to the changing temperatures means that the capacity

for the river systems to be self-cleansing will be reduced and the river ecosystems will have to be managed. As ecosystems are continuously evolving the greatest difficulty will be identifying those systems, which were going to die out in any case and allow evolution to take its natural course. Likewise new arrivals will have to be nurtured and the whole system continuously monitored.

The growth in affluence in recent years has resulted in greater emphasis on active leisure time. Water has always been an attraction to people as a relaxing influence such as in swimming, sailing or cruising; or as an active form of escapism as experienced in motor boats, jet skis, etc. The presence of humans near a water body has a detrimental effect on its quality resulting from waste or other forms of pollution. In pursuing the needs of future generations who will decide what are the priorities and what needs to be done now, if anything, to protect those needs?

GROUND WATER

In comparison with other countries ground water in Ireland is very much under utilised. At present 25% (ENFO) of the water comes from ground water sources. This figure will grow with time as development increases. There is approximately 1100 mm of precipitation occurring in Ireland annually of which an estimated 360 mm percolates into the ground as ground water. This is called ground water recharge (GWR) and varies throughout the Country with the most in the Northwest (512 mm) and least in the South (350 mm). (ENFO) The Geological survey of Ireland (GSI) have categorised the aquifers in Ireland into 8 categories (GSI 1999).

Fifty per cent of the ground water is “developable”, i.e. it can be extracted relatively easily. At present we extract less than 2% of the developable water and of this local authorities use 36%, industry 37% and rural domestic supplies the remainder. Most ground water is extracted in the East; the least in the Northwest and Roscommon uses ground water for 90% of its supply.

In Ireland ground water has many attractions. It is generally of good quality, requires minimum of treatment and is cheaper to develop and distribute when compared with surface abstraction. While the ground water quality is generally good a national survey of ground water quality has not been carried out to date. In addition because it is underground there is a perception that it is

not possible to pollute it. While it may be difficult to pollute due to impermeable over burden, pollution does occur and it can remain polluted for many years. The greatest threats to ground water in Ireland are septic tanks, farmyards activities and unlined landfill sites (ENFO).

When one considers the potential needs of future generations it is essential that our knowledge base of existing groundwater resources be improved. At present no one knows how many wells exist in Ireland today (Wright G.). It is estimated that there are over 200,000 wells of which at least 30% are contaminated and up to 50% in more vulnerable areas. The GSI database contains records of about 25,000 wells. Pollution of ground water in Ireland tends to be microbiological rather than chemical. In fact the levels of chemicals greater than "EU MAC (the maximum admissible concentration for drinking water and arising from human activities) are not common. The main chemical contaminants are nitrates, ammonia, potassium, chloride, iron and manganese (GSI 2000). Furthermore the majority of ground water is extracted from shallow aquifers (less than 120 metres deep). Deeper aquifers have not been investigated and are largely unexploited.

The under utilisation of ground water in Ireland is an asset compared to most other countries where major problems are occurring today due to industrial pollution, over pumping or the aquifers not recharging as a result of changing weather patterns. Where over pumping has occurred rising levels of saline intrusion is also being experienced. Refurbishment and rehabilitation of such aquifers will present major challenges in the future. In Ireland ground water recharge (GWR), which is the refilling of an aquifer, should balance with the discharge. Data on GWR is not widely available but monitoring by the GSI indicates that GWR is dependent on aquifer location and vulnerability. How should this asset be managed so to ensure it is exploited in a sustainable manner in the future?

The forecasted change in the rainfall pattern is for heavy showers, possibly resulting in floods, alternating with much drier periods than at present. If this does occur then the possibility of storing water in times of plenty to meet demand, which is often the highest when water is scarcest, will have to be considered. Aquifer storage and recovery (ASR) is a technology, which can bridge a gap between supply and demand. The use of this technology can allow for increases in demand and reduce investment in major projects, which have to plan for projected growth. The issue that arises is to know what aquifer to use and more importantly to understand the biogeochemical processes that occur underground. Studies are currently under way in the United States to understand the water quantity issues but the water quality changes that may occur during passage and storage require research to be carried out (AWWA).

DESALINATION

The greater part of the planet earth, in fact 97%, is covered by the oceans yet deriving portable water from sea water on a commercial basis is a relatively recent phenomenon.

The ancient Greek philosopher, Aristotle, described the concept of distillation as a method of seawater desalination in the 4th Century BC (WWI June 2001). Since that period economic consideration limited its use to regions of chronic and severe water shortages.

Today advances in technology have dramatically improved the performance and reliability of desalination processes. Until recent years large production desalination plants were constructed adjacent to power plants in order to allow for the boiling of the water and then condensing the vapour. The introduction of membrane technology and the process of reverse osmosis (RO) have dramatically changed the market and the price of desalination has been significantly reduced (WWI April 2003, June 2004). The principal of RO is to force salt water at high pressure through a membrane. The technology is the fastest growing segment of the desalination market and an integral part of most water reuse projects. The desalination process also applies to the treatment of brackish water in estuaries and over pumped aquifers with salinity problems.

While the operating costs for desalination are decreasing rapidly there are a number of environmental issues to be aware of, namely, the amount of energy required to operate the plant and the concentrated brine that is generated by the process. The carbon emissions will have to be considered with the specific site location of the community that it serves. In places like California it has until recently been considered more economical to buy water from other States. The energy consumption in the 1970's using multi stage flash steam technology was 22 kwh/m^3. The consumption in 2003 using RO technology was 2kwh/m^3. (WWI Nov. 03).

The environmental effect of pumping the brine concentrate back into the sea does not have detrimental effects in most situations but its impact has to be given careful consideration. It is often quoted that future wars in places like the Middle East will be over water rights and availability. If this is the case then the desalination technology will be refined even faster particularly in relation to taste and as a stand alone potable water i.e. not having to mix it with other sources. At that stage the price of desalination will be very close to conventional treatment of surface water.

The extreme case to be considered for Ireland, in the next 100 years, has to be those conditions that exist today in the Canary Islands. On these Islands water resources have been over exploited resulting in an unsustainable economy in terms of natural resources. The introduction of

desalination has maintained economic development but rising carbon emissions and compliance with the Kyoto Protocol is presenting challenges. Desalination now provides 90% of the water supply on the Island of Lanzarotte

A recent proposal to build a desalination plant on the Thames Estuary was refused planning permission on the basis of existing water leakage levels in the distribution system and carbon emissions to the atmosphere. This is currently the subject of a public enquiry but Thames Water Company has said that reuse or recycled water costs three times as much as desalination (NCE June '06.)

DEMAND

The demand side of the equation will require detailed attention. The growth in affluence and population is increasing the demand with the use of washing machines, power showers, toilets and gardens. The current per capita figure of 150 litres per head per day is not sustainable going forward. The introduction of water conservation measures and multiple use of the water will have to be given consideration. The education programme and gradual introduction of the new demand standards in the Public domain will require research. The greatest savings in water usage will be made by industry. How will this be achieved considering the increase in hygiene related regulations and the increase in energy required to produce the water. It takes 2400 litres of water to produce the growing animal feed for a single hamburger and that does not include the processing, packaging or transport.

THE FUTURE

What is the possible scenario of the temperature in Ireland increasing by 2 degrees centigrade by 2100. This is the minimum increase that we should be planning to expect. As already stated Ireland will have no effect on the rate of Climate Change even if nothing is done in Ireland to mitigate carbon emissions. The increase in temperature will result in major changes particularly in demands for water over this period. The normal reaction to a 2^0 change in daily temperature is to ignore it as it is not a perceptible change. On the other hand if that change is related to a change in body temperature then a general feeling of being unwell is felt that will require treatment. The forecasted increase in temperature may be perceived as the former but should be treated as the latter. How can the present policy makers manage such a situation?

In agriculture we can expect to see increasing demands for irrigation. We are already experiencing change in the traditional crops grown so as to meet the expanding markets in biofuels. The agricultural industry could further change to growing "water thirsty" crops more

suited to the climatic and seasonal changes we will be experiencing. This will inevitably raise the issue of riparian rights and who owns the water. What will be the relationship between landowners adjacent to water sources (rivers, aquifers) and central government? Industry will continue to expand and in particular the food sector, with the increasing standards of hygiene resulting in further demands for water. On the domestic side the increasing use of domestic appliances, higher density living gardening and growth in affluence will increase usage. How do we estimate quantities for strategies to be developed and how is a value put on the use of natural water.

In relation to supply how can we differentiate what really needs potable natural water and where water of a lesser quality will suffice? It is in this latter area that major reductions in demand can be made.

The level of water lost in the distribution system varies from country to country. In those places where it has been minimized it has only been achieved through a stable and adequate investment programme. In Ireland a major refurbishment programme is commencing where approximately 1% of the watermains will be replaced annually. Until this programme commenced the investment level was in the region of 0.1%. The success of this programme will be a good indicator for what the level of investment should be going forward. In European terms the level of investment is replacement of 3% of the mains annually. These countries use high-pressure systems while we use low pressure. Investing in technology to know where the water is used and maintaining the distribution systems is critical to optimising the use of the available water.

Charging for water and metering of all supplies is an argument often put forward for controlling demand. While Agenda 21 made a sensible observation that "Water is an economic good" it does not automatically mean that "subsidised" water as provided by the Public Sector should cease and market forces allowed to prevail. The World Bank and International Monetary Fund promote the privatization principal in their loan policies. The argument is that if water delivery is more efficient and better off customers properly charged, then it will be possible to spread the service to poorer neighbourhoods and subsidize lower income customers. Likewise those who have more water than they need i.e. farmers may sell it to the market e.g. municipal authorities. The perception is that everything will work out because of "good governance". We must remember that Ireland in the 1980's was a recipient of IMF attention and would such policies be acceptable in the future?

On a micro level if water is charged for then the make up of the Cost Model has to be given careful consideration. The EU Policy is that the true cost of water should be charged to the

consumer. This is acceptable where one considers the operational issues facing water-producing authorities on a daily basis, but if water pricing were to be considered as a conservation measure in the long term then its effectiveness would have to be researched. In the U.S. studies indicate that a 50% increase in rates reduces use by 5% (ANWA). The use of "water meters can be controversial for social reasons and expensive to maintain. The private water companies have to date shown a reluctance to install meters on all premises and only two companies have claimed " water-scarce" status, which permits meters to be installed on a compulsory basis (Water. UK). Metering of commercial premises is used to-day but in the future charging more for high use at peak demand, using smart meters, may be introduced as a demand management tool.

The reuse of water is presently carried out in some Mediterranean Countries. In these situations the treated effluent from the municipal wastewater plants is a source of supply for non potable uses such as irrigating public parks. The next phase of water reuse is beginning at a micro level where individual sites are recycling the water from sinks and washing machines to be used in toilets prior to discharge to a public sewer. In an ideal world each house would have its own treatment and then reuse, thus freeing up sewer capacity.

Harvesting of water is where the rainwater is captured and then used for non potable purposes. This would require preliminary treatment prior to reuse. A pilot study has been carried out on the Millennium Dome in London where grey water from the washbasins, rainwater from the roof and groundwater from a site borehole were treated and monitored. It was found that the groundwater was excellent but for reuse or harvesting water a physical barrier method of treatment such as ultra filtration was required in addition to reed bed technology. (Birks R, et al)

There are two major difficulties for both these methods, namely, actual risks to public health and consumer perception. The ultimate reuse of water is where the treated effluent is to such a high standard that it can be reintroduced with the potable system. In promoting such conservation methods it would be crucial that standards, guidelines and criteria for the use of non potable water based on the risks to the consumer or end user are developed. Misconnections, i.e. connecting to the wrong pipes are all too common in today's environment. One of the interesting outcomes from research by the AWWA is that every community is unique in how it perceives water reuse projects. The historical background, management of information, public dialogue building and maintaining public trust are all critical elements in the promotion of water reuse.

On a catchment basis the reuse of water has to take into consideration the possible impacts downstream of a wastewater treatment works. In some situations the treated effluent improves

the quality of a river downstream. If the treatment works discharges into the estuary or bay then it may be possible to recycle 100% of the discharge. . In addition treatment of wastewater on site by industry prior to releasing into the public sewer system will facilitate the municipal treatment for reuse. The situation may also arise where the discharge has to be considered for recharging the aquifers. At present in the Netherlands the treated effluent is discharged into sand dunes (polders) where it percolates down to the aquifer for later extraction. While Ireland is fortunate in that it does not have a legacy of pollution from industry the issue may arise as to the quality of treatment processes in removing residues from the effluent to enable it to be reused. Overcoming public perception will be a major obstacle, more so in Ireland than in other countries, and the issue is how to develop a long-term programme where progressive reuse is accepted by society

REGULATION

The regulation and statuary instruments currently applied in Ireland are the implementation of EU Directives. These regulations apply to all facets of society with regard to water abstraction, pollution industry and agriculture to the treatment of wastewater. The beneficial use of regulations and law enforcement in society only becomes apparent when society recognises the need for such mechanisms. It is essential though that legislation be formulated in the future with a degree of flexibility to allow it to promote future standards with the minimum of amendments. Should the impact of more stringent environmental laws and the increase in carbon footprint to achieve compliance be considered?

RISKS

People to day seem to have forgotten that throughout history water has been essential to humankind for stability, social and economic development and civilization itself.

We are all aware of the "Hydrological or water cycle", where the water is evaporated from the sea, then falls to the ground and is returned to the sea through the rivers. What is not generally known is that two thirds of the rain gathered by the clouds falls by the time it reaches land. Therefore the maintenance of this cycle is crucial to meeting water demand in the future.

The issue for Ireland is what influence can be brought to bear to ensure that there in no deterioration in the cycle. As the prevailing winds are from the west the perceived greatest external threat comes from the American Continent. This threat may be in the form of a natural phenomenon, such as a volcano eruption or El Nino. Yet the nuclear accident in Chernobyl, Ukraine also reached Ireland. It could also be the result of man made pollution, which is known to lower the evaporation rate. Further external threats may also arise from nuclear accidents, bio

terrorism. The normal risk matrix applies to such events where they may be low risk but high impact. A further risk is the changing temperature of the Atlantic Ocean. The United States Geological Survey have carried out research which suggest that large scale droughts in the US are likely to be associated with warming temperatures of the sea in the North Atlantic. (WWI March 2004).

At present there is a lot of discussion on the fuels used for the production of power and not being reliant on one source of fuel for the power stations. If we assume that the population of Ireland will be in excess of 8 million by 2100 should a similar strategy be promoted where water supplies from the surface catchments, groundwater and desalination are developed as strategic sources so as to guarantee supply for such occasions. This type of risk may be as a result of the increase in global travel and foreign trade. The movement of goods and ships permits a large variety of flora, fauna and animal life to be transported undetected in a short period across continents. While some of these new arrivals may enhance our environment there are also a large number of such arrivals, which will be detrimental to our biodiversity e.g. zebra mussel. The time when Ireland as an island could control who or what entered the country is now consigned to history. How can the environment be protected and managed, as the world gets smaller.

The internal threats commence as the clouds reach landfall and will arise from the increasing population diminishing natural water resources, changing lifestyle patterns, urbanization and the strains they will put on the environment. The competing demands from urbanization, fishing and agricultural industry and the acceptable standard that we wish the quality of our rivers to be maintained will always be subject to debate.

PUBLIC PRIVATE PARTNERSHIPS

The increasing demands on public infrastructure and the reduction in tax rates along with EU limits on public borrowing has led to the introduction of public private partnerships. These types of partnerships have many forms but the overriding principle is that the strengths of each party are optimised and that risks are carried by the appropriate parties. These contracts can have a life span of 15 to 25 years. In a water supply situation it is important that there is an over arching strategy created and managed by the Public Sector. Only the Public Sector has the capability to look forward over a long timescale and plan accordingly. The Private Sector use strategies to develop their companies, which may be bought or sold in the interim, and the commercial market judges them on their return on investments. When climate change and quality of environmental issues have to be taken into consideration only the Public Sector can set the standard and the Private Sector will provide it at a price.

The public and private sectors are continuously finding new ways to develop infrastructure. The critical issue is what scale of funding will be required in the future to repair and replace infrastructure and at the same time meet increasing demands?

CONCLUSION

The Brundtland Report, which was later incorporated into the Rio Declaration (1990), provided a key statement on sustainable development, defining it as:

> *development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*

This statement is particularly relevant whether considering water supply in the future and while the majority of people would agree with these ideals no dramatic changes have been made to their daily lives to ensure these goals are achieved. In fact society has assumed that "authorities" at varies levels are planning on how best to attain the necessary results and that the general public will be informed when changes are required. In conjunction with this logic there is also a perception that technology will resolve whatever issues arise in the appropriate timescale.

The recent urgency associated with climate change and the unacceptability of the "Do-nothing" scenario could be the catalyst for the implementation of the Brundtland Statement. In addition could the growth in consultation on issues of social, environmental and economic importance recent years of stakeholders, whether governmental, industrial or NGO, provide an integrated platform for going forward and reduce the dependency on "perceived" technical solutions.

Water is the kernel for our existence. The continued availability of water is not guaranteed. In fact with increasing demands and changing weather patterns a deficit in meeting needs will arise if not managed in a sustainable manner. The growth in demand can be managed but the availability of new sources will greatly depend on the rate and variation of climate change and over which Ireland will have little influence. As a result while Ireland is adapting to climate change should a strategy of innovation and leadership, as provided by the ban on plastic bags and the smoking ban, for the rest of the world also be pursued?

Disclaimer

This paper was prepared by Mr Michael Phillips, Dublin City Engineer, for presentation at a workshop on "Ireland at Risk", for the years 2050 and beyond, to stimulate discussion on the potential issues relating to water supply. The views expressed are solely those of the author.

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