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ERE MESSENGER

Environmental Resources Engineering

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Peter Alstone and Liza Boyle Join ERE Department

by
Liza Boyle, ERE Assistant Professor, and
Peter Alstone, ERE Assistant Professor and SERC Faculty Scientist

Introduction by
Beth Eschenbach, ERE Professor and Chair

What a pleasure it is to welcome not one, but TWO new faculty members to the ERE department! We are fortunate indeed! Both of these folks have expertise in renewable energy systems, and their specialties complement each other and our department needs nicely. As you will read, Dr. Peter Alstone is already familiar with HSU and the Schatz Energy Research Center (SERC). He has a new type of position in that he will teach half time for ERE and be a half time researcher for SERC. Dr. Liza Boyle comes to us with a love of teaching and some great teaching experience. In addition to renewable energy, she will also share her expertise in air quality with our students. We are so pleased to have these new colleagues join us. Please enjoy reading their stories below. – *eae*

LIZA BOYLE

Looking back, it feels as if I have come a long way since first getting excited about teaching and considering a career as a professor. I have learned to telemark ski; visited eight new countries; started playing ultimate Frisbee, and competed in the USA Ultimate National Championships; moved to three new places; and completed a significant research project, which earned me the title "Dr." After all of that, I am thrilled to be joining the ERE faculty at Humboldt State and getting to teach and do research in such a fantastic environment.

I first got excited about teaching as an undergraduate student, where I was fortunate to get to tutor in a fun, drop-in tutoring center for engineering students on campus. Pushing my knowledge of subjects and getting to help others learn was instantly rewarding for me. I was also a supplemental instruction leader for first-semester Physics and later a mentor for other Supplemental Instruction leaders. This classroom-type teaching was equally rewarding and provided a fun set of new challenges, which I very much enjoyed. With this motivation for teaching, I graduated with my BS in Mechanical Engineering from University of the Pacific and went on to spend a year volunteering.

The first stop on my year of volunteering was Eden Campus in rural South Africa. At Eden Campus, students run

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Liza Boyle

Peter Alstone

IN THIS ISSUE

FROM THE EDITORS

Hello from the Messenger staff! We hope you enjoy this Fall 2016 edition.

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"What's the use of having developed a science well enough to make predictions if, in the end, all we're willing to do is stand around and wait for them to come true?"

F. Sherwood Rowland (1927-2012)

Nobel laureate for his work on atmospheric ozone depletion

Alumni Profiles

Cherie (Kluck) Blatt

BS ERE 1990
Water Resource Control Engineer
North Coast Regional Water Quality Control Board
Santa Rosa, California
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Growing up in rural Wisconsin prepared me to start my major in Wildlife at UW-Stevens Point. However, the lack of part-time jobs to help me pay for college and the lack of professional jobs in natural resources in the 1980's sent me packing to Alaska to find work in the fishing industry. During my year and a half in Homer exploring the beautiful area and working at a seafood processor and a marine electronics store, I heard about Humboldt State as the place to go to complete my major.

I bought a pickup and drove the Alcan Hwy to Tahoe to establish my California residency. After working as a seasonal fire fighter for the USFS-Lake Tahoe Basin, and taking science and math classes at the Lake Tahoe Community College, I landed a job through one of my community college instructors at the Lahontan Regional Water Quality Control Board. Many coworkers there had ERE degrees from HSU and highly recommended it, so I applied and was accepted into the program! My first class was Introduction to Engineering, and my favorite part was learning how to brainstorm to solve complex problems! I was able to live on a shoe-string budget working summers, winter break, and spring break at Lahontan, thereby saving up enough to pay the $260/semester tuition and rent a $100/month room in Arcata from an 85-year old landlady with very strict rules.

Engineering was hard work, no doubt about it! My friends in other majors seemed to have lots of time to do fun things, but I had to stay in most of the time and study. Still, keeping up with the program was the best decision that I have ever made. My experience in Alaska made me especially interested in salmon, so I took extra classes in Limnology from the Fisheries department. My water quality classes, especially water resources, laboratory work, wastewater treatment, and my senior project on the green algae Volvox in Fallen Leaf Lake, helped me to complete my emphasis in water quality and score high on my oral job interview with the state. I then worked as a Water Resource Control Engineer at Lahontan for eight years. My projects included reviewing and inspecting timber harvest operation and erosion control projects for water quality protection, and studying solutions to the Eurasian watermilfoil problem in Lake Tahoe. In 1999, I moved with my family to Santa Rosa, where I was hired at the North Coast Regional Water Quality Control Board reviewing and inspecting timber harvest plans. After 11 years, I took on the dairy regulation program where I help to keep manure and sediment out of surface water and groundwater, and I also help to protect riparian vegetation along streams.

Attending HSU and being involved with the ERE program was a great experience. I learned from dedicated

Alumni Profiles

instructors and I interacted with fellow classmates, all interested in helping the environment. I am extremely grateful to the HSU Engineering program for awarding me a BS degree in a field that has been very rewarding.

There are currently seven ERE graduates at our Santa Rosa office of approximately one hundred employees. One skill greatly needed at our office is Geographic Information Systems. My advice is that all students take as many GIS classes as they can. It is what we look for during job interviews. I recommend that ERE graduates check out new jobs posted on the state website http://www.waterboards.ca.gov/about_us/employment/. New graduates should look at Scientific Aide positions, and those with experience should look at Water Resource Control Engineer positions.

Matt Hillyard, PE
BS ERE 2001
Senior Engineer
Farallon Consulting, L.L.C.
Portland, Oregon

Much of my childhood was spent swimming and fishing Humboldt's many rivers, camping, and exploring the outdoors around our family's cabin on the Mad River. Studying Environmental Engineering seemed like a good way to couple my interests with my aptitude for math and science. As an Arcata native, it was natural for me to consider HSU as an option for college, and after looking into the ERE program, I didn't see a need to search any further. I enjoyed my time in the program, and I especially enjoyed the interesting and challenging classes it provided, particularly fluid mechanics, hydrology, and river hydraulics.

During my last two years at HSU, and for more than a year after graduating in 2001, I worked for a small local engineering firm, Pacific Affiliates, gaining experience surveying rivers to analyze annual geomorphic changes and designing/permitting gravel extraction activities for several gravel mining companies.

In 2002 I began searching for a company that would provide more environmental consulting diversity and I got a job as a staff engineer that was to be a foundation for much of the work I specialize in now. Working in the Arcata office for the San Francisco branch office of an international environmental consulting company, MFG/Tetra Tech., I began to focus on the forest products industry. I worked locally and at sawmills throughout the state conducting soil and groundwater investigations, providing industrial stormwater compliance, and preparing spill prevention, control, and countermeasure plans.

In 2004 I accepted an offer to open and lead an office in Eureka for a national consulting firm, Geomatrix Consultants, Inc. Being the face of my company in the North Coast region gave me the opportunity to have more client interaction than I might have had as a junior person in a large office. Working for national and international companies while remaining in Humboldt County allowed me to work on a broad range of projects and work with people from inside and outside of the local area. It was during this time that I developed an expertise in industrial stormwater permitting and compliance while providing support to multiple companies, and I obtained my professional engineer's license in civil engineering. After that, I took on the job of managing engineer for Integral Consulting Inc's branch office in Eureka. There, I continued working on industrial stormwater and investigation/remediation projects, including one project managing the remediation of approximately 85,000 cubic yards of volatile organic compound and petroleum hydrocarbon-impacted soil at a closed sawmill.

In 2015, my wife and I decided to make a change, and we moved with our two small boys to Portland, Oregon. We have since had another boy and are enjoying the Pacific Northwest, especially finding new outdoor areas to explore. Portland has many similarities to Humboldt, and I have run into a lot of HSU alumni, including a couple of ERE classmates. In May of this year I accepted a position as a senior engineer in the Portland office of Farallon Consulting, an 80-person west coast firm with offices in Washington, Oregon, and California. While much of my work is still in California, I am enjoying taking on new clients and projects in Oregon.

One thing that I really enjoy about consulting is the wide range of interesting and challenging projects to work on. Currently, I am working on projects that include developing corrective actions to reduce aluminum and iron in stormwater runoff at a landfill in central California, developing a strategy to address naturally occurring arsenic in stormwater at a quarry in Eastern Oregon, and developing a plan to clean up a rail spur chemical unloading area at a chemical plant.

Alumni Profiles

Nolan Kloer, EIT
BS ERE 2013
Project Engineer
Blue Oak Energy
Davis, California

I came to HSU as a freshman in 2007 to find isolation behind the redwood curtain. I was looking for a technical degree that would provide me with the opportunity to study a wide range of subjects. Engineering stood out as an exciting option because the idea of learning how to design solutions to environmental problems intrigued me. I also thought that no matter what career I ended up pursuing after college, having an engineering background could be helpful.

Early on in college I developed an interest in river restoration and hydraulics from working an internship with the Sonoma Ecology Center in Sonoma, California. I was certain I'd found my niche, and I chose my design electives to focus on water-related subjects. In parallel with this, I also changed to a new internship and began working as an Ag-Engineer Trainee with the USDA Natural Resources Conservation Service. My responsibilities revolved around designing Best Management Practices for erosion control and irrigation management near areas in South Lake Tahoe, San Luis Obispo, and Ferndale.

Aside from academics and internships, I fell in love with rock climbing at HSU in the Student Recreation Center (SRC). I spent so much time at the rock wall that they eventually hired me as an attendant. Later, I coordinated all SRC climbing operations. At around the same time a few friends and I started the HSU Climbing Club so that we could be sanctioned to travel to competitions and compete against other colleges. As a team, we did well and won podium placements at several national championship events. Toward the end of college, I was involved in growing a non-profit sports agency for rock climbers, called Pro Climbers International (PCI).

I graduated from ERE in 2013, and I stayed another year at HSU to get my MBA. My main purpose for studying business was to develop knowledge and tools to help me build and manage organizations. My graduate research focused on improving fundraising methods for the HSU Alumni Association, for which I developed a statistical model to identify outreach efforts that maximized donations based on certain alumni attributes.

After business school, my girlfriend and I took a 4-month road trip across the United States. We turned my Honda Element into a tiny camper van and migrated between popular climbing destinations with the changing seasons. Extended visits in Colorado, Kentucky, and Arizona showed us just how diverse and beautiful this country is. We enjoyed our brief stint of *fun*ployment, and considered staying vagabonds long term before eventually deciding it would be prudent to find jobs.

Searching for a job quickly taught me the importance of networking. My initial approach of sending resumes blindly to employers wasn't yielding results, so I began reaching out to the network of ERE alumni for leads and advice. It was through these efforts that I found myself interviewing for the job of Project Engineer with a firm called Blue Oak Energy (BOE), which specializes in designing and building large scale photovoltaic (PV) systems. While not the career path I had envisioned early in college, the projects sounded exciting, and the company felt like a good fit. I eagerly accepted their job offer, enticed by the prospect of exploring a new frontier.

I've been at BOE for almost two years now, and I love the day-to-day hustle that comes with working in the private sector. The PV industry is fast paced and poised for continued growth for the foreseeable future. It's an exciting time to be involved in solar. Every day at work there are unexpected challenges that arise and demand quick solutions. My current focus is preparing to sit for the electrical PE exam in 2017. Beyond this, I am excited to see continued advancements in PV technology and broader applications within the built environment.

I never imagined that studying engineering would lead me to where I am today, and I feel very fortunate to have chosen this path. The training that ERE provides to its students is extremely valuable and carries real weight in the professional world. To any current students who might feel unsure about their place in the program, my advice is to *keep cranking*. Enjoy the process knowing that your future is bright. Ω

"Prediction is very difficult, especially of the future."

Niels Bohr (1885–1962)

Engineering Fest

by Kaileigh Vincent-Welling, ERE Senior

The ERE department, with its various club opportunities and active student base, has great potential to make a positive impact in our local community. Inter-club collaboration has been emphasized and risen over the last year. I set out with Lynn Brown as friends and Co-Outreach Coordinators for the Society of Women Engineers (SWE) to take advantage of this energy and kick off the first all-club outreach day. We got the ball rolling last May in a meeting with Beth Eschenbach, ERE department chair, and Jen Buck, the president of the local professional SWE section. The four of us brainstormed ideas for an outreach event to take place in early fall. After talking with ERE professors and local high schools, and receiving a very generous grant from the Professional Engineers in California Government (PECG) Eureka chapter, the fall outreach event idea transformed into the vision of Engineering Fest.

The objective of the Engineering Fest was to provide a free, educational, and fun opportunity for middle school students across the county to participate in various engineering activities that were created and run by predominately ERE students. We teamed up with Eureka High School (EHS) for our venue location to encourage high school student involvement as well. Aletta Sauer, the engineering teacher at EHS and a professional SWE member, became heavily involved as our person of contact and organizer on the EHS planning team. She was vital to our team, collaborating with us in the design of activities and resources to make the event successful. We also utilized Ken Pinkerton's experience as the annual organizer of the famous Humboldt Math Festival to gain more support and assistance with the event.

Engineering Fest: Participants working hard to build the tallest tower out of marshmallows and dried spaghetti noodles.

The outcome of the Engineering Fest was something that neither Lynn nor I were expecting. On the day of the event, Saturday September 24th, the EHS cafeteria was filled with 15 fun engineering activities, about 40 ERE student volunteers from each of the five department clubs and Schatz Energy Research Center, two professional engineers from PECG, some high school student volunteers, and approximately 60 youth from across the county along with their families; all participants sporting giant smiles as they moved from activity to activity. Activities included: a rope water pump, playdough "squishy" circuits, spaghetti noodle/marshmallow towers, an egg drop, a Van de Graff generator, Arduinos, sand filters, and more. ERE professors, Beth Eschenbach and Kerri Hickenbottom also attended and provided a great amount of support for the event.

Overall, the Engineering Fest, which will hopefully become an annual outreach event, was successful in showing how strong our ERE community is and how motivated we students are to positively influence our community and to share with others. What better way than providing children the opportunity to see that engineering is a real possibility where they can help design the world we live in? We give our warm thanks to Ken Pinkerton, Jen Buck, Beth Eschenbach, Kerri Hickenbottom, Aletta Sauer, Ruth Mitchell, and all of the ERE student volunteers for all of their support in this event. We hope that this event will motivate more inter-club collaboration in the future, as well as motivate us all to continue being strong outreach leaders in our community. Ω

Swale and Summer 2016 Update

by Lonny Grafman, ERE Lecturer

I have built my career by creating awesome projects, and some epic failures, with diverse groups of people working together toward a better future. I have been teaching in the ERE department at HSU since 2003, and last year I took my first "sabbatical" when Nexi, the startup I co-founded with Kimberli Hudson and Gabriel Krause, was chosen with 11 other companies out of hundreds to be in the Highway1 accelerator program based in San Francisco. I look forward to telling you more about that in a future ERE Messenger.

For this installment, I am excited to share the Swale project from Summer 2016. Swale is a floating food forest in New York created by visionary artist Mary Mattingly. Our ENGR 215 "Introduction to Design" students have worked on Mary's large, sustainable, and public art projects in New York periodically since 2009.

Background Projects

In 2009, I was the sustainability advisor and volunteer coordinator for the Waterpod, a barge that floated through New York with five artists living aboard for five months. The artists tried to get all of their food, energy, and water from the barge itself, and were quite successful (aside from the chocolate, cake, and wine that magically and frequently appeared). By the end of 2009, approximately 200,000 people had visited Waterpod and were regaled with all types of sustainable technologies, many of which were designed and built by our students.

In Spring 2009, ENGR 215 created and shipped 1,000 pounds of projects to the Waterpod in New York. The technologies included bicycle-powered laptop stations, vertical and hydroponic gardens, a composting toilet, rainwater filtration, a chicken coop, a rocket stove, and experimental renewable energy systems. These projects, which were critical to the success of the Waterpod, were covered extensively by the media. The associated project pages on Appropedia have more than 100,000 hits, and have been used to recreate and adapt projects around the world. Discovery News said, "If rising ocean levels force us to figure out how to float, it might not be an entirely bad thing. Especially if the food tastes like this." The projects can be seen at http://www.appropedia.org/Waterpod.

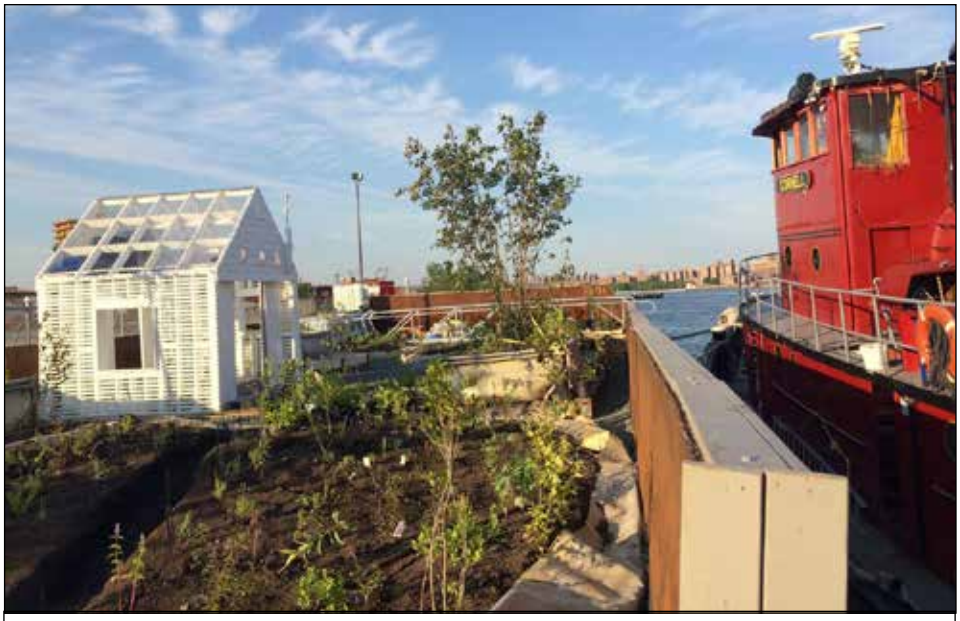
Artistic concept rendering of Swale being towed on the river in New York. *Credit: T. Craig Sinclair*

In 2012, we returned to New York with the terrestrial nomadic Flock House pods. These were domes, eight feet in diameter, that interacted with their neighborhoods to effectively meet their needs. For example, the bicycle power system that was designed and built by ENGR 215 in Fall 2011 had no bike of its own, but instead relied on passing cyclists. That semester, ENGR 215 also designed and built upcycled materials for the skins, windows, and doors of the pods; a power meter; a solar dehydrator; and a two-person human-powered train car. See their projects at http://www.appropedia.org/Flock_House.

Swale

In New York City, as is the case in many locations, it is illegal to grow public food for public use. The water, however, harbors different laws. Maritime law in New York does not exclude the growing of public food for public use, so that is where we are growing Swale.

Swale is 40ft x 130ft of local and perennial food growing on a barge that is traveling through New York. I served as the project manager for the buildout in July 2016, and later as the sustainability advisor. One hundred tons of gravel, soil, compost, plants and supporting materials have converted an old sand transportation barge into an interactive public art piece addressing urban food deserts, sea level rise, and other environmental and social justice issues. Supporting all of the growing food and medicinals are water systems that combine rainwater catchment, city water, and river water treated through a slow sand filter with activated carbon. This water is moved around the barge by human and solar power. In addition, there is a chicken coop and an art house in the center of the barge. The art house, produced by Biome Arts, projects abstract digital



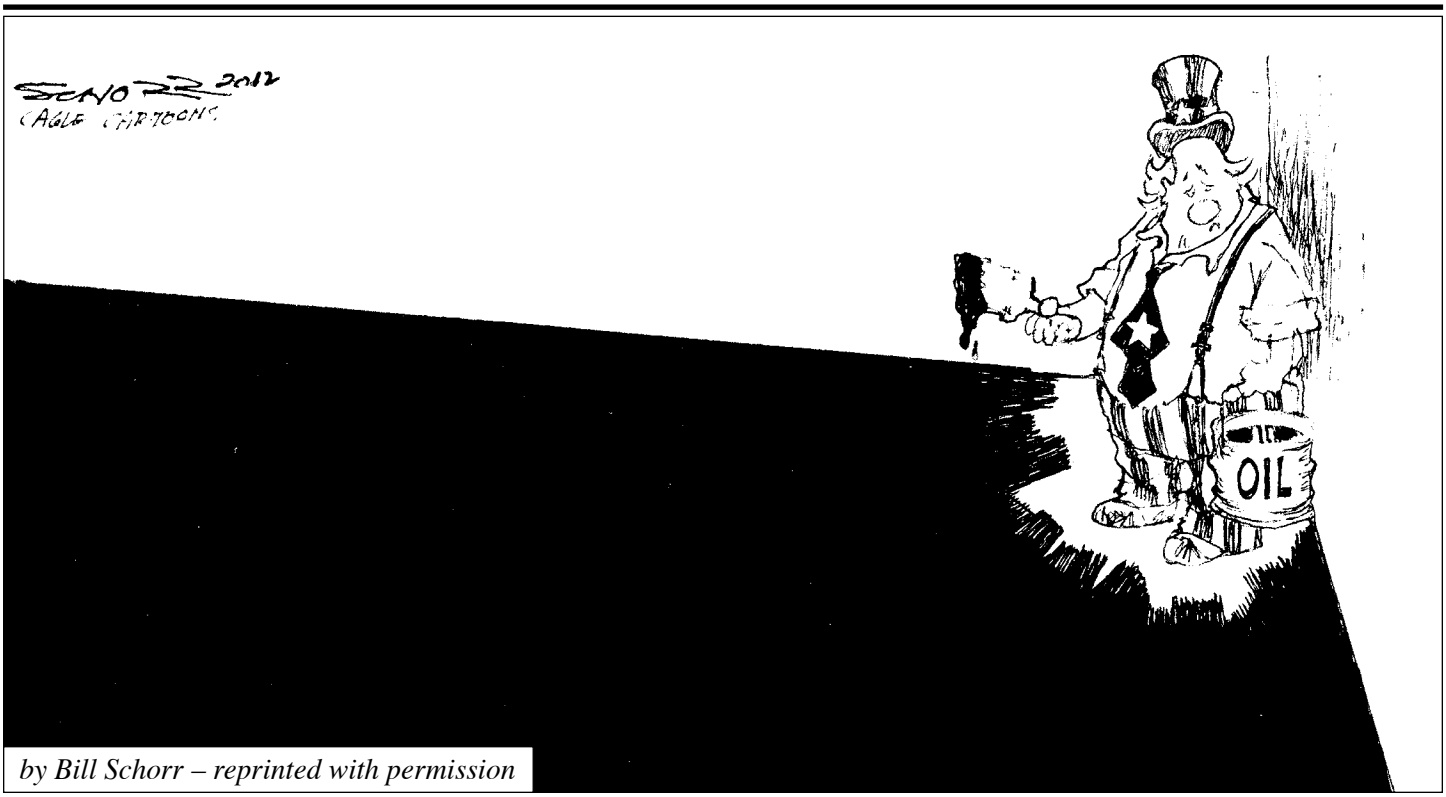
Swale: Planters and the Greenhouse Theater (art house) on board the barge, replete with medicinal and edible trees, all being towed to the Bronx. *Credit: Swale*

art based on input from sensors in various planters. It also serves as a stage for music and speaking events.

For me, the most exciting aspect of all this has been seeing how local communities interact with Swale. For example, in the South Bronx, at Concrete Plant Park, local youth helped build the barge and became docents giving tours while it was docked there. Concrete Plant Park is critically located just two miles from the Hunts Point Food Distribution Center, the second largest food distribution center in the U.S. Yet, with thousands of truck trips coming in and out of the area every day, the South Bronx remains an urban food desert with the trucks leaving behind more empty calories and pollution than whole food and nutrition. In response to these issues and more, the Youth Ministries for Peace and Justice (YMPJ) was borne. YMPJ adopted Swale, ran programming on board, and leveraged the interactive local art to further their important work.

Swale is now at Brooklyn Bridge Park hosting events focused on topics including natural dyeing, rewilding, edible landscaping, the science of living cities, and various food justice issues. The press has been very receptive so far, with publications like New York Times, Huffington Post, and hundreds of blogs enthusiastically covering us. Now, to continue, we need to raise more money, and hopefully partner again with our engaged ERE students. As you can see, Humboldt continues to have positive impacts locally, nationally, and internationally!

For more information on Swale, go to: http://www.appropedia.org/Swaleny and http://www.swaleny.org. Ω



by Bill Schorr – reprinted with permission

New Faculty

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businesses to pay for their education (including room and board). Students get experience starting and running businesses and also get help in math, writing, and computer skills. I helped tutor students while they completed a self-paced introduction to computing module and was instrumental in redesigning the math curriculum to allow for students to get a more personalized math education. Additionally, I learned a lot about working with and teaching a very diverse group of students who were all from outside of my culture.

On returning from South Africa, I began work as an AmeriCorps member at the Northwest Youth Corp's Out-Door High School (ODS). My excitement about teaching had only grown, and, as an AmeriCorps member at ODS, I was teaching primarily math and science to a broad range of high school students. ODS is designed to get students outside, and I enjoyed taking science classes on fieldtrips and leading students on environmental conservation projects. This teaching experience gave me some preparation for teaching students at HSU.

Following AmeriCorps, I moved back to my home town of Boulder, Colorado to attend graduate school at the University of Colorado Boulder (CU). I was (and still am) passionate about renewable energy, and after getting a National Science Foundation Graduate Research Fellowship, I was allowed the flexibility to pursue my own project. I was working with a fantastic advisor in the Air Quality program at CU, and combining these two areas, I began a project looking at dust accumulation on solar panels.

During my graduate work I collected airborne Particulate Matter (PM) concentrations, PM deposition masses, and transmission loss due to deposited PM: first at just two local Colorado sites, then later at a total of five sites across the continental United States. I used all of this data to build a model to predict losses caused by PM deposition (or soiling) for any site using meteorological data and ambient PM concentrations. Building skills in both air quality and renewable energy made me a great fit for HSU's ERE program, which is unique in its combination of environmental engineering and renewable energy engineering.

I am excited about using both my renewable energy and air quality backgrounds at HSU. I plan on collaborating with the Schatz Energy Research Center to continue doing research related to renewable energy implementation and reliability and possibly air quality related research as well. I also plan on improving the environmental strengths of ERE in air quality both by integrating examples into other courses and teaching ENGR 434: Air Quality Management, in the future.

When I am not working, I enjoy exploring the outdoors (hiking a great trail, taking a long bike ride, backpacking through beautiful wilderness, canoeing down a peaceful river, or having a walk and picnic on the beach), baking, and learning something new. Now that I am living in Humboldt, I am looking forward to exploring the Lost Coast, the Trinity Alps, and hopefully learning to sail!

Liza Boyle explores Jökulsárlón beach, covered in pieces of a glacier, in Iceland during a trip in March and April of 2016. Photo Credit: Ellery Ames

PETER ALSTONE

Hi ERE folks! I am happy to introduce myself to you as a new professor in the department, and for some of you this is a re-introduction, because this is my second round of new beginnings at Humboldt State. Back in 2005, I moved from North Carolina to Arcata to study what was then a new research area for me: clean energy systems. By then, I had already completed a bachelor's degree (from North Carolina State in Chemical Engineering), and at HSU I worked toward a masters in Environmental Systems with an Engineering Option.

I had a great experience during my time as a graduate student. I got to help build up the Renewable Energy Student Union (among other things, I designed the logo), got involved at the Schatz Energy Research Center (SERC) with a range of research projects, and had the opportunity to teach a few courses as a lecturer in ERE. Even more, I met my future wife, Andrea, who was a fellow student in the Environmental Systems program, which was a big bonus! After we both finished our degrees, we worked as staff members at SERC for several years. During those years, I worked on

a whole range of interesting projects, from solar hydrogen control systems to research on off-grid lighting systems in the developing world. Also, at that point in time, Andrea and I had our first child, and life was good.

By 2012 I had made the decision that I wanted a career in University-level teaching and research. I moved to the SF Bay area with my family and started a PhD program in Energy and Resources at UC Berkeley. My graduate group at Berkeley was interdisciplinary, which brought together scholars with training in Engineering, Economics, History, Art, Computer Science, and everything between. I focused my research on the intersections between information technology and clean energy development using the example of off-grid solar electricity in the developing world to motivate and ground the work. My dissertation describes how I approached the subject from multiple angles using engineering to get into the details of fast-evolving solar, battery, and LED lighting technology, doing economic and geographic field work in Kenya to understand how people beyond the margins of the electricity grid are able to access power, and developing new data analysis techniques for the large datasets that are now available from cellular-connected off-grid solar systems being sold by the thousands.

After my PhD, I worked for a year as a post-doctoral fellow at Lawrence Berkeley National Laboratory on a different application of information technology for next-generation energy systems: advanced Demand Response (DR). In broad terms, DR refers to having connectivity built into the control systems of buildings, factories, and appliances that have some flexibility in their load. When there are needs to change the demand, for example when peak loads are high and there is danger of not having sufficient generation capacity ready to go, DR lets the grid operator make adjustments to loads and keep the grid stable.

Peter Alstone and Commissioner Mike Florio of the California Public Utilities Commission at a White House event in June 2016, promoting Smart Markets and Energy Storage for Renewables Integration. Dr. Alstone was an invited round table participant at the event.

In California, where we are installing renewable electricity at an unprecedented pace, the need for flexibility on the power system is accelerating and changing. The project I worked on for my post-doc is a first-of-its-kind DR potential study that is funded by the California Public Utilities Commission (CPUC). They are the regulator for the electricity sector in California and are in charge of setting the rules that let new technology systems such as DR either thrive or fail. The results of the study will be released in late 2016, and will help the CPUC reform DR policy for a renewable energy future.

When I saw the job posting for the ERE department in fall of 2015, I had to apply! I feel very fortunate to have the opportunity to come back and teach where I had such a good experience as a student. My new position at HSU is unique; it is a teaching job that also has a research component, so in addition to being an Assistant Professor, I am also a Faculty Scientist at SERC. Currently, I am teaching ENGR 322, where I am working to build in some new analysis tools and techniques I've learned since I left HSU.

In spring 2017, I will teach ENGR 473 (Building Energy Analysis), which I taught or co-taught several times in my first stint at HSU, and I'm excited to bring a fresh look to the material. I'm looking forward to incorporating what I've learned about off-grid solar and DR in the last few years into my teaching. On the research side, I am continuing to work on both the "next generation grid" and off-grid solar electricity, and I expect to find new research avenues as I build collaboration with old and new colleagues at HSU and SERC.

Before I moved to California, I lived on the East Coast, mostly in North Carolina. Growing up in the "big city" of Charlotte (or at least it felt big at the time), I escaped to the mountains or beaches as often as I could. Roaming through the creeks, valleys, and dunes helped me develop an ethic of environmental responsibility and stewardship that I am trying to carry through in my career. I feel lucky to get to live in Humboldt County again, where it is so easy to reconnect with the natural world and beautiful places with even bigger forests and beaches than those I grew up with. I hope to meet many of you in the coming weeks and months in class, in the lab, and on the trail! Ω

Dams and Dam Removal

An Introduction

by Steve Romero, PE (ERE 1996)
Regional Geotechnical, Dams, and Dams Safety Engineer
USDA, Forest Service, Pacific SW Region 5, Vallejo, California

The following is a brief, but balanced, discussion of dams, including: types, roles in our society, ecological aspects, and factors that drive a dam removal.

What is a dam?

There are many types of dams or impoundments existing today, including (but are not limited to) water, agricultural waste, coal waste, hazardous waste, tailings, and debris. These names refer to the type of material retained by the dam. Dams/impoundments retain or convey single phase or two phase materials. For this discussion, single phase materials are defined as any liquid; whereas, two phase materials are liquid during transport while transitioning to solid during deposition.

Over the years I have had the fortune (or misfortune) of working on all the various types of dams/impoundments, each being designed for the material it retains. For this discussion we will focus on single phase dams that retain water.

Water Dams

Details and Societal Benefits

There are more than 80,000 dams tracked in the National Inventory of Dams (NID) database that is maintained by the Army Corps of Engineers. To be included in this database, a dam must meet at least one of the following criteria:

- High hazard classification: the loss of one human life is likely if the dam fails
- Significant hazard classification: the possible loss of human life and likely significant property or environmental destruction
- Height equal to or exceeds 25 feet and storage exceeds 15 acre-feet
- Storage equal to or exceeds 50 acre-feet and height exceeds 6 feet

Additionally, there are hundreds of thousands of dams that don't meet this definition. The majority of these are water dams, and on average they exceed 50 years in age, the design life of most dams.

Among these dams are a number of older (greater than 75 years) water dams that were constructed prior to the established engineering design philosophies and construction controls used today. Most are historic and were built for agricultural or municipal water supplies. Due to replacement cost and regulatory environment, most agencies that own such dams are opting to rehabilitate or remove rather than replace them. Though difficult to estimate due to varying definitions of rehabilitation and removal, rehabs appear to outnumber removals by a factor of at least 3 to 1 for larger dams. That trend extends to the overall dam inventory.

Larger, high-head, water dams are multifunctional in use. This functionality includes aspects of four broad categories:

- Flood control
- Water supply – municipal or irrigation
- Hydropower generation
- Recreation

Many of you have drunk the water stored behind such dams, used the electricity generated by them, recreated on lakes impounded by them, and consumed the food grown using water from them without knowing or fundamentally understanding where or how that water, food, electricity, or parasailing opportunity was made available.

For example, when you think of a dam you probably think of something like Hoover Dam or Shasta Dam, shown in Figure 1. Both of these dams are multifunctional, providing water, power, flood control, and recreation to communities and agricultural interests downstream and adjacent to them.

A variety of factors drove the construction of these particular dams and many like them during FDR's New Deal era, but ecologic health of the associated watersheds was likely a relatively minor factor considered during the planning of such dams. Both Hoover Dam and Shasta Dam completely cut off aquatic organism passage (AOP), which leads us to our next discussion.

Ecological Detriments

When considering ecological issues and impacts associated with dams, AOP is a major consideration. A good way to examine this is to look at the Pacific Power dams: Iron Gate, Copco 1, Copco 2, and J.C. Boyle, located on the Klamath River around the eastern California-Oregon border.

These dams cut off access to historic spawning grounds for Steelhead, Coho Salmon, and Chinook Salmon and are, therefore, responsible for a significant reduction if not the elimination of productive Salmon ecosystems. This has unfortunately occurred on many of the major rivers in the United States.

Other detriments associated with dams include poor water quality of

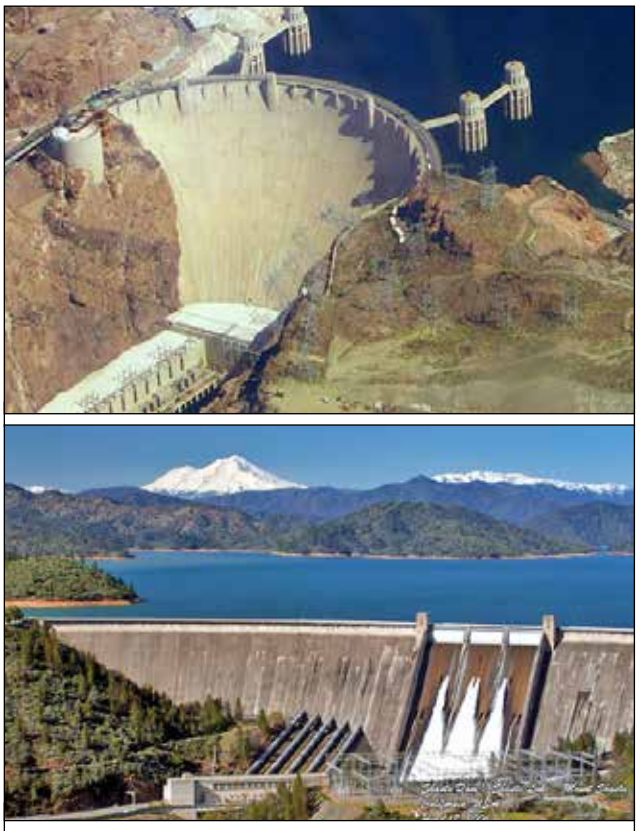


Figure 1. Top: Hoover Dam, Nevada/Ariz border
Bottom: Shasta Lake Dam, California
Courtesy U.S. Bureau of Reclamation

discharged water due to unnatural thermal and dissolved oxygen (DO) conditions. This is because water is usually taken from the lower portion of a lake, where thermal conditions can be near freezing and devoid of DO – anaerobic, in otherwords. High biological oxygen demand (BOD) can also play a role in depleting DO levels, especially in low elevation, low head dams backing up shallow lakes with high concetrations of decomposing organics.

Many larger dams have been fitted with multi-level intakes to address the thermal and DO issues with their discharges. Most water releases from smaller dams occur over their spillways, but late season flows, albeit small relative to the overall seasonal watershed hydrograph, still originate from the lowest point on the upstream side of the dam.

Another issue involves trapped sediments that build up behind a dam over the years. Rates of sedimentation are increasing due to ever-shorter wildfire recurrence intervals, especially in the west. Wildfires typically result in significant increases in stream sedimentation, which can completely inundate streams and spawning grounds in upper watershed tributaries. The sediment is eventually transported to and retained in reservoirs downstream.

The retention of sediments in the reservoir also inhibits beach productions downstream essential for spawning. Heavy metals can also be retained in these sediments, especially if mining activity occures in the watershed above the dam.

Dams, especially high head dams, can eliminate or significantly attentuate the peak flows of a flood hydrograph, and the annual flushing and cleaning of the river system may cease or be significantly attenuated downstream of the dam. Recognizing the issue and impact on river ecology, many high-head dams have begun operating in a manner that, up to a point, mimics these historic flood hydrographs. Since populations downstream of many dams encroach upon, or are in the 100-year flood plane (many states exclude development within this flood plane), the peak flow is typically well below the 100-year flood where populations are at risk.

Ecological Benefits

For many environmentalists the word 'dams' is a four-letter word, and for them, all dams are automatically lumped into a bin labeled 'ecological destruction." In many respects, their views are valid from an aquatic organism perspective, but we must take care not to let a relatively unscientific approach to watershed management drive the National Environmental Policy Act (NEPA) process. The truth is, some dams may have a net benefit on watershed ecology, especially when a long-term view is taken and the effects of climate change are factored in.

Many dams serve or have the potential to serve a sustaining and protective role in our environment. In fact, there is real potential for a substantial increase in the construction and repurposing of dams as climate change progresses. The primary ecological benefits are:

- open water for migrating birds
- ecological restoration
- late season water source in streams impacted by climate change
- isolation of invasive species

The fact is, many dams have been created and/or are maintained for ecological benefits. Most of these have large surface-to-volume ratios, and wind-driven waves promote mixing and diffusion for higher DO concentrations.

Another example of a potentially beneficial dam is the long-maligned high-mountain/elevation dam created primarily for agricultural irrigation. Many are contained within wilderness areas created decades after the construction of the dams. Most are low-head historic structures, and due to their high elevation, most have low average temperatures, which increases oxygen solubility at their surface. All can provide, or have provided, late summer flows downstream. The residual benefit of these late summer flows is that they can be life sustaining to AO in once perennial streams impacted by severe drought.

These high elevation, low-head dams are typically located at the headwaters of their watersheds. The watersheds behind these types of dams are primarily bedrock, which equates to very low sedimentation rates and low BOD. They trap a relatively small amount of runoff (300 to 1000 acre

feet) and provide as much as two months of flowing water to streams downslope. Most have natural occuring AO barriers (waterfalls, extremely steep slopes, etc.) downstream of there location which mean the dams themselves are beyond the reach of migrating fish. Streams within the watersheds in which these dams are contained are currently or projected to be impacted by drought.

The majority of dams owned by the US Forest Service in California fall into these three categories: late season water source, ecological restoration, or wetlands for migratory birds. Most are contained in areas affected by drought as shown in Figure 2.

The Decision to Remove a Dam

Now that we have covered the various functions, detriments, and potential benefits of dams, let's move on to the discussion of dam removal. If you are interested in the topic of dam removal, you may be familiar with the discussion around the Pacific Power dams on the Klamath River. Many of the aforementioned ecological detriments as well as benefits are associated with these dams. All are barriers to AOP, cutting off access to historic spawning grounds for Steelhead, Chinook salmon, and Coho salmon. From an ecological health perspective the problems and solutions for these dams may seem relatively straight forward; however, the cost for their removal is currently estimated at half a billion dollars.

Most dam removals involve a complex array of competing issues including stakeholders for and against. Removals also raise a host of environmental concerns.

Stakeholders who generally advocate for dam removal can flip flop on the issue when a removal is proposed for a dam that impounds a lake that they personally utilize.

The cost of removing the dam structure can be a relatively small part of the total cost if significant sediments have been deposited behind the structure. Cost escalates exponentially if those sediments contain heavy metals from mining operations upstream of the dam.

I have removed a number of dams over the years, and in my experience, the most difficult aspect for the engineer is litigation associated with the removal. All significant removals I have been involved with occurred due to the unacceptably high level of risk the dam posed to human populations or the downstream environment. Characterizing risk, as utilized in dam safety, is accomplished either qualitatively with assessments by experienced engineers or quantitatively through a reliability and consequence study. It is these analyses that are typically scrutinized if a proposed removal is litigated when risk is the primary driver for removal.

Experience with the Pacific Power dams demonstrates that removals can take years and even decades to accomplish, and cost is typically the limiting factor. As an example, Mike Horse

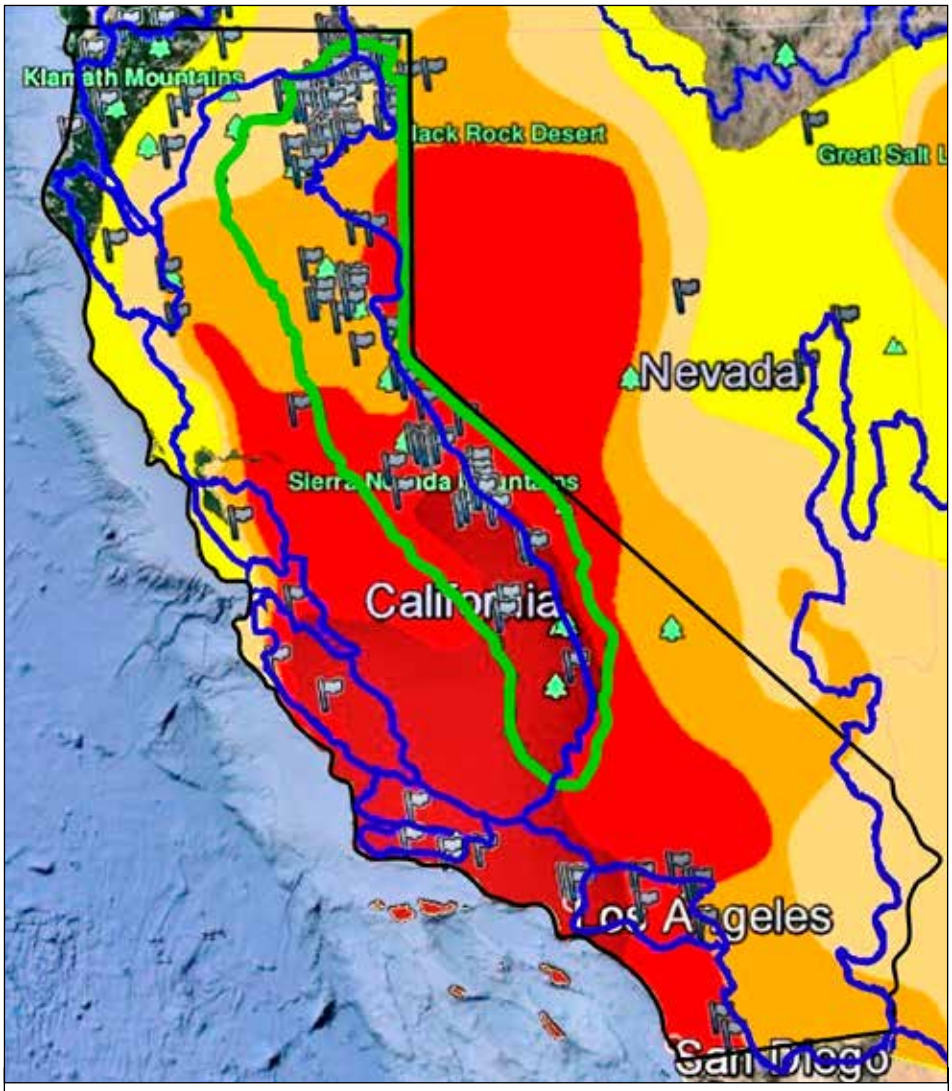


Figure 2. U.S. Forest Service dams and their proximity to watershed boundaries within drought-impacted areas of California. Dams in the northern portion of the state were constructed primarily to support migratory birds. Flags indicate Forest Service water dams. Green line deliniates boundary of Sierra Nevada mountain range. Blue lines indicate major watershed boundaries. Darker shades of red/orange indicate higher drought severity. *Courtesy U.S. Forest Service*

dam in Montana, a dam removal project I was involved with, took 10 years and $35 million to accomplish from the time the decision was made to remove it. See Figure 3. You can watch a time-lapse video of the removal of the Mike Horse impoundment at https://www.youtube.com/watch?v=N8gc9LZh1pE.

Cost is typically a function of the dam size, but even smaller dams can be relatively complex and costly to remove. An example is a dam 'removal' I was involved with in the 1990s in eastern Kentucky. The dam was a 25-foot tall coal refuse dam that had partially failed due to a rusted outfall pipe (a common failure mode), which caused the front half of the dam to slide or erode away. The impoundment was approximately two thirds full with coal waste, with water the rest of the way up to the outlet pipe. Homes were located just downstream. The emergency remediation involved a partial removal of the dam down to the sediment line and the construction of a rock dam/buttress on the downstream face to prevent catastrophic failure. The cost of the work was approximately half a million dollars (about $750,000 today). The bulk of the cost resulted from difficulties associated with limited access.

Another project currently underway in southern California involves the removal of 72 small check dams, each 2 to 12 feet in height. The primary driver for cost on stream restoration projects is access, since many of the dams are located in areas of steep terrain. Because of the limited access, blasting and hand labor will be used to remove the majority of the dams. For this project funding is coming from several sources including federal, state, and local, yet the sheer magnitude and scope of the project requires a phased removal as funding becomes available.

You can watch an interesting video of a dam removal (Marmot Dam in Oregon) involving a "wet breach," at https://www.youtube.com/watch?v=i1NI2ia3nDw. Take care, however, that you don't think sediment retained by a dam (naturally occurring or not) can be allowed to simply wash downstream for every dam removal project. Channel gradient, head, volume of material retained, type of material retained, gradation of material retained, population at risk downstream, AO, and a host of other issues would come into play when that option is considered.

Figure 3. Mike Horse Dam, Montana. Top: Prior to removal. Bottom: During removal.
Courtesy U.S. Forest Service and Montana Department of Environmental Quality

Concluding Remarks

My hope with this short discussion on dams is that, as you transition from college to your careers, you adopt a forward-looking and balanced perspective on watershed health. Climate-driven issues will require some out-of-the-box solutions that may not align with deeply-held beliefs. Global watershed issues, relative position of a dam in the watershed, net detriments/benefits, lifecycle cost/benefit including cost to replace/remove, and a host of other issues come into play during new dam planning, replacement, or removal studies.

Two issues that will undoubtedly determine the fate of many dams during your careers are: effects of climate change and constrained or declining budgets.

As an engineer, your job is to apply science and math to solve problems in a practical way for the benefit of your client and society. You must understand the objectives, not just the emotions, that lead to practical solutions for resource-driven alternatives. Ω

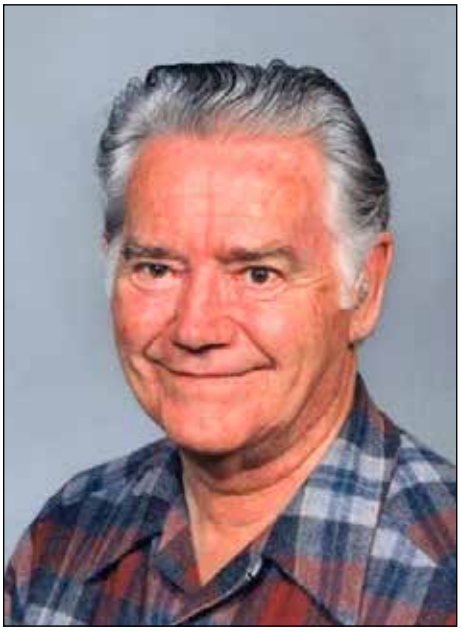
In Memoriam

HSU CE and ERE Founding Faculty Member

Charles Milton "Jim" Roscoe

1923 –2016

by the family of Jim Roscoe



Charles Milton "Jim" Roscoe passed away peacefully on October 13, 2016 in Eureka, California at age 93. Born January 18, 1923 to Stanley Boughton Roscoe and Martha Emma Beer Roscoe, Jim began his life on the family ranch in the Mattole Valley before moving to Eureka in 1928 to attend school.

A love for learning was clear throughout Jim's life, both as a dedicated student and committed university professor. From Eureka High School, graduating co-valedictorian, he attended Humboldt State until his enlistment in the V-12 Navy College Training Program. There, he transferred to the University of Oklahoma, where he earned his Bachelor's Degree in Civil Engineering. He attended Officer Candidate School and received his commission as Ensign, assigned to the Naval Civil Engineers' Corp (the Seabees). He proudly served his country designing projects in the Western Pacific Theater, notably the radar tower that replaced the famous flag raised by the marines on the top of Mount Suribachi on Iwo Jima. Upon honorable discharge he continued his education, completing his Master's Degree in Civil Engineering at Stanford University.

On August 29, 1948 Jim and Mary Patricia Gross were married. They shared 35 wonderful years until her untimely loss to cancer in 1984. Together they raised three sons, Jamie, Rob and Tom, and were giving, supporting and loving parents**.** They shared with their sons a love of camping and the outdoors**,** music, theater and time spent with friends.

Jim was blessed to spend the last 15 years of his life in the loving company of Doris Mullen of Kneeland. Together they enjoyed travel, music, crossword puzzles, a good game of cards and laughter-filled Sunday family brunches.

While Jim enjoyed working in both public and private sectors, including his private practice, as a highway engineer for Caltrans, and as City Engineer for Arcata, his true passion was teaching. For more than 25 years (1957-83), Jim shared his passion with his Humboldt State students, including organizing the original Civil Engineering degree program and overseeing its accreditation in 1960. After a one-year sabbatical at UC Davis in the early 1970's, Jim was instrumental in transforming the Civil Engineering program into the current Environmental Resources Engineering program, one of the earliest in the nation. The Engineering Materials Laboratory at HSU is named in his honor, and the Roscoe-Schenler scholarship supports promising future Environmental Engineers.

In the 1960s Jim partnered with his long-time friend Earl Biehn, and as part of their development in Bayside, Jim designed, and together they built, the covered bridge on Brookwood Drive, which qualifies for listing on the National Register of Historic Places for its local significance.

Jim enjoyed the challenges of land surveying, which he continued into his late 80s, including monument restoration work with Mike O'Hearn in the Mattole Valley, an area dear to Jim's heart, and where he maintained a home throughout his life. Named Surveyor of the Year by the California Land Surveyors Association in 2006 at age 83, he took pride in resolving thorny discrepancies in previous surveys. His civic contribution included many years on the Humboldt County Building Department Board of Appeals.

Jim was a lifelong lover of music. He sang with the HSU a cappella choir, the Humboldt Harmonaires and the Redwood Chorale, participating in several overseas tours. He had a keen wit and enjoyed wordplay of all manner; puns and limericks were his playground. He was a man of integrity, with a strong moral compass.

Jim was a generous, loving man who delighted in bringing joy to others and did so daily. He always had a kind word and a welcoming smile, and he could find a learning opportunity in any situation. Jim would light up a room with a song on his lips and a twinkle in his eye. He will be greatly missed.

A celebration of Jim's life was held on November 5, 2016 at the Bayside Grange Hall in Bayside. In lieu of flowers, the family wishes any remembrances be made to the Roscoe-Schenler Engineering Scholarship Fund at HSU. Ω

ERE Clubs Information Board

Compiled by Jax Gill, ERE Senior

Organization	Fall 2016 Activities	Spring 2017 Planned Activities
ERE Student Association (ERESA) **Email:** *eresa@humboldt.edu* **Temporary Webpage:** *http://tinyurl.com/HSUERESA*	• ERE coffee table • Welcome Back Pizza • All Clubs meetings • ASCE Pizza with Professionals • New officer elections • Fall Follies (Thurs before Thanksgiving) • Presentations by professionals • Locker raffle	• ASCE Leadership Conference • ASCE Wastewater Treatment Comp • Mock interviews at local firms • ERE rafting trip • Ice Cream Social • ASCE ERE Awards Banquet • ASCE Order of the Ring Ceremony • ERE graduation reception • Locker raffle
Engineers Without Borders (EWB) **Email:** *humboldtewb@gmail.com* **Webpage:** *Updated URL coming soon*	• West Coast and Mountain Region Conference in Las Vegas • Begin domestic sanitation project with Affordable Homeless Housing Alternatives (AHHA) in Eureka • Hospital Well water project in Camoapa, Nicaragua with the North Coast Professional Chapter (NCPC) • Sanitation project in La Manzanilla, Mexico with NCPC	• Assessment trip to La Manzanilla, Mexico with NCPC • Sanitation project with AHHA • Begin domestic water treatment project with United Indian Health Services (UIHS) for the Yurok tribe • Begin an international program • Assist with the NCPC Homebrew Festival fundraiser for projects
Renewable Energy Student Union (RESU) **Email:** *resu@humboldt.edu* **Webpage:** *www2.humboldt.edu/resu/*	• Planning for Spring 17' RESU Reunion • Update the HSU Solar Radiation Monitoring Station (SoRMS) Document. • Support the Race to Net Zero team • Solar panel testing with Jacob Rada • Build an Arduino controlled RESU banner	• RESU Reunion • Race to Net Zero Competition • Build smoothie bike blender • HSU Solar Radiation Monitoring Station • Fundraising TBD
Society of Women Engineers (SWE) **Email:** *swe@humboldt.edu* **Webpage:** *hsu.swe.org*	• Internship application / resume building workshop • SWEshi • Societal Conference in Philadelphia • Engineering Fest	• Girl Scout Day • SWE Social • 2017 SWE Regional Conf in San Jose • Blue Lake Middle School Outreach Community Project – TBD • Mentoring Program with professional SWE members • Regional Leadership Summit
Society of Hispanic Professional Engineers (SHPE) **Email:** *shpe@humboldt.edu* **Webpage:** *https://www.facebook.com/shpe.hsu/*	• ERE Drop-In Tutoring sessions • Celebración de Independencia fundraising event • Día de Los Muertos Alter Making & Potluck Celebration • SHPE National Conference in Seattle • 5-Year course planning	• ERE Drop-In Tutoring sessions • Celebración Latin@ fundraising event • SHPE Regional Conference in Oregon • Graduation Party • 5-year course planning

In Memoriam

Nicholas Colton Anderson

1991–2016

by Richela Maeda, ERE Graduate Student

Last spring we lost recent ERE graduate Nicholas Anderson. Nick graduated in Spring 2015. He focused his studies on water resources and management, and did so with dedication and passion. He was always eager to learn, and to help others whenever he could.

Nick was an enthusiastic member of the ERE community. He also played on the HSU rugby team. On weekends, when not studying, Nick rode his dirt bike, played guitar and piano, and spent time with his friends and family. He explored the many opportunities life offered him.

Born and raised in Southern Humboldt, Nick had an amazing community of family and friends, and he always welcomed new people into his life. Nick was often reserved and quiet, and he didn't seek attention, but his warm heart and sense of humor attracted others from all walks of life.

After graduating, Nick explored water-related job opportunities in the area. He was training with the Briceland Water District to become an operator and was interested in learning about ways to help his local community with the changes in water practices that they are currently experiencing. His love for Humboldt County filled him with the desire to give back to the community and environment that he came from.

The last two years of Nick's life brought with them two very serious difficulties: he lost his step-dad and he developed a seizure disorder that would ultimately end his life. Despite these challenges, Nick worked hard and completed the ERE program with a smile on his face. As he had always done, Nick was able to look beyond the hardships and maintain a grateful, positive attitude. In the last months of his life, he was working to rebuild a strong relationship with his loving mother and was ready to begin a career in environmental engineering.

Although the loss of Nick feels sad and all too abrubt, he had an amazing and happy life filled with people who cherished him. He reminded us that while working hard is important, enjoying life, being silly, and having meaningful relationships are the real treasures of life. Ω

Día de los Muertos

Remembering Our Loved Ones Through Tradition

by Tanya Garcia, ERE Junior

This year marks the second annual ERE Día de los Muertos hosted by the Society of Hispanic Professional Engineers (SHPE) as part of its mission to bring Latinx culture to the Humboldt community. Día de los Muertos (Day of the Dead) is an Aztec celebration that dates back more than three thousand years. It is founded on the belief that, in the fall, the spirits can visit the living, especially on November 1st, Día de los Angelitos (Little Angels) and November 2nd, Día de los Muertos. It is a tradition of honoring lost loved ones that is celebrated throughout the Latinx community by creating altars containing photos of lost loves, their favorite food, candles, fresh flowers, sugar skulls and any items that reflect that person's joy, life, and personality. It is a joyous celebration of the lives of our loved ones that have passed, where we offer them their favorite earthly desires so that they are happy during their visit back to the living world. SHPE hopes that the bright warm colors of the altar remind us to appreciate life and all our loved ones, alive and past. We welcome everyone to participate next year with their own altars. Ω