Alternative Water Sources for Sustainable Water Use

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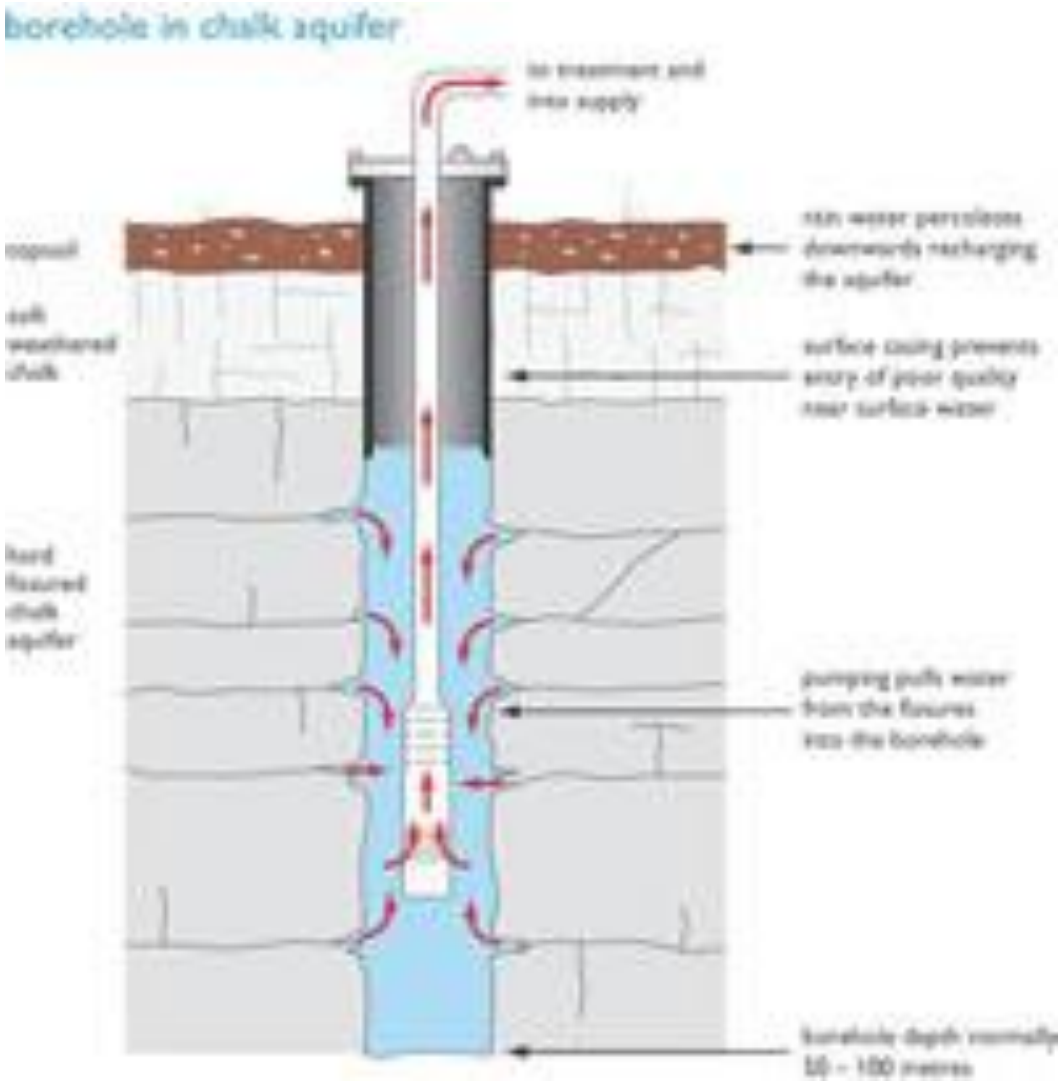
Pressure on Water Resources

- Less predictable rainfall - droughts and floods.
- Increasing population means increased demand.
- Agriculture has broadly increased demand for irrigation.
- Result is that there is more pressure on existing water resources, both surface and groundwater.
- This can provide a threat to the natural environment due to abstraction which can reduce levels of groundwater and flows in rivers and streams on top of natural impacts.
- This is a global problem and requires a much more holistic approach coupled with innovation, ingenuity and determination to solve it.
- In addition the solutions will require long-term planning and co-ordinated thinking in terms of policy.
- How do we deal with these apparent conflicts and what are the alternative “sources” of water?

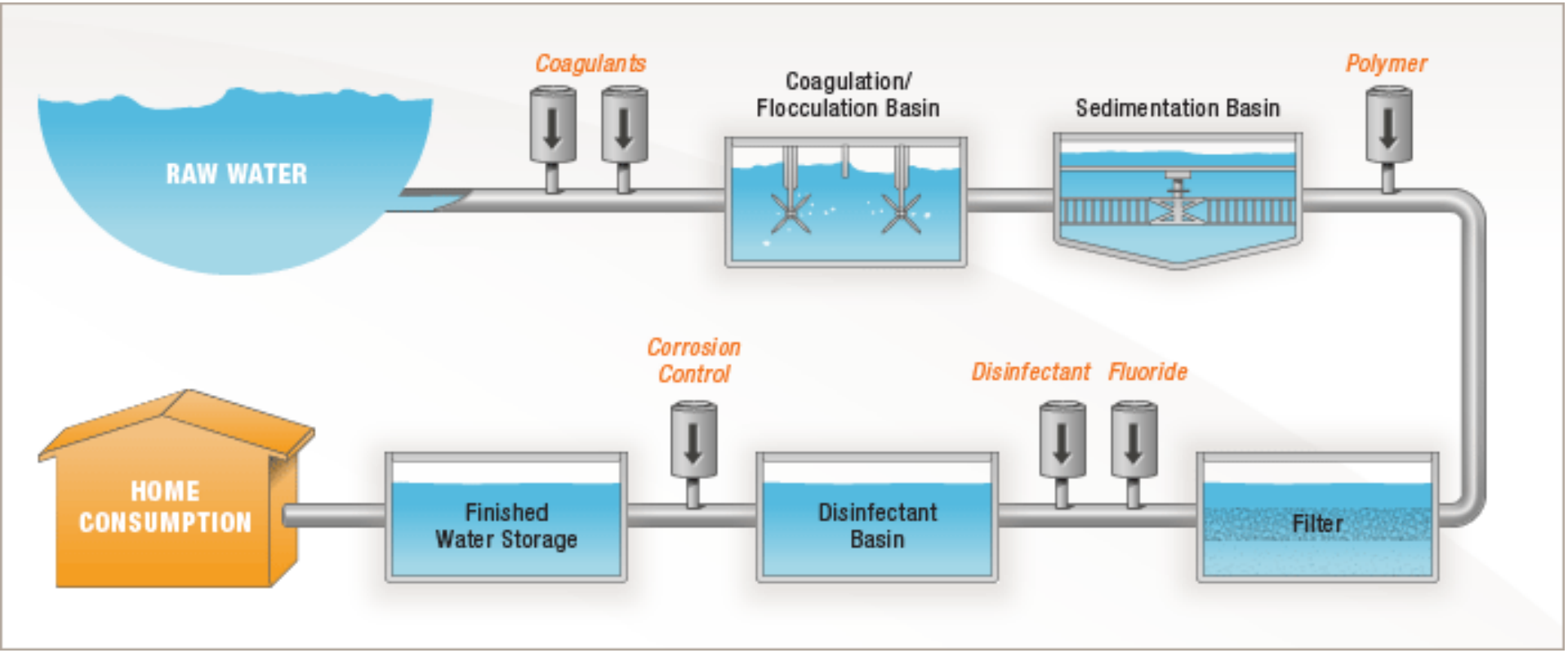
Water Sources for Abstraction

- There are significant issues in being able to manage abstraction to provide water for us and maintain sufficient water for nature.
- Surface waters provide an important source but quality is often very variable and they are frequently more vulnerable to pollution. However, when pollution stops then recovery can be relatively quick.
- Groundwater is frequently an important source of water for drinking and other uses. It is generally less vulnerable to pollution but even when pollution ceases it may remain contaminated for many years.
- Both sources suffer from extended drought conditions, 2-3 years.
- Water companies and private abstractors aim to minimise treatment as far as possible for several reasons.
- The chance of finding new unexploited natural sources of fresh water in the UK are fairly remote.

Groundwater Abstraction



Drinking Water Treatment



What are the options to improving resilience?

- We have to think about how we achieve a balance between water use and supporting the natural environment.
- This involves everybody because we all have a part to play!

  Reduce demand and wasteful water use – water efficiency, education, universal metering.

  Reduce leakage.

  Re-use/ recycle wastewater – different options.

  Turn to saline/brackish sources - desalination.

  Capture more rainfall, naturally (improve groundwater recharge) and artificially (reservoirs), SUDS, less hard standing (reduced flood risk).

  Long distance transfer?
- There are advantages and disadvantages to all of these and the solution will probably require all or elements of all.

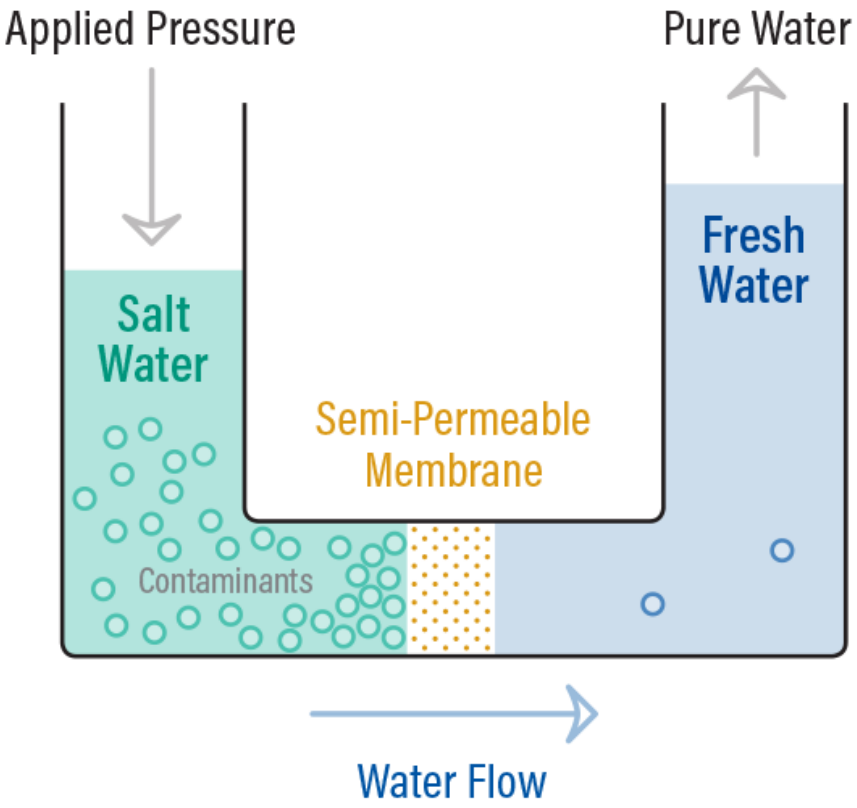
Water Quality

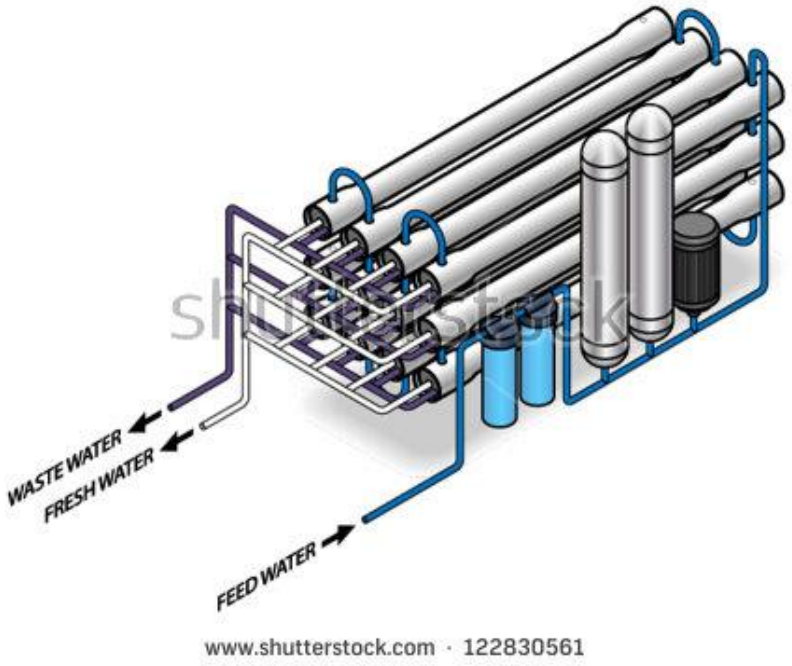
- The key issue in examining alternative sources of water is that they are either saline or the starting quality is lower than normal.
- Water quality is a vital consideration. The WHO Guidelines for Drinking Water Quality are about safety and acceptability.
- We do follow the standards in the European Drinking Water Directive, which is being considered for revision and which has been pretty successful.
- The Water Framework Directive has excellent aims but sometimes gets sidetracked because achieving those aims can be very difficult. Considers quality and quantity.
- The concerns are pathogens and some chemicals, including contaminants of emerging concern, e.g. EDCs (endocrine disrupters), pharmaceuticals, personal care products (e.g. triclosan), substances such as PFOS/PFOA (persistent perfluorinated molecules).

Desalination

- Desalination is widely practiced in many parts of the world.
- There are two approaches:
  - Thermal desalination which is still used in some middle-east countries.
  - Reverse osmosis using membranes which is more widely used and is used for all new installations. Need pre-treatment to protect the membranes plus cleaning and maintenance.
- Desalination was used for the Channel Tunnel and Thames Water has a desalination plant in the Thames tidal zone. Allows abstraction at times when salinity is lower.
- Jersey has a desalination plant for peak lopping and managing nitrate.
- Huge increase in desalination in many parts of the world.
- That means there is research and development to improve processes and make desalination more efficient. That, in turn, means reducing energy requirements and extending the life of plant.

Reverse Osmosis





Issues for RO

- It has a high energy requirement but in future we will be able to mitigate that by using renewable energy sources.
- Overall is the energy use significantly greater than current treatment requirements?
- The membranes don't just remove what you want removed and don't always remove what you do want removed.
- The membranes do allow some contaminants/constituents through, e.g. boron and some small polar organic molecules. May need additional treatment or tighter (more expensive) membranes.
- Need to remineralise the water to reduce corrosion, increase acceptability and in many cases try to replicate the water it is replacing.
- There is a concentrated waste stream that needs disposal or treatment.
- Pumping costs to get the water where you need it. It will depend on the locations of the plant and where the demand is.
- Planning approval – shouldn't be underestimated.

Wastewater Re-Use

- We collect sewage and some industrial wastewater. Having collected it we considered it to be waste to be disposed of as cheaply as possible. This drives the level of treatment.
- However, increasingly it is recognised as a valued resource that can be an important source of water – part of the managed water cycle.
- The European Commission sees re-use of wastewater as a very important part of water resource management in water stressed parts of Europe.
- Need to design re-use projects to take into account what we want to achieve because the end use drives the level of treatment needed.
- Industrial uses.
- Irrigation.
- Direct and indirect potable use.
- Can be used to maintain wetlands and river flow and for groundwater recharge.

Re-Use in the UK

- We have practiced indirect re-use of wastewater for over 100 years.
- Mostly this was unplanned and about disposal of sewage.
- Gradually we got to understand that we needed to improve wastewater treatment to reduce contamination to maintain surface water quality.
- Some rivers depend on treated wastewater inputs for their flow.
- Gradually we understood more about chemical contaminants in wastewater and our understanding is continuing to improve.
- Improvements in wastewater treatment help reduce various contaminants but discharge requirements are still limited.
- Planned re-use projects- Flag Fen, Langford Recycling Scheme, Old Ford treatment plant for the Olympic Park, Thames Water Deephams Proposal.
- My proposal to the Commission and European Parliament was to start long-term investment in wastewater treatment to deal with emerging contaminants and promote re-use.

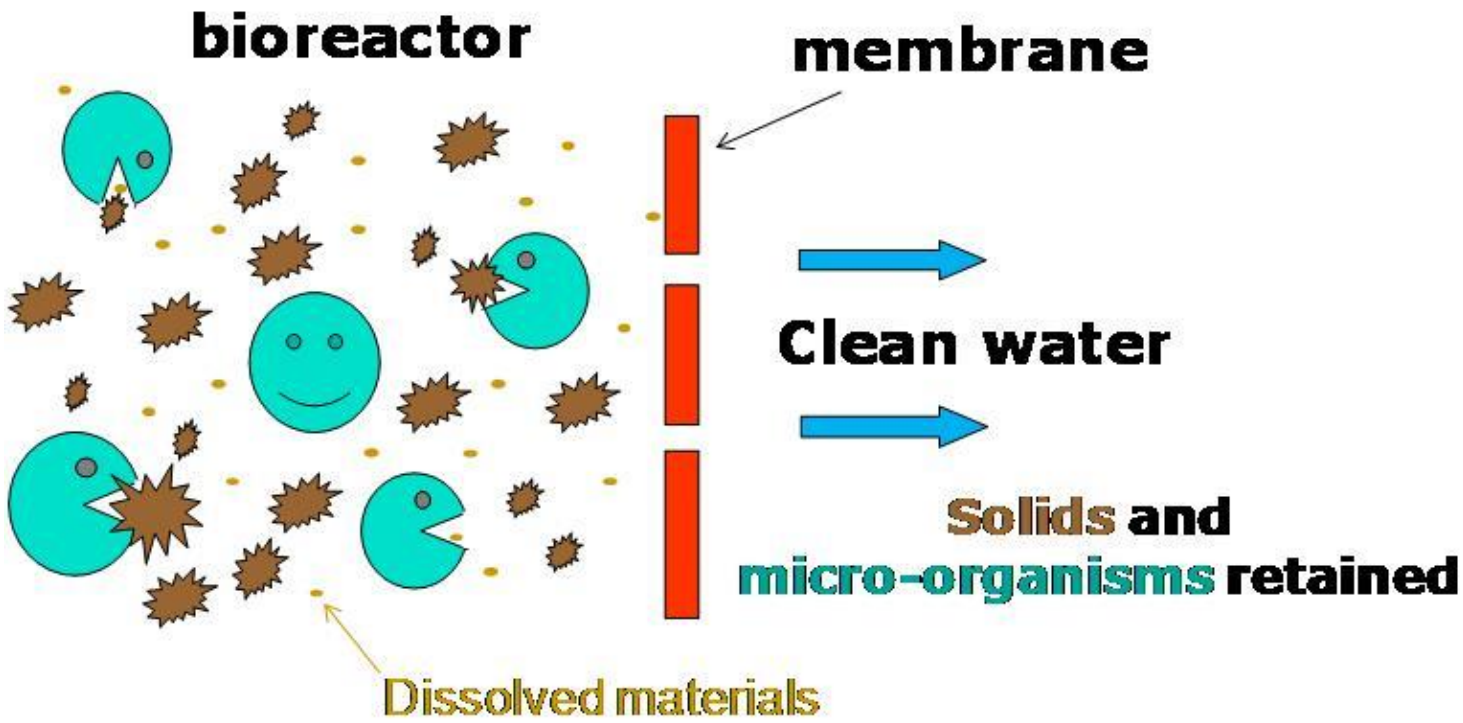
Re-Use Round the World

- Spain and many other countries for irrigation.
- Singapore NEWater as a significant part of making them self-sufficient in water. Industrial demand outstrips available NEWater, but water used to top up reservoir.
- Australia has several schemes in the East. Tried dual pipe systems and they do have groundwater recharge.
- US groundwater recharge and direct re-use schemes, e.g. Orange County California. Not helped by CNN's headline of Toilet to Tap.
- The common theme is public and political recognition of the need and how that relates to the alternatives.
- Acceptance is vital but short political cycles don't help. Sometimes aided by separating recycled water in concept by storage in some form. When does recycled water just become water?

Treatment and Approaches

- Enhanced traditional wastewater treatment for increasing river flows or groundwater recharge. The quality and stability of quality will be important depending on the scheme. (Traditional approach)
- Membrane bioreactor (MBR), possibly with granular activated carbon and or advanced oxidation and/or disinfection. (Olympic Park)
- Reverse Osmosis basically the same as desalination but need to be aware of more contaminants that may pass through the membrane.
- Discharge to wetland.
- Discharge into a river upstream of drinking water intake.
- Discharge to a drinking water reservoir.
- Groundwater recharge. (Provides a conceptual break).
- Direct potable re-use. (US)

MBR


bioreactor
membrane
Clean water
Solids and
micro-organisms retained
Dissolved materials

What are the Barriers to Implementation?

- Lack of appropriate international standards (realistic standards). Particularly important for agriculture.
- Cost implications although these may be more to do with new infrastructure than running costs. Short-term mentality doesn't help.
- Dealing with the RO waste stream (more opportunity for recovering resources?)
- Available water may not be close to where we need it.(Pumping)
- Public acceptance of the need. May be linked to cost and also suspicion of motives of private water companies as well as the "YUK" factor.
- Need a financial regulatory system that encourages innovation.
- Need a positive view from the Environmental Regulator.
- Need to have acceptance of the need to protect the natural environment and willingness to pay.
- Political will.
- Opposition from single issue interest groups.
- Brexit???

Conclusions

- Both desalination and wastewater recycling are now widely used around the world and the technology is available to implement them. That technology is improving all the time. – It is doable.
- There are clear benefits but these have to be balanced against costs.
- Need to be cleverer at using renewable energy.
- We need to be better at valuing the benefits to the natural environment and “ecosystem services”. We also need to value water more highly.
- Climate change means we have to start implementing systems to ameliorate the effects sooner rather than later.
- We need to convince everybody of the necessity and the benefits.