

Brian Carroll

Nate Ebel

Christopher Tate

Kelly Hugo

Climate Change Mitigation 435

Project Write-up

Dr. Karen Humes

12/17/10

Updated for Geography 493

Dr. Gundars Rudzitis

### **Objective:**

To present a feasibility study utilizing the Aquaculture wastewater that goes directly to drain and could be used in the boiler at the Steam Plant on the University of Idaho Campus, minimizing water that needs to be pulled from the Aquifer.

Wastewater from the Aquaculture Wet-Lab, on the West end of campus, is currently being used during the summer months for irrigating the University grounds. They currently average about 2gpm that goes to drain which may be utilized in the future.

As a result, our group focused on wastewater that came directly from the Aquaculture student projects in the College of Natural Resources (CNR). After students were finished with their projects, we hypothesized that a standard procedure be implemented so that wastewater from their projects could be piped through to the Steam Plant via an existing tunnel system. The CNR is in such close proximity to the Steam Plant and there is already an existing tunnel system, that this project seemed feasible. There is also sufficient amount of holding tanks to compensate for additional water being pumped into the Steam Plant. The same goes for the filtration system. The wastewater from the CNR could easily be pumped through the existing filtration system to be purified for usage in steam production.

## **Methodology:**

The project we propose utilizes wastewater from the University of Idaho Aquaculture Department, in the College of Natural Resources (CNR) Building, to be implemented into campus steam production. Minimizing the amount of water that needs to be removed from our local aquifer to make-up for the water lost throughout campus steam and condensate system.

The U of I Steam Plant currently operates with a daily make-up water average of about 6% which equates to around 3,500 gallons of water per day that needs to be pumped from our local aquifer (Smith, 2010). This water can be taken from student project wastewater in CNR. A protocol needs to be designed and implemented to utilize the wastewater from these student projects in the Aquaculture Dept., so that a standard operating procedure is in place for all water that is discarded or replaced on a daily basis.

The amount of water that is available from the Aquaculture Dept. in CNR is variable depending on what kind and how many student projects are going on at any given time. For example in 2009 there was an average of 42 gallons per minute (gpm) which equates to 22,200,000 gallons for the year. So far in 2010 they have used 1,770,000 gallons with a cost of \$3.46/100 cubic ft. Or \$23,663.10 for the year (Holthaus, 2010) with about 2-4 million gallons of that being used for backwashes (filtration cleaning). With records going back to 1990 the amount of water being used has a variability from the maximum recorded amount of 58 million gallons per year from 94-2000 to the minimum value of 16.2 million gallons in 2008 (Holthaus, 2010). These numbers show that there is a significant amount of water that is being pumped from our local aquifer.

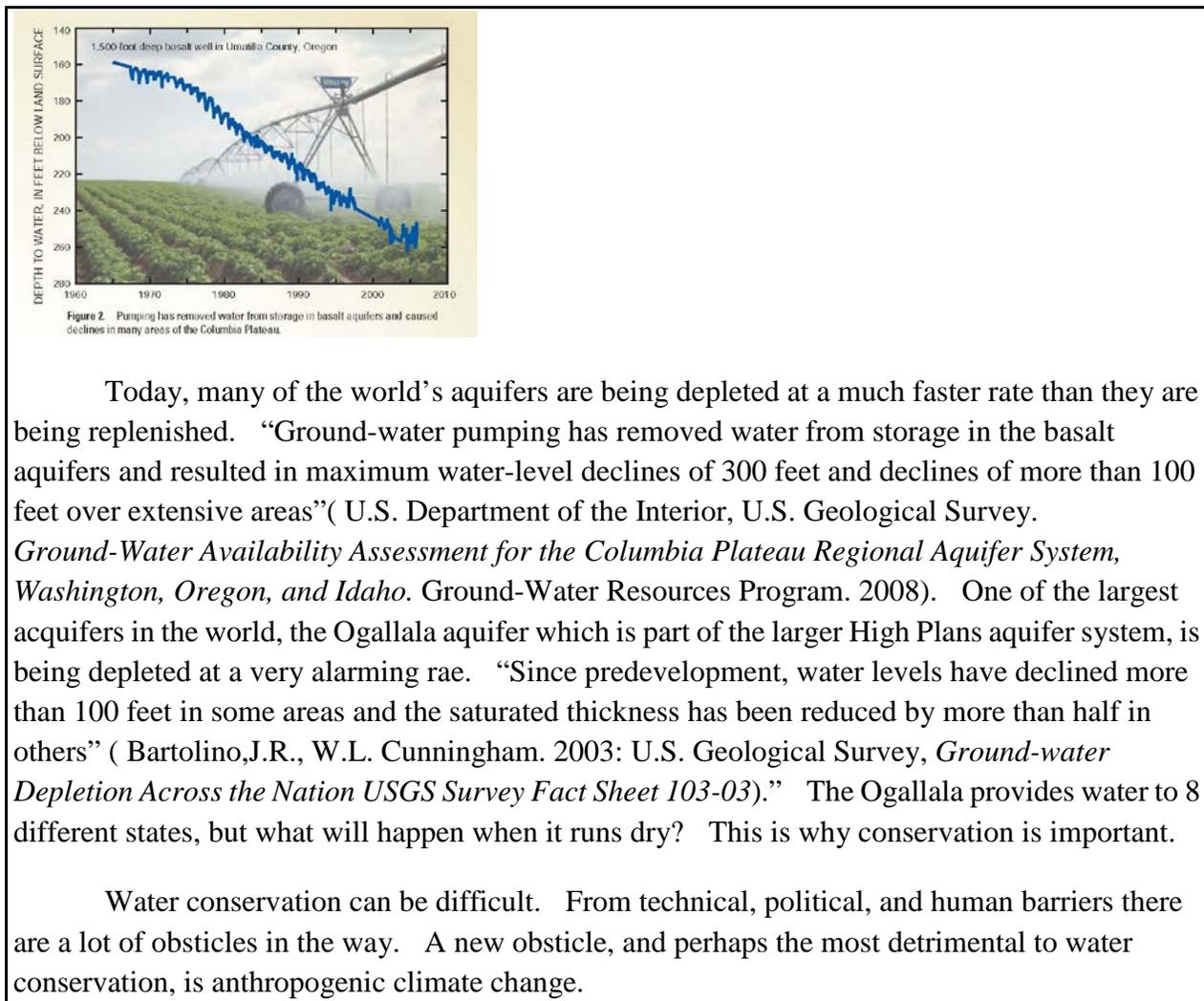
By utilizing the existing tunnel system that connects CNR to the Steam Plant and current storage and filtration systems at the U of I steam plant, the feasibility of this project and the amount of water that can be conserved, this project should be beneficial to the entire campus and local community. The cost/benefit factor needs to be seriously considered and analyzed at the next Sustainability/project management meeting on campus.

## **Significance:**

Global ground water is one of Earth's most precious resources. Many consider ground water to be renewable and think little of water conservation. Conservation of fresh water resources is going to become a very important issue over the next several decades, as global climate regimes start to shift.

Part of understanding why groundwater conservation is important is understanding where our water comes from. The water we all use every day comes from aquifers. An aquifer is an underground layer of permeable rock or other materials, which can hold water, and water can be extracted from. The point at which this water can be reached is called the water table. Sometimes the water in an aquifer can be ill suited for human use. Pollution and salinization are both common occurrences that affect the suitability of ground water. In these cases the water must be treated before it can be used.

To make this water accessible to humans, wells are drilled to pump water from the aquifer to the surface. Ideally, the rate at which water is pumped will not exceed the rate at which the aquifer is replenished. Replenishment most often occurs naturally with rainwater making its way to the aquifer, although sometimes injection wells must be used to pump make-up water into deep aquifers to keep an even pressure.



Today, many of the world’s aquifers are being depleted at a much faster rate than they are being replenished. “Ground-water pumping has removed water from storage in the basalt aquifers and resulted in maximum water-level declines of 300 feet and declines of more than 100 feet over extensive areas”( U.S. Department of the Interior, U.S. Geological Survey. *Ground-Water Availability Assessment for the Columbia Plateau Regional Aquifer System, Washington, Oregon, and Idaho*. Ground-Water Resources Program. 2008). One of the largest aquifers in the world, the Ogallala aquifer which is part of the larger High Plains aquifer system, is being depleted at a very alarming rate. “Since predevelopment, water levels have declined more than 100 feet in some areas and the saturated thickness has been reduced by more than half in others” ( Bartolino,J.R., W.L. Cunningham. 2003: U.S. Geological Survey, *Ground-water Depletion Across the Nation USGS Survey Fact Sheet 103-03*.)” The Ogallala provides water to 8 different states, but what will happen when it runs dry? This is why conservation is important.

Water conservation can be difficult. From technical, political, and human barriers there are a lot of obstacles in the way. A new obstacle, and perhaps the most detrimental to water conservation, is anthropogenic climate change.

“Observed warming over several decades has been linked to changes in the large-scale hydrological cycle such as: increasing atmospheric water vapour content; changing precipitation patterns, intensity and extremes; reduced snow cover and widespread melting of ice; and changes in soil moisture and runoff”( Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds., 2008: *Climate Change and Water. Technical Paper of the Intergovernmental Panel on Climate Change*, IPCC Secretariat, Geneva, 210 pp). Several of these things can, and will have an impact on ground water.

Observed effect	Observed/possible impacts
Increase in atmospheric temperature	<ul style="list-style-type: none"> <li>Reduction in water availability in basins fed by glaciers that are shrinking, as observed in some cities along the Andes in South America (Ames, 1998; Kaser and Osmaston, 2002)</li> </ul>
Increase in surface water temperature	<ul style="list-style-type: none"> <li>Reductions in dissolved oxygen content, mixing patterns, and self purification capacity</li> <li>Increase in algal blooms</li> </ul>
Sea-level rise	<ul style="list-style-type: none"> <li>Salinisation of coastal aquifers</li> </ul>
Shifts in precipitation patterns	<ul style="list-style-type: none"> <li>Changes in water availability due to changes in precipitation and other related phenomena (e.g., groundwater recharge, evapotranspiration)</li> </ul>
Increase in interannual precipitation variability	<ul style="list-style-type: none"> <li>Increases the difficulty of flood control and reservoir utilisation during the flooding season</li> </ul>
Increased evapotranspiration	<ul style="list-style-type: none"> <li>Water availability reduction</li> <li>Salinisation of water resources</li> <li>Lower groundwater levels</li> </ul>
More frequent and intense extreme events	<ul style="list-style-type: none"> <li>Floods affect water quality and water infrastructure integrity, and increase fluvial erosion, which introduces different kinds of pollutants to water resources</li> <li>Droughts affect water availability and water quality</li> </ul>

(Observed effects of climate change and its observed/possible impacts on water. (Bates,Kundzewicz,Palutikof, 2008)

The impacts shown in the table all can have a large impact on global water resources. Agricultural regions may have to change irrigation sources and practices. Desert regions may become even more dry, or could become too wet harming local flora species. Many of the world’s largest cities are located at sea level and could begin to lose land to rising sea levels, and many small island nations could be lost all together.

In Moscow, Idaho water is pumped from the Columbia Plateau regional aquifer system. The biggest impact of climate change on the resources of this aquifer will be changes in annual precipitation patterns. Precipitation events are predicted to become more extreme and fewer in number. This will have 2 major impacts on the replenishment of the local aquifer:

1. With more time coming between precipitation events the aquifer will go longer without being replenished.

2. When precipitation events become more intense, runoff increases. This causes less water to saturate the ground and replenish the aquifer.

This combination will increase the rate at which we deplete our ground-water reserves, and place a much larger importance on conservation. Water conservation projects will become key in managing the freshwater resources of the region. This is why we chose to focus our project on conserving water at the University of Idaho which currently uses large volumes of water every year in all phases of operation.

## **Lessons Learned:**

### **Feasibility**

All permanent construction projects are handled through University of Idaho Facilities Services Department (Facilities), however the process for obtaining approval and launching a project is somewhat convoluted, and not entirely standardized. The entities originating a project, the project's size and scope, and the source of funds are the primary factors that determine how this process proceeds. Strictly speaking, our project is feasible. It has long-term economical and ecological merit, and is very much in line with a current philosophy at University of Idaho (UI) that puts conservation projects at priority. There are, however, several obstacles to implementation.

### **Obstacles**

According to Ray Pankopf, Architectural & Engineering Services Director at UI, University of Idaho is exempt from Moscow City and Latah County building codes. Facilities are the body that oversees, and is responsible for safe and sound building practices at UI. If a construction project is of small scale and can be handled "in-house" the process of having a project approved for scheduling is streamlined considerably. After interviews with Facilities and Plumbing, we found that our project, though borderline, would likely require some outsourcing.

Once a need for outsourcing has been determined, several factors come into play. Though the actual pipe-fitting is on low-pressure lines and fairly straightforward for our project, Plumbing is limited essentially to maintenance and may not have the tools and resources to complete the job. In this case a professional plumber would be needed, and a formal bidding process would begin. Facilities require outsourced plumbers to be licensed and insured. This may involve bringing an engineer into the process if the plumber deemed it necessary to do so, to protect him/herself against liability, or for structural or mechanical considerations. If an engineer is brought into the fray, then Facilities has to become more involved via approval meetings and oversight. This will increase cost and time, thereby extending any economical payoff.

The amount of plumbing that needs to be added will have little impact on what is currently in place

for campus steam production and delivery. Projects of this magnitude, although in context of current campus renovations are relatively minor, are usually opened up for bid to contractors. Due to the budget setbacks of the last decade the University of Idaho's Facilities Management Department does not have the man-power to complete a project of this magnitude while still performing their day-to-day duties.

We originally envisioned a passive system that used gravity as the energy source to regulate flow. It turns out that an electrical pump may need to be installed to facilitate the project. Another subcontractor, a licensed electrician, might be needed to install the pump to Facilities' standards. This would increase the initial costs and add operating and maintenance costs, again extending economical reward.

The final obstacle we identified was the possible down-time in the lab during the refit. Scheduling would need to be coordinated as to not interfere with sensitive ongoing or new research.

### **Originating Entities and Funding**

The actual process of writing up a proposal and presenting it to the right people should be done by an engineer or architect familiar with the project. Various meetings would have to take place and several different administrators, architects, and engineers would have to approve of the project before anything could be started. The time and costs of the project would have to be more heavily researched by those who have access to the budget as well as the code guidelines.

The person(s), organization, or facility requesting a project is given consideration by Facilities when determining the feasibility of a construction project. This consideration cannot be untangled from the issue of funding. According to Trina Mahoney, Director of Budgeting at UI, if this project had been proposed two years ago, funding may have been found under an Energy Savings Contract bond that was dispersed to make various and ongoing ecological and economical improvements on campus. Bonds are a common source of revenue for campus projects.

Another source of funding could be from departmental funds. If the Forestry or even Geography department had a perceived need and chose to use allocated funds for the project, Facilities would work closely with these stakeholders to implement the design – or Facilities as a department could choose to fund it themselves. These sources are Internal Capital Projects, and have considerable weight.

There is also a list of projects sent yearly to the State Permanent Building Fund to be considered for funding from state monies. These projects tend to be “large” in scope, and it is unlikely that our project would receive much notice on this platform.

Finally there are gifts and small grants. If I, as a private individual or other entity, chose to gift the cost of this project by funds generated by grants, personal profits, or fundraising, Facilities would begin the process of working with the departmental stakeholders and myself to see the project

through.

## **Surprises**

We were surprised by the degree of access we had to high-level departmental administrators, and their candidness. These busy individuals, more often than not, would eagerly brainstorm a few ideas that would assist actually implementing this project, without solicitation. We were also surprised at the widespread support across different departments for this project, departments that are removed from any substantial benefit. That speaks to the philosophy we mentioned earlier: the people that constitute University of Idaho care enough about conservation to stop what they are doing to give consideration to even a fairly small project. But universities are the crucibles of enlightenment. Perhaps we should not be so surprised after all.

## **Summary**

Our project is practical and viable. Unfortunately, professionals from the private sector would need to be invited to bid and give professional opinions before we could devise a comprehensive cost-benefit analysis. But there are some benefits that are self-evident. Water recourses may be the single largest factor that contributes to our survival in the face of climate change. It is widely accepted that we will not be able to reverse our warming trend by altering any one contributing factor. Geo-engineering is not an option at this point, and it becomes more evident that the best we can do is to alter our lifestyle of rampant consumption at an individual level, with an eye towards a global goal. By implementing conservation on a small scale, we are not only mitigating the effects of climate change – we are adapting.

This project was done with the hope of bringing to light how much water is being used and wasted from our local aquifer. When dealing with current climate change issues, freshwater aquifers should take a high priority or future generations will suffer the consequences that the lack of freshwater will present.

## **Bibliography**

Bartolino, J.R., W.L. Cunningham. 2003: U.S. Geological Survey, *Ground-water Depletion Across the Nation USGS Survey Fact Sheet 103-03* .

Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds., 2008: *Climate Change and Water*. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 210 pp

Holthaus, Mike. Facilities Management Utilities Department, 2010; provided Spreadsheets displaying Water usage in College of Natural Resources and Aquaculture Department

Mahoney, Trina. University of Idaho, Budget Office, Director, Interview December 2010

Pankopf, Raymond. University of Idaho, Facilities Management, Architectural and Engineering services, Interview December 2010.

Smith, Scott. Foreman University of Idaho Steam Plant, 2010; provided information about current Steam Plant operations and capabilities.

U.S. Department of the Interior, U.S. Geological Survey. *Ground-Water Availability Assessment for the Columbia Plateau Regional Aquifer System, Washington, Oregon, and Idaho*. Ground-Water Resources Program. 2008.