

WATER SUPPLY CONFLICT: LAS VEGAS AND THE GREAT BASIN AQUIFER

Introduction

'The wars of the 21st century will be fought over water, not oil...': Ismail Serageldin, Vice President, World Bank 1995.

As populations rise globally, there is increasing competition both amongst humans and between humans and other life forms for the water on which we all depend. A side-effect of climate change can be an increase in drought-prone areas. (Drought is a prolonged period with less than expected precipitation.) Droughts can persist for several years, and yet our reactions to them are often short-term, expecting the precipitation to return soon. More people than ever are now living in arid areas, and more are impacted upon by drought conditions and their associated hazards such as forest fires.

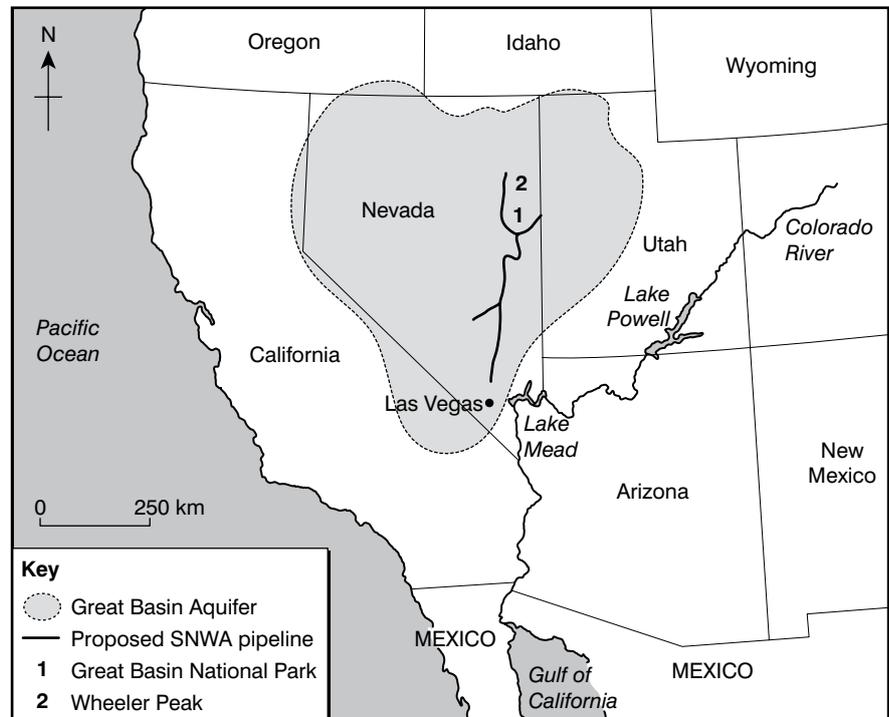
Water is a finite resource and we are beginning to realise that it needs careful, sustainable management if conflicts are not to occur. Many rivers, such as the Danube and its tributaries that flows through 17 countries, are shared by more than one country, a situation which could lead to future problems if one country wanted or needed to take a larger share. Some water is stored under the ground in permeable rock layers (aquifers), and these stores may underlie several countries. In this case study, the aquifer underlies several states of the southwest USA.

The arid Southwest of the USA

The state of Nevada sits within the Great Basin between the Sierra Nevada Mountains to the west (which block off the rain-bearing winds from the Pacific) and the Rockies to the east, in the mainly arid or semi-arid southwest USA. The hot Mohave Desert in southern Nevada continues into California, whilst in central Nevada is located the cooler desert of the Great Basin.

Since 1999 this area of the USA has suffered from a prolonged drought. Between 1999 and 2009 the Colorado

Figure 1: The Great Basin Aquifer



River's flow has been on average 66% of normal. Lake Mead and Lake Powell, the two main reservoirs in the Colorado system, have only been 52% full. In 2002 Lake Powell only received 25% of its average input of water. Southern Nevada relies on the Colorado for 90% of its water supply at present, but with falling reservoirs there is a fear that there will not be enough water to go round in the future. It is thought that the reduction in precipitation may be linked to climate change as rain-bearing winds track further north. Average temperatures have increased in the Colorado basin over the last 25 years, adding to the evaporation rates. This is at a time when the population of the southwest is increasing along with water demand in what is essentially, for southern Nevada, a desert environment. Water rights from the Colorado were allocated in the 1920s which, as is now realised, was a wetter period than today, and over-extraction is becoming a problem.

The Great Basin Aquifer

The Great Basin Aquifer (Figure 1) is a complex system of water-storing rock strata that underlies most of

Nevada, half of Utah and parts of California, Oregon and Idaho. It is made up of a series of smaller basins and aquifers which are connected to surface water via springs and also to each other, although the water flows are not yet fully understood. Ranchers operating in the area have noticed that in a dry year and even with little extraction from them, the springs can fail. In the 1980s there was a move to protect the area and its water by designating it a national park. This eventually occurred in 1986, and the Great Basin National Park is centred on Wheeler Peak, whose snows eventually provide water for the surrounding valleys via the aquifer.

Background to Las Vegas and its water supply situation

The city of Las Vegas is situated in the hot, arid Las Vegas Valley in southern Nevada (Figure 1). Its desert climate means that precipitation is only 114mm a year (Figure 2) and its maximum temperatures can be over 40°C. Although extreme, this climate has attractions for various activities and groups of people which have

Figure 2: Climate of Las Vegas

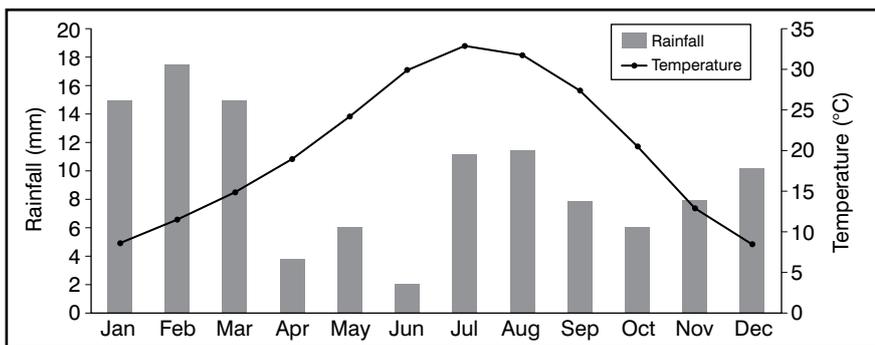


Figure 3: Reasons why people move to the arid southwest of the USA

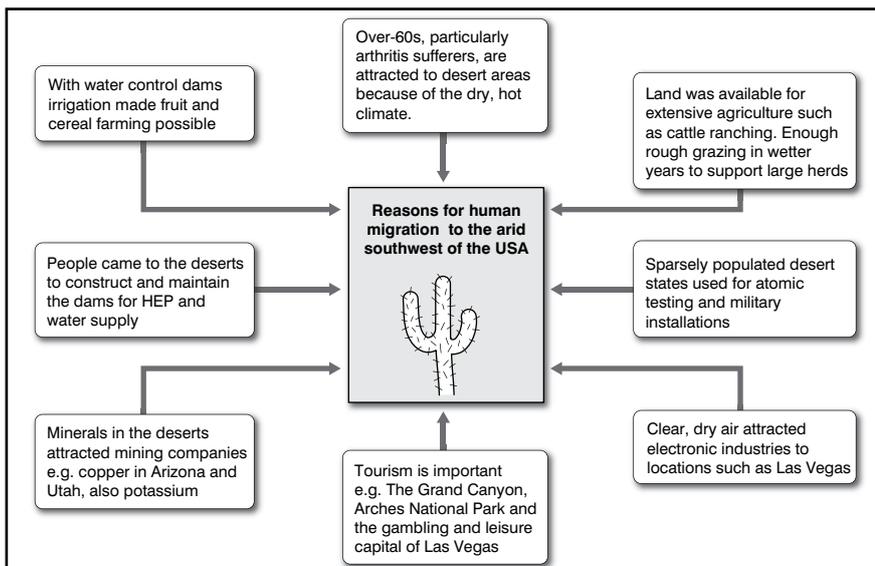
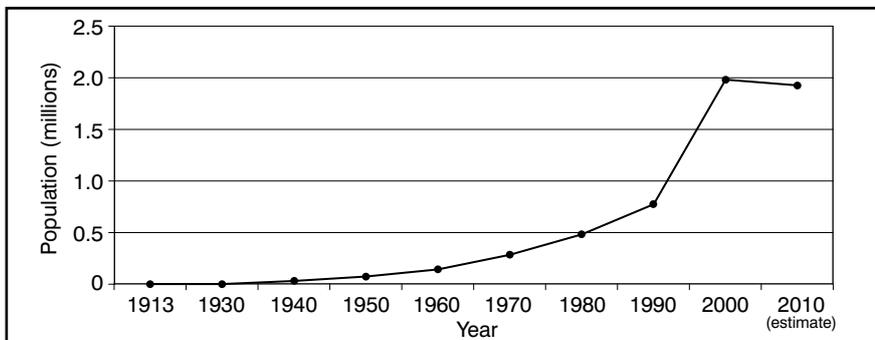


Figure 4: The growth of population in the Las Vegas Area



been summarised in Figure 3. In the 19th century Las Vegas (meaning 'the Meadows', in Spanish) was a stopping point on the great treks westward because water bubbled to the surface in naturally occurring springs, providing drinking water for humans and horses. Later, this water was used by the steam trains that came through, with the development of the railway. The water originated in the mountain areas surrounding Las Vegas and found its way downslope within the rocks to settle beneath the valley floor in aquifers.

As the town grew, more water was

needed and eventually the aquifer could no longer provide for all the town's needs. In the 1920s agreement was made with the other states that bordered the Colorado River as to how much water each could take; today most of Las Vegas's water comes from the river. Figure 4 shows the rapid increase in population of the Las Vegas Valley from the 1950s. This period also saw the beginning of the development of the huge casino resorts which attracted tourists, gamblers and the people to service the resorts. These resorts, examples of which are the Luxor and Caesar's Palace, provide luxury

hotel accommodation, pools, and entertainment 24 hours a day. At the start of the 21st century Las Vegas was the fastest growing city in the USA, with workers being attracted by employment opportunities in the gambling, entertainment and leisure industries. Others were attracted by the fact that because so much money was collected by the state from gambling taxes, there was no state income tax. As the population of the valley headed for two million, pressures on water resources also grew. From the 1950s, continued extraction from the aquifer beneath Las Vegas itself caused the land to subside by as much as a metre, cracking roads and damaging buildings.

In the state of Nevada almost 90% of the water allocation goes to agriculture and food production. Agriculture supports about 6000 jobs in the state but this is equivalent to the number of people who can be employed by just one of the large casino resorts. There is a rural/urban divide; while ranchers often resent the water demands of the burgeoning population of Las Vegas, it is the city that is bringing the greatest wealth to the state and arguably it should therefore be allowed some of the water from beneath the agricultural regions.

The drought from 1999 meant that with continued development, the water from the Colorado would not be enough to support the expanded settlements. A second intake pipe was constructed to take water from deeper in Lake Mead, as there was a fear that the lake's falling water level might mean that the water flow would stop. At present a third, even deeper intake pipe is being built, which is expected to be completed in 2013, but this is still taking Colorado River water. In the 1990s the state of Nevada also renegotiated the terms of its extraction of water from the Colorado River and gained some increase. Historically Nevada had water rights to the Muddy and Virgin rivers which flow into Lake Mead and it has been trying to recover those rights to widen its portfolio of water resources. However there is again some opposition from agricultural interests in those areas. Measures were introduced to better use waste water and to recycle water that was used for some of the resort water shows or fountains, but it was clear that something else needed to be done if the city was to continue to grow. Such growth is important to

Box 1: Pipeline Information

- Pipeline to begin pumping 2015
- Eventually pumping 293 billion litres a year
- Cost about \$5 billion
- 485 km buried pipeline
- 34 groundwater wells
- 3 pumping stations
- 6 regulating tanks each capable of holding 1.5 million litres
- 1 storage reservoir of 180 million litres
- Other link pipelines, electrical infrastructure etc
- Secure fencing to keep system safe

the city for its wealth, but it is in an unsustainable location. It is extracting far more water than is produced within the area.

Despite worries about water resources the state of Nevada is still permitting new developments, such as 120,000 new homes and six golf courses at Coyote Springs, 94km to the north of Las Vegas. The recent downturn in the American economy has slightly reduced the pressure to find new water resources, but it has also meant there is less money, at present, to pursue Las Vegas's controversial solution to its water supply problem: the Southern Nevada Water Authority (SNWA) pipeline, accessing water from beneath the valleys to the northeast of the city.

The proposed pipeline

The original plans for the pipeline have been reduced (Box 1) under pressure from environmentalists and the farmers of the valleys from beneath which the water will be pumped. Six valleys are involved, but the most controversial ones are the Snake Valley (of which 70% is in the neighbouring state of Utah) and Spring Valley. These areas support many family ranches and also important ecosystems on the valley floor based around the greasewood shrub, a xerophytic bush that can cope with low precipitation rates and has long roots to reach the groundwater. It has been suggested that when pumping begins it would be best to pump hard and remove the water availability from these plants so that they die, the idea being that the water they would have used and evapo-transpired into the atmosphere is then available for the people of Las

Figure 5: Impacts of the proposed SNWA Pipeline

Social Impacts	Economic Impacts	Environmental Impacts
<ul style="list-style-type: none"> • Ranchers will no longer be able to support their herds or to grow the fodder crops. • Fewer jobs available as farming declines. • End of rural community life in areas dried out by water extraction. • People, especially younger adults, will migrate elsewhere, further disrupting the community. • The springs from the aquifer are the sole drinking water source for the Goshute tribe who have lived in the area for 1000 years. • Resentment between the farmers whose water is being taken and the urban populations of Las Vegas. • The problem of fighting the construction of this pipeline has helped community cohesiveness. 	<ul style="list-style-type: none"> • Reduction in local incomes as agriculture fails. • Not enough new jobs to replace those lost. • National parks and wildlife refuges would likely have far fewer visitors if damaged as expected. • Game hunting of e.g. deer would stop; another source of income lost for the area. • Goshute tribe weave baskets from willows that need the aquifer's water to grow. 	<ul style="list-style-type: none"> • Specially adapted plants such as the greasewoods would die out. • Impact on dependent ecosystems. • No plant roots to hold together the soil so dust storms would cause problems. • The groundwater level would fall, taking water out of reach of many plants and also causing subsidence/lowering of the land. • In the area of expected groundwater decline are 3 national parks, 4 national wildlife refuges, 4 state wildlife managed areas and 20 endangered species such as the desert tortoise, the vermilion flycatcher and the Moapa dace (a fish). • The Desert Wildlife Refuge, created in 1936 to protect the bighorn sheep which are gradually disappearing, would suffer. • The Pahrnagat ('place of many waters') is a series of lakes, internationally important for stopovers for migrating birds on the Pacific Flyway. The aquifer feeds these lakes.

Vegas. However, with the greasewoods and their dependent ecosystems gone, the light desert soils would no longer be held together. This, along with the fact that this area experiences strong winds (sometimes of over 100km an hour), would likely lead to polluting dust storms, as happened in the 20th century in Owens Valley, California, when water was diverted to Los Angeles (see website reference at the end of this **Geofile**).

The SNWA has been buying up ranches as they have come onto the

market in Spring and Snake Valleys, along with their associated water rights. As more ranches have been bought up, many of the remaining ranchers, fearing that their farms will not have enough water once pumping to Las Vegas begins, are now also willing to sell. In 2006 the Robison Ranch in Spring Valley was sold to the SNWA for \$22 million, far above its estimated value of \$4 million. So far, \$78 million has been spent buying up land and water rights in the two valleys. An agreement had to be negotiated with the state of Utah

for the water rights below Snake Valley with an outcome in 2009 that each state would have 50%. However, many of the ranchers in Snake Valley oppose the pipeline and the pumping out of what they see as the lifeblood of the area. They have seen the impact of one farm using extensive irrigation resulting in the failure of several springs. Multiply this by the huge amounts of water that are planned to be pumped from the aquifer to Las Vegas, and the farmers expect the springs and wells to run dry very quickly. Figure 5 shows a summary of the likely impacts if the pipeline goes ahead. In 2007 the State Engineer gave permission for the building of the pipeline, with an expected date of 2015 for pumping of 20% of the water to begin. However, the recent credit crunch has put plans on hold, and as the project is held in abeyance, the costs and protests are mounting. In January 2010 it was suggested by the Nevada Supreme Court that the application process to pump water from beneath the Snake and Spring Valleys was flawed, and there is now a fear that the whole process might have to start again. The SNWA is also looking into diversifying its water resources by desalinating sea water. The treated water would be piped in from the Pacific coast of the USA or from the Gulf of California in Mexico. Although a much more expensive scheme at present, it may be a more sustainable solution than destroying fragile ecosystems in the Snake and Spring Valleys, and also less controversial. The SNWA has recently said that it would now build the pipeline only if absolutely necessary.

Are there any other alternatives?

At present the daily residential use of water per capita in Las Vegas is 742 litres (compared with 129 in the UK). The city has worked hard to improve water conservation and the use of grey water (recycled water) e.g. for watering golf courses, but it still spends five times as much in developing new water resources as on water conservation.

Albuquerque in New Mexico is a desert city of 525,000 which is working to reduce its water consumption greatly. Albuquerque has an annual rainfall of 225mm and began serious water conservation in 1993 when it realised that the aquifer

on which it depended, fed by the Rio Grande River, was declining. The groundwater level fell by 49 metres over a 30-year period as its population and water demands both grew. The city government realised that water resources are finite and that it couldn't just keep on increasing its demand for water. If the aquifer failed, from where would the water come? The aim was to reduce consumption by 30%, and in fact by 2001 consumption had reduced by 33%. To do this:

- A large budget of \$1 million a year was allocated for publicity and education relating to water efficiency and conservation.
- Tariffs for water are structured so that the more you use, the higher the cost per unit.
- All households and businesses are offered a free water use assessment.
- Households are offered rebates for using low-flush toilets, water-efficient dishwashers and washing machines, and using desert landscaping in their gardens rather than turf.
- Children are educated about living in desert environments and their responsibilities towards water use.
- Water regulations, especially in drought conditions, are enforced by a team of eight officers.

Las Vegas is undertaking a wide range of strategies that mirror some of Albuquerque's. The SNWA realises that to manage demand, it needs a mix of education, water pricing, regulation and incentives. Residents already have limits as to how much turfed lawn they can have, and watering of gardens is now strictly restricted:

- In summer, watering only before 11.00am and after 7.00pm, when evaporation rates are lower.
- In winter, only on one day a week.
- In spring and autumn, only on three days a week.

People are also now encouraged to wash their cars in a car wash where all the water is collected, cleaned and re-used, whereas when washing the car at home most of the water would be evaporated.

By conserving water, Las Vegas reduces the need to make unsustainable demands on water that many people feel they do not have the right to. Perhaps the citizens of Las Vegas need to consider whether unregulated growth can always be a good thing. Global climate change is going to bring more challenges, perhaps an increase in the length of drought for the southwest. Can it be sustainable to live in a desert area and have a domestic water consumption level of nearly six times that in a temperate developed country such as the UK? As water shortages worsen, there will not only be more conflicts over demand between different stakeholders within Nevada, but also with other stakeholders in adjacent states. Clear, careful and more sustainable management is needed to give this area the element of sustainability it needs if it is to continue to support its population in its choice of desert living.

Websites for further research

www.snwa.com/html
 Website of the SNWA which contains access to useful video material.

www.greatbasinwater.net/about/index.php
 Website of the Great Basin Network, a body which tries to protect the underground water resources of the aquifer.

www.ovcweb.org/OwensValley/OwensValley.html
 Website of the Owens Valley community, with useful history of water issues.

FOCUS QUESTIONS

1. Using an example you have studied, explain how conflicts have arisen over water use and what strategies are being used to try and solve the conflicts.
2. Evaluate the attitudes of various stakeholders towards the proposed SNWA pipeline.
3. 'The pressures for urban and economic growth outweigh the possible environmental impacts.' Discuss with reference to the situation in southern Nevada.