Freshwater Engineering Project List

Teacher Version

Review the water engineering case studies and discussion questions.

North America

Client Name: City of Calgary (Alberta, Canada)

Basic problem: The City of Calgary needed to increase the capacity to treat all the wastewater the people of Calgary were producing. The city turned to the Bow River as a new outlet on which to build an additional wastewater treatment plant. However, Bow River is a world-class sport-fishing river, so the liquid waste from the plant had to meet strict requirements before being discharged into the river.

Group Discussion Question(s): How could the solution meet the city's goal of reducing the use of potable water for non-potable needs?

Engineering Solution: The innovative design for the water-treatment plant includes wind power, which provides 50 percent of the energy to the plant; a green roof; use of locally available construction materials; minimization of construction waste; use of recycled building materials; and energy-saving heating/cooling systems. Portions of the treated sewage will be reused within the plant, and portions will irrigate the nearby city tree nursery and Blue Devil Golf Course. This will help the city to achieve its long-term water efficiency goal of reducing the use of potable water for non-potable needs.

Class Discussion Question(s): What is the importance of locally available materials, minimization of waste, use of recycled materials, energy-saving systems, and reduction of the use of potable water for non-potable needs? Why are freshwater uses for recreation important? Why does it matter if people form personal connections to water?

Client Name: City of Aurora (Colorado, U.S.)

Basic problem: The city of Aurora needed to supplement its water supply. Severe drought conditions prompted the city to look for ways to supplement its water supply that would protect residents and businesses during droughts and meet future needs without seriously impacting the environment.

Group Discussion Question(s): What is drought? What are its causes and consequences?

Engineering Solution: The city officials, residents, environmental experts, professors, and others compared different ideas before deciding to use water from the South Platte River, which would be filtered and treated before entering the reservoir. The engineering firm designed a purification system that combines natural and advanced purification to meet this challenge. First, the water is purified through a process called riverbank filtration in which water is pulled through sand and gravel found along the banks of the South Platte River. The water then filters in a protected aquifer area. The use of the aquifer reduces the need for more energy-intensive filtration. Following treatment, water is piped 35 miles through 60-inch-diameter steel pipes to a new 50-million-gallon-per-day treatment facility that uses ultraviolet light at short enough wavelengths to disinfect the water.

Class Discussion Question(s): How might this engineering solution need to be different in a developing country?

Freshwater Engineering Projects, continued

Africa

Client Name: Indigenous Education Foundation of Tanzania (IEFT) via Engineers Without Borders- USA Portland Professional Chapter (Lashaine Village, Monduli District, Arusha Region, Tanzania)

Basic problem: Due to the absence of permanent surface water or groundwater aquifers, the people of Lashaine depend on seasonal watering holes (large depressions where water collects during the rainy season) as the village's only water resource. Humans, livestock, and wildlife share these watering holes. The watering holes often dry up during the dry season, leaving the villagers with contaminated water stored in tanks or having to ship water from neighboring villages.

Group Discussion Question(s): Discuss the seasonality of water. Discuss the need to share resources with animals, both wild and domestic.

Solution: To combat this problem, the Engineers Without Borders team worked with local contractors and villagers to create a rainwater harvesting system and solar energy system at Orkeeswa Secondary School. The water system includes two 60,000-liter tanks that collect rainwater from the school roof and a bio-sand filter to provide safe and reliable water.

Class Discussion Question(s): Discuss the importance of planning for maintenance needs in engineering.

Europe

Client Name: Thames Water (London, England, U.K.)

Basic problem: The lack of capacity of London's 150-year-old Victorian sewer system is currently causing weekly sewage discharges to the tidal area of the Thames River.

Group Discussion Question(s): What are the impacts of a growing population on a finite area?

Solution: The construction of a new 25-kilometer tunnel under the city and a 10-kilometer tunnel under the River Lee carries storm water and sanitary overflows to expanded and upgraded wastewater-treatment plants. The Lee Tunnel, the deepest tunnel in London, dives down to 98 meters below ground at its lowest point. This extreme depth enables the storm sewage to flow downward to the wastewater-treatment plant while also avoiding other tunnels, pipelines, and cables that exist under London, particularly the Olympic Park cable tunnels.

Class Discussion Question(s): Discuss where storm water/water runoff goes and the impacts of pollution.

Freshwater Engineering Projects, continued

Asia

Client Name: USAID (Sri Lanka, Maldives)

Basic Problem: When a 9.3 magnitude earthquake hit the western coast of northern Sumatra in December 2004, it created the single deadliest tsunami in world history, with over 200,000 people dead or missing and over 1.5 million displaced. The country's infrastructure was considerably damaged.

Group Discussion Question(s): What systems might need to be built or rebuilt in the wake of a deadly tsunami?

Solution: The engineering firm partnered with the United States Agency for International Development to help rebuild and improve the damaged infrastructure throughout the several island nations affected by the disaster. In addition to reconstruction or rehabilitation of nine schools, installation of new water supply systems, and reconstruction and upgrades of three damaged fishing harbors, an extension of the projects included creating a health network TV system; water, sustainability, sanitation, and health workshops; and school health awareness training programs for all community members.

Class Discussion Question(s): What is desalination and what are its benefits and challenges?

Client Name: Gippsland Water (Traralgon, Victoria, Australia)

Basic Problem: The client was concerned with the impacts of drought and climate change on Australia's water supply systems.

Group Discussion Question(s): How might the impacts of drought and climate change be reduced through new water systems or facilities?

Solution: A facility called the Gippsland Water Factory will improve regional waterways, increase the amount of freshwater in the local ecosystem, and significantly reduce odor emitted from the open channel section of the regional outfall sewer (a sewer that receives wastewater from a treatment plant and carries it to a point of final release). It will also produce 20 percent of its required operating energy through internal energy-recovery processes. The factory will treat 35 million liters a day of municipal and industrial wastewater and produce 8 million liters of high-quality recycled water each day. Treatment of municipal and industrial wastewater occurs in two parallel systems, enabling the facility to manage saline and nutrient pollution. This meets the community's economic, environmental, and energy needs and minimizes greenhouse gas impacts.

Class Discussion Question(s): What is bioremediation? How can these facilities meet community needs in indirect ways?