OFFICIAL PUBLICATION OF THE AMERICAN SOCIETY OF MINING AND RECLAMATION

reclamation matters

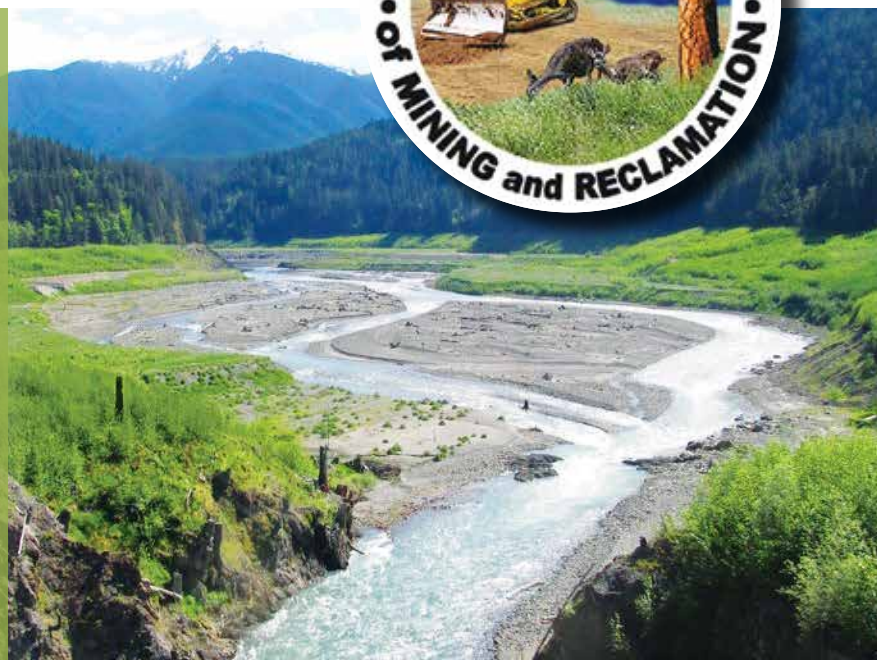
Fall 2018

Elwha River Restoration

Mitigation Banks in Mine Permitting and Reclamation

The Flight 93 National Memorial Reforestation Project

Highlights of the 2018 ASMR St. Louis Conference



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is published by
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DEL Communications Inc.

PRINTED IN CANADA | 09/2018

Message from the President

By Gwen Geidel, University of South Carolina

It has been a pleasure to work with Kim Vories, ASMR's Past President, this last year, and I look forward to building on his foundation as well as that from recent past presidents Pete Stahl and Brenda Schladweiler. I also look forward to working with our newly elected ASMR National Executive Committee (NEC) members: Michelle Coleman, Hannah Angel, and Dustin Wasley, as well as our new President-Elect Kevin Harvey.

I would also like to recognize Ed Janak, Sarah Flath and Cindy Adams, our outgoing NEC members, for their dedication to the ASMR organization and their expert advice during the past two years.

One of the issues that the NEC and I will continue to address this year is recognizing and building on the expanding role of our members in reclamation, restoration, reforestation, and rehabilitation in a variety of land disturbance settings (which I will generally refer to as "reclamation"). With our increasing ability to change, move and impact the Earth's surface, so too have we increased our ability to become better stewards of the earth and enhance our reclamation abilities in all fields from vegetation to soil to water management. While many of us began this work with the mining industry and have witnessed the tremendous strides and improvements in reclamation and mining since ASMR's beginnings, as coal mining was at the forefront of reclamation efforts, this knowledge has expanded to solving issues in a vast array of disturbed settings from man-made to natural disturbances.

While our expertise has grown, our ASMR membership has not. Therefore, now is the time to evaluate our society and explore how we can best meet our purpose and objectives (https://www.asmr.us/About-ASMR/By-Laws), which include encouraging and assisting others working "in efforts to reestablish, enhance, or protect our natural resources disturbed by mining or other human activities, or by disturbance through natural events." To accomplish this, the NEC is drafting a strategic plan to build on our reclamation and mining history, yet consider ASMR's path forward to continue to meet our purpose and our expanding areas of expertise.

While ASMR has been historically tied to the coal sector, our reclamation efforts rapidly expanded and built on that knowledge. We embrace the new generation of companies, individuals, and agencies that have become stewards of the land, water, and air. We recognize that these professionals have expanded into a variety of areas where these skills and knowledge are imperative to improve, maintain, reclaim and restore the valuable lands with which we work.

Will mining continue to be a part of this effort? Absolutely. The 2017 DOE report (DOE, Staff Report on Electricity Markets and Reliability, Aug 2017) and recent data from the US Energy Information Agency (www.eia.gov) indicate that coal will continue to be a part of the U.S. power supply, albeit at lower percentages than in the past (having dropped from about 52 percent of the electric generation source fuel to about 30 percent in the last 15 years). Coal will continue to be mined even as coal-fired power plants are retired from the electric grid and reclamation of past and present mines is critical. But most sources of electric generation also require reclamation or stewardship; whether natural gas fracking pads or land beneath the vast solar arrays. And as indicated above, energy is only one sector of our economy where stewardship and reclamation are essential. Considering the percentage of land that has been disturbed for urban, commercial, governmental or personal use, ASMR's continued efforts are important.

As we know, effective reclamation maintains ground and surface water quality and ensures that existing and new soils will retain value. Our by-laws mandate that we share this knowledge, therefore, we continue to explore ways to share this knowledge and to learn from even more professionals in this field as we promote sustainable reclamation and restoration of disturbed sites. I am confident that as we all strive to be stewards of the earth that this ambition will assist us with meeting these goals.

I look forward to this coming year and welcome your thoughts, comments or suggestions. geidel@sc.edu ■

I'm Still Listening

By Jeff Skousen, West Virginia University

"You should take this range ecology class," my friend Craig told me in 1977 when we were students at Brigham Young University. "You'll like it." Little did I know at the time that listening to Craig's voice and, more importantly, taking action would be a life-changing event. I took the class and enjoyed it, which resulted in my changing majors from Accounting to Range and Soil Sciences. And this began my life-long journey in learning more and more about soils, plants, and environmental sciences, which eventually directed me to land and water reclamation. I've been researching, working, consulting, and teaching in the natural resource sciences for 35 years.

I've found that these voices, when I listen, have had remarkable influences on the direction of my life and career. No matter the source of the voice, whether it is loud or soft, rationale or insane, I've tried to listen and follow the voices that ring clear and inspire me. Here are a few more examples of these voices.

"A part-time position is available at the US Forest Service Shrub Sciences Laboratory." In one of my range science classes in college, my professor made this announcement. I listened and acted. I immediately went to the lab and met Jim Davis, who hired me on the spot. I worked for three years with Jim during my undergraduate and MS degrees. He helped me immensely with encouragement and advice throughout my years at BYU.

"Have you considered getting a PhD?" was a loud and clear voice from Jim Davis, my boss. Listening to him caused me to reflect on the idea, which resulted in my attending Texas A&M and earning that PhD degree.

"I think you'd be a good fit at West Virginia University." This voice from John Sencindiver largely settled the question of my accepting a faculty position at West Virginia University. By listening to that reassurance, I moved forward into an academic profession rather than accepting a position in industry.

"Will you consider hosting the 1990 ASMR meeting in West Virginia?" The voice was Bill Plass. I was a new member of ASMR and I never would have imagined that someone as inexperienced as me could organize and lead such a conference. Coordinating the meeting allowed me to meet and interact with a new cast of characters in the mining and reclamation industry in the US, as well as members of ASMR. Listening to Bill initiated my active involvement with ASMR, which led to the development of lifelong friendships with many ASMR members. Since then, I have been the ASMR president twice, hosted and coordinated three joint meetings with ASMR and other organizations, published extensively in ASMR proceedings and journals, and have served as the Reclamation Matters editor for 15 years.

"I'd like to introduce you to some of my friends in China." Quiyun Sun invited me to go to China in 1998, and because I listened, we spent 18 days traveling throughout the coal mining region, and meeting and greeting his friends in the Chinese coal industry. Since that initial trip, I have visited many more times and established lasting friendships and collaborations.

These are just a few examples of voices that changed my life. Voices still inspire me to act. Listening to them stimulates me to reflect on things I wouldn't have imagined myself. Sometimes the voices are external, some internal, and some from inspiration.

Can you remember the voices that excited you and caused you to act?

Do you have a voice that can inspire others?

I'm still listening. ■

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Wild Women of Reclamation
St. Louis, Missouri 2018

The sixth gathering of Wild Women of Reclamation (WWR) occurred in St. Louis at the 35th ASMR Annual Meeting on June 4, 2018. Women in all stages of their careers gathered to have breakfast, network, create mentoring opportunities, discuss experiences, and most importantly, have fun together. We enjoyed presentations by Summer King, an Environmental Scientist for the Quapaw Tribe of Oklahoma, and Jennifer Franklin, an associate professor at University of Tennessee. The goal of the gathering is camaraderie and to have a discussion of common experiences, sometimes unique as women, in the pursuit of better reclamation. This affiliation is also a tool we can use to empower women to have confidence in our abilities, advance in our careers, mentor the future generation of professionals, and improve the lives of everyone through our interactions.

Wild Women of Reclamation also puts together an email newsletter several times throughout the year. The newsletter highlights what members of the group have been doing including updates on research projects of students, cool projects we are involved in at work, and to exchange other information. If you are interested in sharing/writing an article for the Wild Women of Reclamation newsletter, please email Michelle and Cindy (emails are below). We would love to hear from you and what you've been up to.

Jennifer and Summer have provided short summaries of what they presented at our breakfast. We appreciate Jennifer and Summer's willingness to share their experiences and journeys on how they came into the field of reclamation and how the relationships at ASMR have helped shape their careers. If you were like me and missed the breakfast, these summaries will provide a glimpse of what was missed and a reminder for those who attended.

Front row, left to right: *Jenni Kane, Michele Valkanas, Cassie Phillips, Stephanie Jean, Mehgan Blair, Michele Coleman, Brenda Schladweiler.* ***Standing row:*** *Gwen Geidel, Briana Mayfield, Jennifer Buss, Jennifer Franklin, Sara Klopf, Hannah Angel, Zenah Ordorff, Summer King, Lindsay Shafer, Rebecca Steinberg, Natalie Kruse-Daniels (Wolfe), Jane Uglum, Dina Lopez, Amy Blyth, Amy Sikora, Nancy Trun, Taylor Wall, Zepei (Maggie) Tang.*

Summer's Summary

I was honored to be asked to present at the 2018 Wild Women of Reclamation breakfast by my mentor Michele Coleman. I am the Environmental Scientist for the Quapaw Tribe of Oklahoma, and my main duties involve the Tar Creek Superfund Site. While I am new to the reclamation world, I had a bit of a circuitous journey to get here. I began my college career as a meteorology major at the University of Oklahoma, changed majors and schools for several years, and ended in my hometown with an Environmental Management BS and Industrial Management MS from Northeastern State University. I worked for the United Keetoowah Band, a small Cherokee tribe in eastern Oklahoma, for 13 years before I had the amazing opportunity to work for the Quapaw Tribe in 2016. I now assist with the tribe's superfund remedial action work and liaise with local universities conducting field research at Tar Creek. You can contact me at sking@quapawtribe.com

Jennifer's Summary

As a child, I always loved the outdoors, particularly the long walks with my grandmother who taught me the names of all the plants that grew along the trails and roadsides. But after graduating from high school, I wasn't sure what I wanted to do for a living and spent three years in college in three different majors, none of which really suited me. Over the next 10 years, I met my husband, moved to British Columbia, had many interesting jobs and adventures, and

finally re-discovered my love of plants and the natural ecosystem around me. I returned to school and got my first degree in Botany, and I took every course in geology that I had a chance to. Finding that jobs for botanists at the BS level were few and far between, I decided that my passion was in the applied sciences and continued my education, this time in forestry at the University of Alberta. My research project was the reforestation of tailings in the Athabasca oil sands, and I attended my first ASMR meeting in Albuquerque, New Mexico in 2001, where I presented my research results. In 2002, I landed a faculty position in the University of Tennessee and have been there since, teaching and conducting mine reclamation research. I have been an active member of ASMR since 2003, and the support and friendship of my ASMR colleagues has meant a great deal to me over the years. Thanks go to all my old and new friends, and I look forward to seeing you all next year! You can contact Jennifer at jafranklin@utk.edu.

Both women took a meandering path to the field of reclamation, which is just part of the journey. Some women know exactly what they want to do in college, while others take longer to discover their career path. Each path is different. I look forward to hearing and/or reading more about other stories on how you ended up in the career you are in now and your life and education experiences that got you to where you are today. Thanks to all who attended the Wild Women of Reclamation breakfast and those who have submitted articles to our newsletter.

Remember to follow up with your mentors and mentees whether you connected with a new one at this meeting or past meetings. Mentoring is a great way to form friendships and learn about reclamation work being conducted in different parts of the U.S. and the world.

WWR is a group that provides mentorship and professional support for women in reclamation. WWR is open to any female who works in the field of reclamation, whether a practitioner, academic, consultant, service provider, in the natural resource industry or other. There are no fees, no forms and no formalities to join. Current co-chairs are Michele Coleman and Cindy Adams, and we can be reached at MColeman@nbpower.com and cindya@sgm-inc.com

So, fellow Wild Women of Reclamation, please join the WWR LinkedIn account by contacting Cindy and continue to share your stories of "worst days of work" and "lovely wildflowers." Also, let Michele or Cindy know if you have an article you'd like to share in the WWR Email Newsletter. If you have suggestions about improving networking and communications, please don't hesitate to contact us. We will see you at our next meeting in Big Sky, Montana in June 2019! ■

June 4th participants

Haulin' ASMR 2018

With ASMR 2018 in the rearview mirror, it's time to reflect upon the great early morning group that is Haulin' ASMR! Haulin' ASMR is catching on as a great way to see the host city of our annual conferences, meet new people, network about ideas, and get some exercise so that we have the stamina to make it through eight hours of stimulating presentations, followed by late nights with poster presentations and socials, dinners, and organization meetings.

With the hotel right next to the airport, on what turned out to be a very busy intersection, the Haulin' ASMR group had to be creative in coming up with a route to run over the week-long conference. The group steadfastly participated in World Environment Day on June 5 by "plogging."

June 6th participants

Plogging is a combination of jogging while picking up litter. It started as an organized activity in Sweden in 2016 and spread to other countries in 2018 following increased concern about plastic pollution. As a workout, it provides variation in body movements by adding bending, squatting and stretching to the main action of running.

Attendance varied each morning, based on who had presentations that day, or other commitments. Most mornings, between five and 10 participants arrived at the meeting sign. New faces were seen each morning as about 25 participants laced up their running shoes and made new connections while enjoying the cooler morning temperatures over the five-day conference. Participants this year included Michele Coleman, Clyde DeRossell, Dan Guy, Craig Kreman, Katie Little, Ryan Mahony, Buck Neely, and Brad Pinno.

We are excited to see what Big Sky has to offer next year in Montana! An invitation and running shoe reminder will be sent before the 2019 conference. Getting the reminder throughout the winter months is a good motivator for starting or keeping up with your training regime on those cold days.

We look forward to seeing everyone – and many new faces with running or walking shoes at Big Sky in 2019! ■

Mitigation Banks in Mine Permitting and Reclamation

By Heath Rushing and Nate Ober, Ecosystem Investment Partners, LLC, and Civil & Environmental Consultants, Inc.

Editor's note: A version of this article appeared in the magazine* Mining Engineering*, November 2017.

Mining companies need to be flexible and seize favorable market opportunities for their products. Therefore, many companies face the challenge of obtaining mining and environmental permits in a timely manner to capitalize on the prospects. Another challenge that often arises during mine design and planning is compensating for unavoidable impacts that the mine is anticipated to have on the natural environment. These two challenges can hinder mining companies from moving forward quickly and, all too often, the circumstances that were favorable when the project was proposed have become less favorable by the time all the permit requirements and approvals have been cleared. Therefore, most mining companies are interested in quicker ways to gain environmental permits, shorten timelines, and be more certain of obtaining the permits to carry out their next project. One increasingly popular way to do this is through a relatively new kind of service: the mitigation bank.

Mitigation banks typically purchase property or easements through property that were previously degraded and impacted by agricultural, industrial, or resource disturbance activities (Figures 1 and 2). The bank establishes a baseline of the degraded property, restores it to a functional environment with reclamation contractors, and then estimates the functional environmental uplift which produces credits.

Normally, the disturbed areas are reclaimed to restore streams and wetlands so that fish and aquatic organisms can survive, and to provide ecosystem services such as wildlife and riparian habitat (Figures 3 and 4). Appropriate native species of plants including trees and shrubs are planted, and steps may be taken to introduce wildlife to the new habitat. In some cases, a special focus is placed on creating habitat for rare and endangered species of plants or animals.

The reclaimed property is then inspected by regulatory authorities, coordinated through an Interagency Review Team (IRT). If the property is determined to be effective as natural habitat, the site is entered onto the list of mitigation bank properties and is allocated credits based on the functional environmental uplift of the chemical, biological, and physical conditions anticipated upon maturity of the site. These credits, held or owned

Figure 1. Vehicle traffic in the stream channel has led to extreme substrate embeddedness.

Figure 2. Erosion of stream banks and sediments have filled the stream substrate.

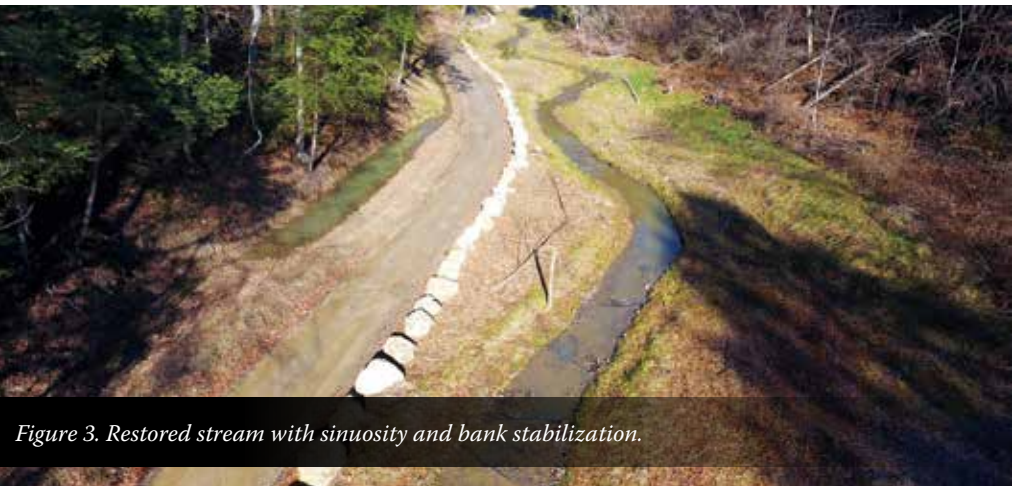


Figure 3. Restored stream with sinuosity and bank stabilization.

Figure 4. Restored stream with pools and riffles with accompanying riparian habitat.

by the mitigation bank, can then be sold to mining companies or other entities, who need "credits" when causing an unavoidable permitted environmental impact elsewhere.

For example, a mining company constructing an access road across a stream that may cause a permitted environmental impact would buy credits to offset the aquatic impacts to the stream as required by the Section 404 Clean Water Act permit that governs those unavoidable aquatic impacts. The mitigation bank used for offset credits must have an IRT-approved service area that includes the location of the impacts.

The mitigation bank is required to monitor the site(s) yearly to determine site reclamation success. Yearly monitoring reports are provided to the U.S. Army Corps of Engineers. In West Virginia, the protocol used for determining reclamation success or environmental uplift is called the West Virginia Stream and Wetland Valuation Metric.

Why Regulatory Authorities Prefer Mitigation Bank Credits

In many ways, mitigation banks offer advantages over the original do-it-yourself (permittee responsible) mitigation route, which would see the mining company creating its own credits and then seeking regulatory approval for those credits. The problems with do-it-yourself approaches include:

- Lengthier process – Creating offset credits can take years, often due to the need to provide eight or more years of site-specific data regarding species found in the area to be affected.
- Uncertainty in the process – Providing their own offset credits introduces uncertainty into the costs and timelines of the company's project, as the offset projects may be rejected by environmental inspectors/regulators.
- Continued responsibility – If a permittee does its own mitigation and it fails, that company is liable to re-do the mitigation, incurring expense and effort and more time.
- Regulatory pressure – Regulators may place very close (and time-consuming) scrutiny on any offset projects that the mining company creates itself.

By contrast, there are many advantages to working with mitigation banks. Regulators prefer to work with mitigation banks (or other In-Lieu Fee programs) because a contract called an Umbrella Mitigation Banking Instrument (UMBI) governs the terms and conditions of the project. For instance, the UMBI contains more than 20 items that must be described in the agreement, including: 1) service area definitions, 2) accounting procedures, 3) legal responsibilities, 4) reporting protocols, 5) goals and objectives, 6) maintenance requirements, 7) performance standards, and 8) credit release schedules. An instrument generally requires one or two years to receive approval. Here are additional advantages:

- Legal requirements – The 2008 Mitigation Rule, which agencies must follow, states that mitigation bank offset credits are the most preferred method of mitigation, and that the least preferred are mitigation steps for which the permittee (such as a mining company) is responsible.
- Time savings – Data from the U.S. Army Corps of Engineers' permitting database indicates that while it takes an average of 122 days to obtain a Clean Water Act permit using a mitigation bank, it takes an average of 237 days for mitigation done off site by the permittee to obtain the same permit.
- Cost savings – The fixed costs of restoration projects owned by the mitigation bank are spread out over many credits, reducing the price per credit. Buying credits saves up-front costs because the money is expended for a guaranteed product that has pre-met all regulatory compliance. Conversely, do-it-yourself mitigation

requires many up-front costs for an uncertain outcome.

- Liability transfer – Perpetual liability for the mitigation is transferred to the mitigation bank when a credit is purchased, while with permittee-responsible credits, the liability stays with the company causing the environmental impact.
- Focusing on your company's strengths – Using a mitigation bank means that the mining company can focus on what it does best – extracting mineral resources – rather than investing time and money in reclamation projects that may or may not meet their mitigation needs. By using a mitigation bank, the mining company is assured that the credits purchased represent approved natural habitat restoration by companies that specialize in land and water reclamation for environmental benefits.

Getting Good Results from Mitigation Banks

Select an appropriate bank

Your first step is to find a mitigation bank that meets your needs. Factors to consider include a bank that has:

- Credits in the same service area as your intended project (check with regulatory authorities to see if the credits available will be applicable to your project).
- A good track record of doing work that is considered acceptable by regulators and providing credits when and where they are needed.
- A healthy pipeline of projects that can be expected to produce credits which are available when you need them.

To find such a bank, it is best to start by asking for recommendations from colleagues. Environmental and engineering firms may be able to make recommendations, advise you on how to choose a mitigation bank, and work with it to achieve your objectives.

And check the Regulatory In-lieu Fee and Bank Information Tracking System (RIBITS) for information, an online resource developed by the U.S. Army Corps of Engineers with support from the EPA, the U.S. Fish and Wildlife Service, the Federal Highway Administration, and NOAA Fisheries.

Start early

Mining companies may want to put their focus on delineating an ore resource and developing their extraction plan early in the project development phase, rather than expending effort on mitigation and the holdups associated with environmental permitting. Therefore, having prior relationships with a mitigation bank could help to minimize the time and process to mitigate anticipated impacts.

Mitigation banks and mining companies have something in common: long planning horizons. It can take years from the start of exploration to putting the first load of coal or ore through the mill, and remediation and restoration of habitat can be similarly lengthy. This means that it is important for mining companies to consider forward-buying and reserving of credits several years into the future so that those credits will be available when needed.

Be prepared to shop around

While the credits themselves are a commodity, the price is variable. Some areas have many mitigation banks, driving down the price per credit; in others, scarcity pushes the price up. The price of the credits must be factored into the start-up costs for the mine, but those costs can be considered firm, unlike the costs of some commodities needed for mining.

Build a partnership

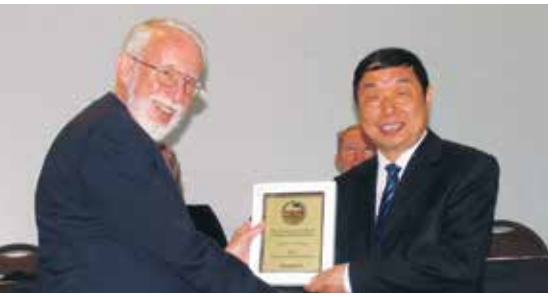
These long planning horizons mean that it is appropriate for the mining company to build a long-term relationship with a mitigation bank. This includes working with the bank to build good stakeholder relations. In addition, using a mitigation bank can also create good community relations. The newly-restored habitat near the mine may be made available to the public for uses such as hunting and fishing. The mitigation bank may have employed local contractors and companies to do the work including operators of heavy equipment as well as for crews to help vegetate the restored property. These jobs, and the economic spinoffs, are particularly valued in areas impacted by the scaling-back of the coal industry.

Mitigation banks, with more than a decade of experience and an increasingly strong track record, are a new tool for mining companies – a tool that holds promise for the future.

For more information, please contact the authors at:

https://ecosystempartners.com/

http://www.cecinc.com/ ■



Pioneer in Reclamation Award
Professor Zhenqi Hu

The Pioneer in Reclamation Award is presented to an individual who has had significant impact and influence in the field of land reclamation and environmental science relating to mined land reclamation over their entire career. Zhenqi Hu received his BE in mine surveying from China University of Mining and Technology (CUMT), Beijing, ME in mine surveying from CUMT, and his PhD in land reclamation from CUMT and Southern Illinois University-Carbondale.

Professor Hu's research and teaching in mined land reclamation spans his entire 28-year career. He is known as a pioneer of mine land reclamation in China and was the first PhD in the field of mine land reclamation in China. He is Professor, College of Geoscience Surveying Engineering, CUMT-Beijing; Director, Institute of Land Reclamation and Ecological Restoration; and Director, Engineering Research Center of Mining Environment and Ecological Safety, Ministry of Education, the Peoples Republic of China. His research includes subsidence land reclamation, coal waste pile revegetation, surface mined land reclamation and contaminated land remediation. He has mentored and supervised seven post-doctoral candidates, 91 PhD students and 100 MS students.

Professor Hu has been recognized for his research and teaching by his peers, institutions and government agencies numerous times. He received the ASMR Reclamation Researcher of the Year Award, Outstanding Teacher Award, Beijing Education Committee, Award for Outstanding Young Scientist (three times), and Recipient of the UK Royal Fellowship Program with China. He has published numerous refereed journal articles (21 since 2009), written 6 books and has eight patents in the field of land reclamation in this time. One of his supporters wrote that a strength of Dr. Hu is "communicating his research findings to the reclamation community, to his colleagues at other universities in China and throughout the world, and maybe most importantly to government officials at both the national and provincial levels in China." Zhenqi is a lifetime member of ASMR. He was a strong supporter and organizer of cooperative relationships between land reclamation organizations from several countries, which is reflected in the formation of the International Association of Land Reclamation.

Congratulations to Professor Zhenqi Hu for his selection as a Pioneer in Reclamation by ASMR in 2018. Professor Hu was nominated by Brenda Schladweiler. ■

Early Career Award in Reclamation
Julie LaBar

This award was initiated in 2015 to recognize outstanding contributions by our early career members of the society.

Dr. Julie LaBar received her PhD, MS, and BS in Environmental Science from the University of Oklahoma. She is presently serving as a postdoctoral researcher in the Environmental Engineering Department at Saint Francis University in Loretto, PA. She has expertise in aquatic biogeochemistry, emphasizing mine water quality, and the development and refinement of passive treatment technologies. Her graduate advisor, Dr. Robert Nairn, was so impressed with Julie's work ethic and knowledge in the field that she served as research scientist and was responsible for analytical support of federal, state, and private research grants totaling over $10 million. While employed full-time in this role, she pursued her PhD, focusing on fundamental ionic strength effects on biogeochemical processes in mine water passive treatment systems. In her short career, she has five journal articles and numerous scientific presentations. She has been recognized for her teaching skills with at least two fellowship awards. She has been a member of ASMR for 10 years and has served the society through the development and maintenance of the society Facebook page.

It is an honor to present the 2018 ASMR Early Career Award in Reclamation to Julie LaBar. We look forward to her leadership and continued career in the field of land reclamation and water chemistry. Julie was nominated by William H.J. Strosnider. ■

William T. Plass Award
Dr. Robert G. Darmody

The Plass Award is given to a person who has distinguished themselves over a long time in the field of mined land reclamation at the local, regional, national, and international levels. The award is the highest honor the ASMR has and recognizes those in research, teaching, outreach, and administration.

Dr. Robert G. Darmody received his BS in Conservation and Natural Resource Development from the University of Maryland (magna cum laude), MS in Soil Science from the University of Maryland, and his PhD in Soil Science from the University of Maryland. He was employed as an assistant professor of Pedology at the University of Illinois in 1981. He was promoted to associate and then to full professor at UI. Since 2013, he has served as Executive Secretary of ASMR. He received the Outstanding Student Instructor recognition from the University of Illinois for 12 years (1985-2010). He was elected Fellow of the Soil Science Society of America and the American Society of Agronomy. He also was awarded the Reclamation Researcher of the Year from ASMR.

Bob has a long history of research relating to mining and its environmental and agronomic impacts. His research in the effects of mining on subsidence was the first such investigations anywhere and remain unique in the world. This research provided evidence that underground mining including longwall mining effects on subsidence could be mitigated. He has served as a consultant in mine subsidence mitigation in the USA and Australia and is now working with regulators and researchers in China. In addition to his teaching and research responsibilities, he served as Director of the University of Illinois Surface Mine Reclamation Program for several years. His research findings have been published in many journal articles, books, and technical meeting proceedings. He has served ASMR as president, Chair of the Soils and Overburden Technical Division, and editor of the JASMR. He has also served as associate editor of the *Journal of Environmental Quality.*

It is with great honor that the society awards Robert G. Darmody the William T. Plass Award for 2018. Dr. Darmody was nominated by Jeff Skousen. ■

Richard I. and Lela M. Barnhisel Reclamation Researcher of the Year Award
Paul Eger

The Richard I. and Lela M. Barnhisel Reclamation Researcher of the Year Award recognizes substantive contributions to the advancement of reclamation science and technology through scientific research. Paul Eger received his BS (cum laude) in chemical engineering from the University of Rochester, NY, and he completed course work in chemical engineering and environmental health from the University of Minnesota. He is environmental engineer with Northwest Technical Services in Virginia, Minnesota. He has been employed in the field of environmental engineering for over 40 years in Minnesota, Colorado, Venezuela, and the United Kingdom.

Paul has been involved in the regulatory role and as a consultant in mined land and water reclamation. His emphasis has been in the areas of waste organic amendment of mine tailings, pioneering work in wetlands through passive treatment, peat-based sorption media, and active chemical treatment. He has published over 95 journal articles, conference and workshop proceeding and university publications. Two special activities deserve special notice. He led the efforts on decommissioning a decade old biochemical reactor and he was instrumental in developing passive technologies for selenium removal. He has served the society on the NEC and as president. He has received the Reclamationist of the Year Award from ASMR and state and national recognition for his research and technology development.

It is with great pleasure that ASMR's 2018 Richard I. and Lela M. Barnhisel Reclamation Researcher of the Year Award is presented to Paul Eger. Paul was nominated by Robert Nairn. ■

Scholarship PhD
Kenton Sena

Scholarship MS
Amanda Pinnino

Scholarship BS
Justin Hugo

Oral Presentation 1st Place Grad
Amanda Pinnino

Oral Presentation 2nd Place Grad
Stephanie Jean

Oral Presentation 3rd Place Grad
Michael Nattrass

Oral Presentation 1st Place Undergrad
Grayson Koeneman

Oral Presentation Honorable Mention
Cassie Phillips

Oral Presentation Honorable Mention
Nick Shepherd

Poster 1st Place
Michelle Valkanas

Poster 2nd Place
Brandon Holtzbaur-Schweitzer

Poster 3rd Place
Brianna Mayfield

Poster Honorable Mention
Jennifer Kane

**Eric Lovelace,
Forest Keeling Nursery**

**Bill and Eric Krippaehne,
Pacific-Intermountain Distribution**

**Brenda Schladweiler,
BKS Environmental**

**Kevin Harvey and Rachel Schmidt,
2019 ASMR Meeting**

**Doug Beahm,
BRS Engineering**

**Amy Blyth,
Trihydro**

**Jeff Trump and Angie Sherman ,
Office of Surface Mining**

Maurice Davis,
Truax Seed

Marcus Anderson,
Foam Concepts

Tom Tenerovicz,
VOSS Signs

Michael Shema, Katie Astroth, Brian Butts,
Civil and Environmental Consultants

Michael Sieczkowski,
JRW Bioremediation

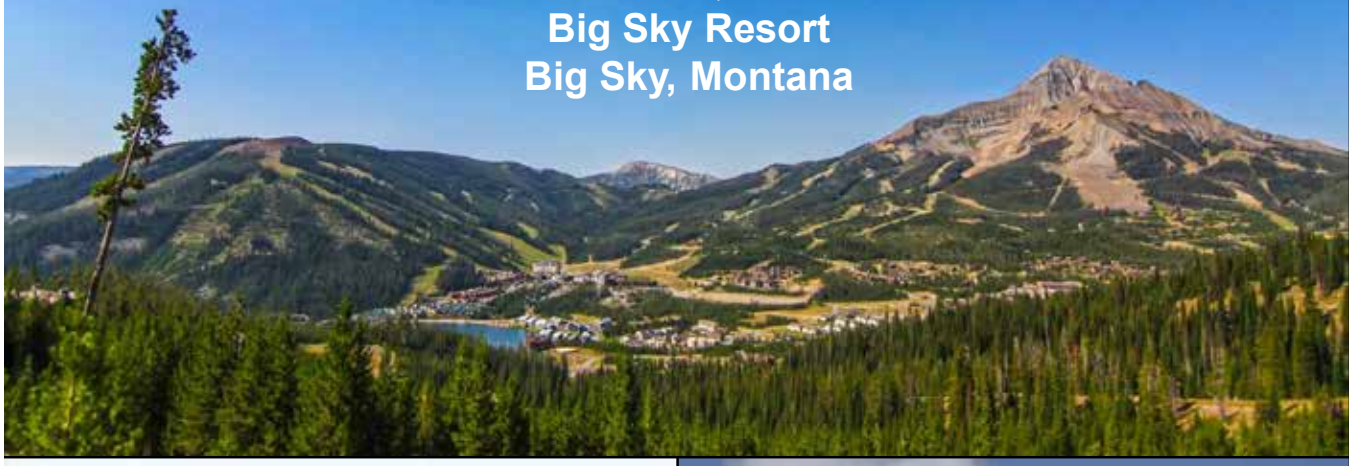
Tom Bowman,
Rocky Mountain Bioproducts

Seth Cude and James Brown,
RESPEC

2019 ASMR Conference
36th Annual Meeting of the American Society of Mining and Reclamation

Welcome Back To Montana, The Land Of Reclamation Pioneers

June 3-7, 2019
Big Sky Resort
Big Sky, Montana



The conference field trip will explore Yellowstone, America's first National Park, where environmental conservation and reclamation were born.

2019 ASMR Conference
36th Annual Meeting of the American Society of Mining and Reclamation

June 3 to 7, 2019 Big Sky, Montana

Welcome Back to Montana: The Land of Reclamation Pioneers

Call for Abstracts

This conference will focus on, but will not be limited to, the technical areas identified below and will provide a forum for the dissemination of information through presentation of research findings, field tours, workshops, and open discussion. Potential technical areas include: reclamation, ecology, restoration, reforestation, tailings, soil and water management, land use planning issues with respect to mining, oil & gas, conventional and alternative energy, contaminated land and other disturbances. Submission of abstracts and other items should be sent to Robert Darmody, ASMR Executive Secretary: rdarmody@illinois.edu.

If you are interested in moderating and organizing a session, please contact Rachel Schmidt, local planning committee, at rschmidt@kcharvey.com

Paper Categories

Abstracts can be for oral Power Point presentations (25 minutes max), posters, or, new this year, video presentations (details to follow). Four types of abstracts or papers will be considered as described below. Draft copies of abstracts are due by January 11, 2019. Abstracts will be placed on the ASMR.US web page prior to the meeting and Power Point presentations and videos will be uploaded to the web after the meeting, pending the author's permission. "Infomercials" are not appropriate unless specifically tied to research data.

1. Research paper – these papers should be replicated lab or field research.
2. Case Studies – include, but are not limited to, non-replicated field or lab studies and may be examples of mitigation tactics that have been employed at a field site. They could be replicated projects in space and time, but have not been subjected to statistical analyses.
3. Demonstration project – these may be demonstrations of a new product, method, or technology of commercial value, but presented with defendable data and be more than just a clever sales pitch.
4. Other – these may include such presentations as a policy paper.

Program and Other Important Dates

The Program Committee invites the submission of abstracts, deadlines are as follows:

1. Abstracts (200-350 words, see example), and submittal forms, should be received by January 11, 2019.
2. Acceptance of the abstract will be sent to the author after review, before January 25, 2019.
3. Abstract revisions, if necessary, must be received by April 12, 2019.
4. All PowerPoint presentations must be turned in upon arrival at Big Sky at the on-site registration desk so they may be placed on the appropriate computers. A cloud site will be established for abstract uploading as well.
5. Times for individual presentations will be posted on the ASMR web page under Upcoming Meetings as soon as the program has been finalized.

ASMR 2019 Conference Abstract Submission Form

Corresponding Author:

Paper Title:_____

Agency/Company:_____Address:_____

City, State, Zip:_____Telephone:_____E-Mail:_____

Presenter Name:_____*Student?_____Yes_____No_____

Co-Authors_____

Submit your abstract and this form as Word or pdf files by January 11, 2019 to: rdarmody@illinois.edu

Presentation Format: _____Oral _____Poster _____Video

Presentation Type: _____Research Paper _____Case Study _____Demonstration Project _____Other

Will you submit a written paper to JASMR? _____Yes _____No

If yes, please contact R. Barnhisel, JASMR editor, for specifics: asmrjournal@twc.com

Number the top three technical divisions in which you feel your presentation best fits. This will be used for review and approval of your abstract:

_____Ecology _____Forestry/Wildlife _____Geotechnical Engineering _____Refuse and Tailings

_____Land Use Planning and Design _____Soils and Overburden _____Water Management

_____Revegetation

Workshop Sessions

If you have ideas for workshops/symposia, please contact Kevin Harvey: kharvey@kcharvey.com 406 585-7402

* ASMR Student members who are presenting a paper may be eligible for a Student Travel Grant and/or to compete for cash awards in the Student Presentation Competition. See the ASMR.US web site for details.

ASMR CONFERENCE ABSTRACT EXAMPLE

The Use of Spectral Reflectance as a Reclamation Tool1

A.J. Smith2, B.C. Jones, and C.D. Doe

Abstract: Detailed abstracts are limited to 200 to 350 words and should provide statement of the problem, methods and materials, experimental design, major results, and conclusions. The language of the Conference is English. The title of your abstract should be short and descriptive. Indicate the presenter by an asterisk after their name. The text of your abstract should use 12-point font, Times Roman preferred, single-spaced. The margins of the text should be 1 inch on all sides. Units of measure are to be expressed in SI Units, such as g m-2 (grams per square meter), mmols kg-2 (millimole per kilogram). Non-SI Units and English units are to be avoided. The use of color graphics and electronic images is acceptable. Please indicate the Technical Session in which you think your paper should be considered from the list on the submission form. Identify additional key words. Indicate title and organization for each author, students should be identified as such. Give the location of the work, if it is field-based and OK with the principles, as note3.

Additional Key Words: Listing of those not in the title.

1. Oral (or Poster or Video) paper presented at the 2019 National Meeting of the American Society of Mining and Reclamation, Big Sky, MT. Welcome Back to Montana: The Land of Reclamation Pioneers, June 3 - 7, 2019. Published by ASMR; 1305 Weathervane Dr., Champaign, IL 61821.
2. Allen J. Smith (presenter), Professor, Plant and Soil Sciences, University of Kentucky, Lexington, KY 40546; Barbara C. Jones, Ecotoxicologist and Certified Associate Wildlife Biologist, Altec, Georgetown, KY, 40552; and Charles D. Doe, PhD Candidate, University of Illinois, Urbana IL 61801.
3. Work reported here was conducted near 40° 06’ 07” N; 88° 14’ 59” W.

_____

Abstracts are to be sent electronically to rdarmody@illinois.edu along with the completed submission form. Requests for additional information should be sent to:

Robert Darmody, ASMR Executive Secretary rdarmody@illinois.edu or Kevin Harvey, ASMR 2019 Conference Chair kharvey@kcharvey.com

Elwha River Restoration:
Tribal Voices Matter in the Restoration of Natural Resources

By Jenise M. Bauman and James Kardouni

Brief History of the two dams on the Elwha River

The headwaters of the Elwha River reside 72 kilometers within the Olympic Mountains where it flows south to north through old- and second-growth forests and empties into the Strait of Juan de Fuca (Figure 1). Until recently, much of the Elwha River Basin was inaccessible to anadromous fish, fish that migrate between freshwater and marine ecosystems (Duda et al. 2008). This was due to the installation of two dams between 1912 and 1923; the Elwha (32 meters high) and Glines Canyon dam (64 meters high) were located 8 and 22 km from the river mouth, respectively. Both were outfitted for hydroelectricity that initiated the economic growth of the western Washington Peninsula region by powering sawmills, a steel mill, pulp and paper mills, and the U.S. Naval Yard (Sadin and Vogel 2011). However, this development came at a cost for the Lower Elwha Klallam Tribe who lived in that region for 1000s of years. The Elwha River valley was a provisionary system for the tribe, notorious for plentiful fish runs, abundant wild game, and healthy beaches that harbored abundant shellfish. Culturally, the river was the place of creation for the Elwha Klallam Tribe and harbored their iconic spirit, the Thunderbird.

After the completion of the two dams, the environmental impact was evident. Historical runs of 500,000 salmon were dramatically reduced to 5,500 fish restricted below the lower Elwha dam (Pess et al. 2008). This prominent decrease in native and keystone fish populations included salmon species such as chinook (*Oncorhynchus tshawytscha*), chum (*O. keta*), pink (*O. gorbuscha*), and coho salmon (*O. kisutch*; Duda et al. 2011a; Quinn et al. 2017). Other species such as sockeye salmon (*O. nerka*), rainbow trout (*O. mykiss*), cutthroat trout (*O clarkia*), and bull trout (*Salvelinus confluentus*) were land-locked upstream (Brenkman et al. 2008). The Elwha River naturally processes relatively high rates of sedimentation and when intact, fine and coarse sediment enriched the nearshore environment along the Strait of Juan de Fuca (Randle et al. 2015; Schartz 1994). However, once the dams were placed, the sediment transported was drastically altered, which reduced the estuary, eroded the beach, and gradually eliminated the nearshore habitat. These changes reduced populations of shellfish that relied on the sediment-rich environment and impacted other species such as aquatic plants, sea urchins and cucumbers, bottom and forage fish, avian species and aquatic mammals including the iconic orca whale (Shaffer et al. 2008). This reduction in provisional resources coupled with the U.S. imposed treaties resulted in the demise of the economic and spiritual foundations of the Lower Elwha Klallam Tribe (Sadin and Vogel 2011).

Despite the environmental impact, the two Elwha power plants operated with little regulation for 50 years. It wasn't until the late 1960s and early 1970s where the Federal Power Act required the owner, the Crown Zellerbach Company, to license the dams

Figure 1. The Elwha River watershed is located west of Port Angeles, Washington. The headwaters of the Elwha River reside 72 kilometers within the Olympic Mountains where it flows south to north into the Strait of Juan de Fuca. Image maps the placement of two former dams, the 32-meter Elwha dam located 8 km and the 64-meter Glines Canyon dam located 22 kilometers from the river mouth. Base map provided by Olympic National Park.

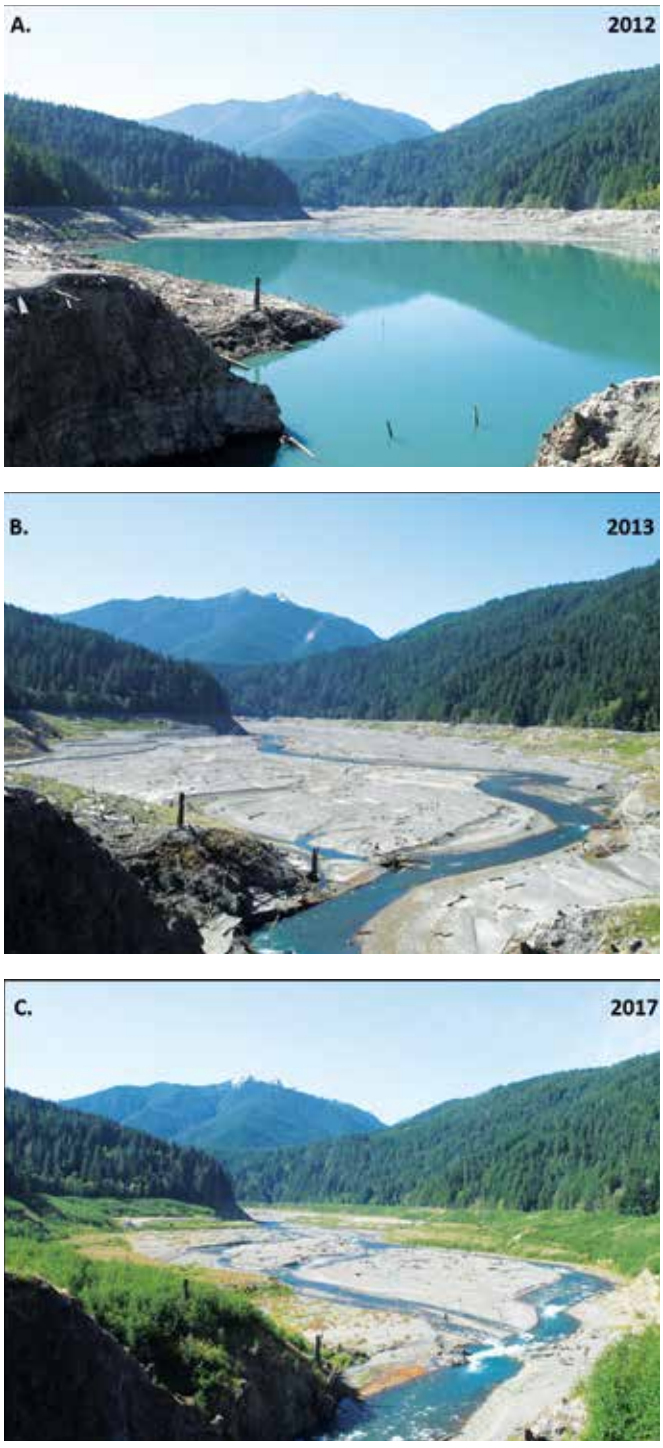


Figure 2. Panel A) Gradual removal of the Glines Canyon dam provided a slow drawdown to protect downstream fish and to adaptively manage sediment redistribution. Panel B) The Elwha River transported most of the released sediment downstream to the estuary, while portions remained along the dewatered reservoir beds in 2013. Panel C) After five years, the river channel remained dynamic as the vegetation begin to fill in the valley walls and terraces. Photos provided by Josh Chenoweth from Olympic National Park.

with the Federal Energy Regulatory Commission (Sadin and Vogel 2011). In addition to maintenance required for structural integrity of the two dams, the licensing also required the construction of fish passageways (Service 2011). For the Lower Elwha Klallam Tribe, who had been advocating for dam removal since the early 20th century, this gave them leverage for intervention that gained them subsequent support from environmentalist groups (Guarino 2013). The costs/benefit analysis combined with the potential for the restoration of the Tribe's salmon runs began to sway public and political opinion in favor of dam removal (Duda et al. 2008). In 1992, the Elwha River Ecosystem and Fisheries Restoration Act was enacted and required the restoration of habitat and native salmon runs (Winter and Crain 2008). Two environmental impact statements then determined that removal of both dams was necessary to restore the riverine ecosystem function and processes (DOI 1995 and 1996). The dams were then purchased by the Department of Interior in 2000 with a decommissioning planned for the following decade (Gregory et al. 2002). Importantly for the Lower Elwha Klallam Tribe, the dam removals were viewed as a spiritual and economic revival of their cultural heritage (Guarino 2013).

The Restoration of the Elwha River Valley

The proposed restoration project constituted the largest known dam removal to date (Duda et al. 2008). For the restoration of riverine systems, it was hypothesized that the removal of dams will result in restoring historic flow regimes, sediment exchange, the transport of large woody debris, riverine connectivity, and the overall improvement in water quality (temperature and chemistry) (Pohl 2002; Stanley and Doyle 2003). However, due to the novel approach to large-scale dam removals, a knowledge gap in how the biota would respond existed and the short-term and potentially significant abiotic and biotic disturbances were suspected (Major et al. 2017). The two dams on the Elwha River were estimated to store ~21,000,000 m^3 of sediment prior to removal (Warrick et al. 2015). Therefore, the major concern was the impact to the downstream terrestrial and aquatic habitats by the increased sediment deposition and suspended sediment concentrations (Pizzuto 2002; Stanley and Doyle 2003). In addition, the significant influx of sediment release would significantly alter the quantity and quality of food resources to the existing biota, favoring disturbance-adapted species or early-successional communities (Duda et al. 2008; Foley et al. 2017).

The gradual dam removal began in 2011 with strategic planning to protect downstream aquatic wildlife and to adaptively manage sediment redistribution (Figure 2A; Randle et al. 2015). The smaller Elwha Dam was completed the following year and the larger Glines Canyon dam was completed by summer 2014. During draw-down and demolition, the Elwha River transported most of the released sediment downstream to the estuary, while a portion remained in place along the dewatered reservoir beds (Figure 2B; East et al. 2015; Gelfenbaum et al. 2015). The resulting sediment released was estimated to include 10.5 million metric tons of sediment from the reservoirs. The ~4 million metric tons of sediment accumulated in the river delta resulted in over a meter of sediments deposited in the estuary and a 400-m expansion of the river mouth delta landform (Figure 3; Foley et al. 2017; Warrick et al. 2015). The initial effects of these geomorphic and hydrologic

Figure 3. As the dams were being decommissioned, there was an influx of sedimentation flowing from the Elwha River. It is estimated that 4 million metric tons of sediment accumulated in the river delta. This resulted in depositing a meter of sedimentation in the estuary, expanding the beach 400 m, and creating new landforms at the river's mouth. Photo credit: Tom Roorda.

changes cascaded to biological systems, reducing the abundance of macroinvertebrates and fish in the estuary and shifting community composition from brackish to freshwater-dominated species (Rubin et al. 2017). During dam removal, newly formed nearshore habitats were quickly colonized by fish communities such as ESA-listed Pacific salmon and trout (*Oncorhynchus* spp.), and smelt (*Thaleichthys pacificus*), and non-native, American shad (*Alosa sapidissima*). However even with the sediment flux, total species richness and Shannon diversity indices were similar between before and after dam removal (Shaffer et al. 2017). Aquatic community response was linked to substrate changes; the deposition of sand on gravel resulted in an increase in flatfish and sandlance, where deposits of mud on sand favored bivalves (Rubin et al. 2017). Shortly after deconstruction, the Elwha River bull trout, which were landlocked for nearly a century, resumed anadromy and predation on marine prey (Quinn et al. 2017).

In the terrestrial areas within the river valley, the dam deconstruction resulted in approximately 325 hectares of formerly inundated lake beds in various stages of recovery (Warrick et al. 2015). Some fine sediments settled along the valley walls while coarser substrate formed terraces, particularly along the former Glines Canyon Dam reservoir bed (Figure 2B and C; Chenoweth et al. 2011). The restoration goals, led by biologists at the Olympic National Park (ONP), were to create an early establishment of native plants to accelerate forest succession to regain functions such as erosion control, water temperature regulation, and habitat creation, while managing against exotic plant invasion. Large woody debris (LWD) was distributed throughout terraces via helicopter to diversify the topography and create microsites to aid in plant establishment (Figure 4; Chenoweth et al. 2011). Over 320,000 native trees and shrubs, and 3,000 kilograms of seed of forbs and graminoids were introduced, all harvested from regional seed sources and locally greenhouse grown. The functional diversification of plant material aided in creating structural diversity, which creates differing canopy structure and rooting depths needed for slowing water and controlling erosion in areas adjacent to the river. Native conifers were also planted, which will eventually aid in salmon habitat by cooling waters by the production of shade and providing LWD to the river that will create deep, cool pools for healthy aquatic habitat.

The revegetation initiative has been met with varying results. Along the valley walls and terraces, where fine sediments, organic material, and soil moisture were present in soils, directed plantings were successful. This substrate was deposited above the reservoir floor along the neighboring forest approximately 0.3 to 2.7 meters thick. In addition, valley walls comprised of fine sediment were quickly and naturally colonized by pioneer species such as red alder (*Alnus rubra*), black cottonwood (*Populus trichocarpa*), and willow (*Salix spp.*; Figure 4). Conversely, areas where sediments were coarser and devoid of water holding capacity, natural recovery did not occur, and tree plantings suffered from high mortality. Along the reservoir floor adjacent to the river, terraces were formed comprised of unconsolidated materials of sand, gravel, and cobble (Figure 5). These coarse layers measure approximately 3.3 to seven meters deep and suffer from reduced water-holding capacity, nutrient availability, soil organic matter, and microbial communities (Calimpong 2014, Cortese and Bunn 2017). Problematically, the floodplain substrates of newly exposed sediments of dewatered reservoir beds are especially prone to bank erosion and invasion from exotic plant species (Chenoweth et al. 2011; Michel et al. 2011; Orr and Stanley 2006). To combat this, ONP restoration efforts also included seeding native forbs and grasses, which were relatively successful in providing adequate vegetation cover in coarse soils.

The Return of the Salmon

The projection based on the Environmental Impact Statement estimated that, contingent on the health of the fisheries, the river could see more than 31,000 chinook, 34,000 coho, 10,000 steelhead, and 275,000 pink salmon produced in the Elwha River

Figure 4. Western Washington University undergraduate students record data from restoration seedlings in May of 2017. Large woody debris (LWD) was distributed throughout terraces via helicopter to diversify the topography and create microsites that aid in plant establishment. Native conifers such as such as Douglas fir (Pseudotsuga menziesii) and grand fir (Abies grandis) were planted for future LWD production as the forests develops. This image shows the sharp contrast in soils driven by substrate. Valley walls, comprised of fine sediment, were quickly colonized by pioneer species such as willow (Salix spp.), red alder (Alnus rubra), and black cottonwood (Populus trichocarpa). In contrast, the substrate on the terrace is very coarse with cobble and sand, which makes natural vegetation recovery difficult.

Figure 5. Along the reservoir floor adjacent to the river, terraces were formed comprised of unconsolidated materials of sand, gravel, and cobble. These coarse layers measure approximately 3.3 to seven meters deep and are perched above the existing water table. In March 2018, a herd of resident Roosevelt Elk (Cervus canadensis roosevelti) were observed roaming between the terraces and the existing forests.

on an annual basis (Major 2017). In August of 2012, the Lower Elwha Klallam tribe ceremonially welcomed chinook salmon back to the 8-km stretch of the Elwha River (Rice 2012). By 2013, over 4000 Chinook salmon were observed spawning above the previous location of the Elwha Dam (Figure 6; McHenry et al. 2015) with other species documented above both dams (Anderson and Hoffmann 2017). What was unanticipated, was how quickly chinook, coho, pink, and chum salmon returned to the upper portions of the Elwha River. In 2016, 25 percent of the chinook redds (salmon egg nests) were found above the former Glines Canyon dam, which was as far as 37 kilometers above the former dam site (Mapes 2017). Recent fish numbers have fluctuated, presumably due to the impact sedimentation during removal had on the river-dwelling juvenile salmon prior

Figure 6. Gradual flushing in the main river channel has resulted in adequate spawning sites in portions of the main channels. In the Fall 2013, Chinook salmon (Oncorhynchus tshawytscha) were observed spawning in habitat just below the former Glines Canyon dam site. Photo provided by Olympic National Park.

to their sea migration. Further, although gradual flushing in the main river channel has resulted in adequate spawning sites, it may be a several more years until the floodplain channels are fully recovered (Peters et al. 2017). Therefore, it is anticipated that full recovery may take another couple of decades to achieve.

Restored riverine habitats with associated riparian floodplains and forests play an important role as wildlife corridors. Wildlife facilitate seed dispersal and nutrient transfer processes. Avian species such as the American robin *(Turdus migratorius)* represent an important native seed disperser due to their high local abundance and propensity to deposit native seed across the former lake beds (McLaughlin 2013). Other avian species that will interact with the riverine system include the harlequin duck *(Histrionicus histrionicus),* common merganser *(Mergus merganser),* American dipper *(Cinclus mexicanus),* belted kingfisher *(Ceryle alcyon),* spotted sandpiper *(Actitis macularia),* northern rough-winged swallow *(Stelgidopteryx serripennis)* and bald eagle (*Haliaeetus leucocephalus*; Duda et al. 2008). Little was known about pre-project wildlife populations in the Elwha River, however, it was thought that the previously flooded habitat was important wintering area for many species (Winter and Crain 2008). It is speculated that the dams led to a decrease of habitat for terrestrial wildlife residents such as Cooper's hawk *(Accipiter cooperii),* Douglas squirrel *(Tamiasciurus douglasii),* pileated woodpecker *(Hylatomus pileatus),* yellow warbler *(Setophaga petechial),* Roosevelt elk *(Cervus canadensis roosevelti),* black-tailed deer *(Odocoileus hemionus),* beaver *(Castor canadensis),* and mink (*Mustela vison;* Hosey and Associates 1987; Winter and Crain 2008). Within less than two years since dam removal, wildlife such as black bear, deer, and elk have been observed wandering the planting sites of the former reservoirs (Figure 5), leaving behind seed-rich scat from the surrounding forests.

Over 100 species of wildlife depend on salmon during one or more stages of the salmon's lifecycle (Pess et al. 2008). Due to their migratory nature, salmon emerge from freshwater systems as juveniles and ultimately acquire above 90% of their biomass in the oceans. This accumulation results in large amounts of marine-derived nutrients (MDN), such as nitrogen, phosphorus, and carbon within their tissue (Willson and Halupka 1995). Studies have documented the connections between wildlife

Figure 5. The Elwha River restoration project provides opportunity for students and researchers from all over the country. Students from Western Washington University and Huxley College on the Peninsulas assess growth, soil development, and mycorrhizal development on the coarse terraces above the former Glines Canyon Dam (seen in the background).

dispersing salmon carcasses throughout the aquatic and terrestrial environments (Helfield and Niaman 2003). Recent post-dam removal studies have demonstrated marine forms of carbon and nitrogen associated with salmon tissue were transferred to a terrestrial avian consumer, the American dipper (*Cinclus mexicanus;* Tonra et al. 2015). Therefore, the restoration of the historic salmon runs may also restore the inputs of MDN into riparian and riverine food webs within the nitrogen-limited Elwha River valley (Duda et al. 2011b). Though empirical data is lacking, this deposition of MDN is hypothesized to benefit the overall ecosystem productivity.

The Future for the Elwha River Restoration

Research leadership from the Lower Elwha Klallam Tribe, Olympic National Park, Northwest Fisheries Science Center of NOAA Fisheries, US Geological Survey, Coastal Watershed Institute, Peninsula College, and Western Washington University have provided baseline data for long-term study. Research projects initiated by universities, government, and non-profit organizations from across the country provide contributions in areas such as fisheries and wildlife biology, sediment, forest successional dynamics, plant and microbial interactions, climate, hydrogeomorphology, biochemistry, and the fate of large woody debris. Working with research partners, these projects provide exciting study for undergraduate and graduate students (Figure 7). The Lower Elwha Klallam Tribe, whose perseverance and advocacy have proven to be a key force in freeing the rivers, will remain situated as the experts of their traditional territories and the Elwha's natural resources (Guarino 2013).

Acknowledgements

I want to thank the scientists and colleagues who took the time to provide me with project information. I was first introduced to this enormous field site by the lead vegetation restoration ecologist, Josh Chenoweth of Olympic National Park. His expertise was valuable in facilitating undergraduate and graduate projects that has helped me gain experience in this system. I also want to thank Dr. Anne Shaffer, who also took the time to host my students and me throughout her research site. I also received much support and guidance from my colleagues, Barbara Blackie, Nancy Bluestein-Johnson, Dr. Rebecca Bunn, Dr. Brian Hauge, Dr. Jim Helfield, Dr. Peter Homann, Amy Lawrence, and Dr. John McLaughlin.

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Why Do We Keep Having to Reinvent Successful Reclamation Processes and Practices?

By Neil Humphries and Jeff Skousen

Natural Cycles and Life-Spans in Knowledge

It has been suggested that there is a natural and cyclic life-span to almost all types of knowledge and practice in all disciplines, and that's why we are seemingly forever "reinventing the wheel" (Humphries, 2016). Natural cycles of knowledge gained and lost occur in three primary ways.

First, knowledge and experience is lost when leading players and their cohorts move or retire. We are all familiar with the loss of "institutional" knowledge and hands-on experience when older colleagues leave or retire. The knowledge gained by these individuals through years of hard-earned experience and by failures and successes is hard to replace. This makes it particularly challenging for someone who moves into the position with less experience and background.

Second, loss of knowledge occurs with changes in political parties, appointed directors of agencies, regulatory authorities, and administrative personnel. These changes result in adjustments of priorities, agendas, and responsibilities. Administrative guidance documents from a previous regime may be renamed, revised, or discarded. Technically-experienced people may be promoted to administrative positions where their knowledge is not recognized because they are working in a different arena, and their opportunities for sharing their information with others is restricted. Their skills and experience are overlooked, discounted, or altogether forgotten, with the additional loss of their carefully-collected archives which are no longer appreciated by others for their intrinsic value.

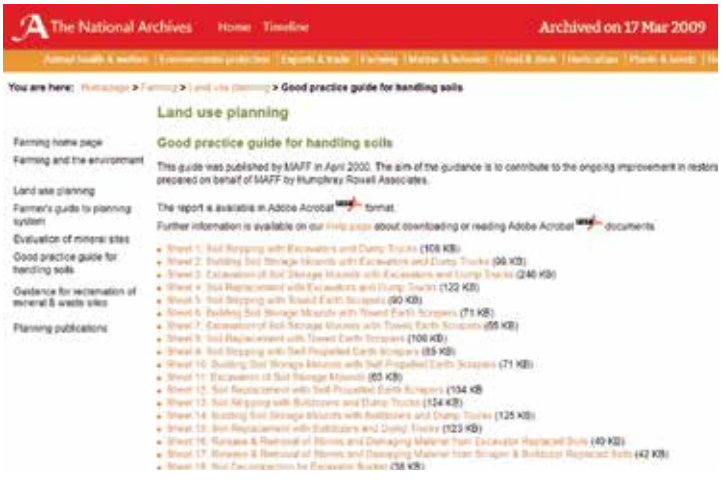

Figure 1. Image of Archived MAFF 2000 Soil handling Guidance web page.

Third, another example of losing knowledge is by changing methods of obtaining information. For example, the old way of obtaining information was typically done by gathering articles and hard copy sources from public and personal libraries such as books, manuals, and printed literature resources, which were written by recognized authorities and experts. Compare this to the common reliance today on web-based search engines that may only have "bite-sized pieces" of information written by unrecognized and sometimes less-experienced people without the value of peer-review.

An Example of a Near Miss of Lost Knowledge!

The universal importance of soil handling in the reclamation of disturbed land has long been established (Schaller and Sutton, 1976; Barnhisel et al., 2000; Humphries et al., 2018; Macdonald et al., 2015; Zipper et al., 2013). Soil conservation and replacement are key factors in the sustainable use of land and providing ecosystem services following mineral extraction and reclamation. Hence, the type of earth-moving equipment and methodology used, as well as the materials replaced on the disturbed site, are critical to the character and function of the rehabilitated soil ecosystem.

The need for defining good practice in the way soils are handled by machines arose in the UK following failure to consistently achieve good quality agricultural restoration in the 1970s. After extensive research and much debate during the 1980s and 1990s, the UK Government published its earth-moving equipment and handling guidelines in 2000 (MAFF, 2000). The guidance is a distillation of 30 years of research and operational experience and comprises 19 method sheets specifying the operations for three combinations of earth-moving equipment (excavators with dump-trucks, bulldozer-excavator-dump truck, and earth-scrapers) (Figure 1). It was well-researched, authoritative and complete, and well-written. The MAFF guidance became the UK standard methods document, being widely referred to and used by the mineral industry and their consultants, and the planning authorities and their statutory advisors in the UK. This MAFF guidance document was the recognized source of knowledge and practice on this subject, and it was widely available to all

interested parties. It is still regarded to be highly relevant and it is the core guidance for the UK's high-speed rail and largest national construction project (HS2, 2017).

However, in 2009 the MAFF operational-based guidance was archived and replaced by a "code of practice" for soils on construction sites (DEFRA, 2009; Figure 2) and which now appears on the UK Government website as the prime source of soil handling guidance. So, what happened?

The change in government and politics in the early 2000s resulted in the disbanding of the guidance's patrons, the Ministry of Agriculture Fisheries and Food (MAFF) and the Department of the Environment (DOE) in 2002, with their replacement by the Department of Environment Farming and Rural Affairs (DEFRA). The new government's agenda switched from a primary emphasis in reclaiming mineral extraction sites to reclaiming brownfield sites. While the DEFRA code cites the MAFF guidance document, it leaves the choice and method of soil handling to the operator. Consequently, the MAFF guidance is no longer so widely followed. This is partly because of the lack of knowledge by those recently entering the industry planning arena of its existence (the document having been archived and not available on the DEFRA web site) and partly because quicker and hence cheaper practices can be selected with the result that reclamation performance success is becoming more inconsistent. With this neglect, there is a real danger that the knowledge base and the lessons learned between the 1970s and 1990s will have to be relearned, reinvented, re-researched, rewritten, and re-accepted sometime in the future.

UK Industry Initiative

The current UK Government policy is not to produce further guidance on process and practice. This is left to the participating industries. The mineral industry through the Institute of Quarrying (IOQ) has taken ownership of the future of the MAFF guidance document and is working with DEFRA's executive agency (Natural England) to formulate its updating (Humphries et al., 2018). The IOQ will use it for training the next generation of mineral planners and operatives. With changes in the equipment combinations predominantly used (i.e., earth-scrapers are rarely if ever now used in the UK) and the over-riding safe working legislation and practices, it is timely that the guidance is updated (see Humphries et al., 2018). Knowledge input for the update is coming from soil and reclamation specialists, mineral resource and permitting planning authorities and advisors.

It is almost certain that without the initiative that the MAFF guidance document would have run its life-span. With its loss, sometime in the future as reclamation performance became more widely unsatisfactory, the drive to find a successful process and practice will have had to begin again and the past 50 years of accumulated knowledge rediscovered (Figure 3).

What Might Be Done?

What can we do to avoid the loss of knowledge gained through experience over time and recorded in traditional literature sources? First, we must be aware this syndrome exists, and we

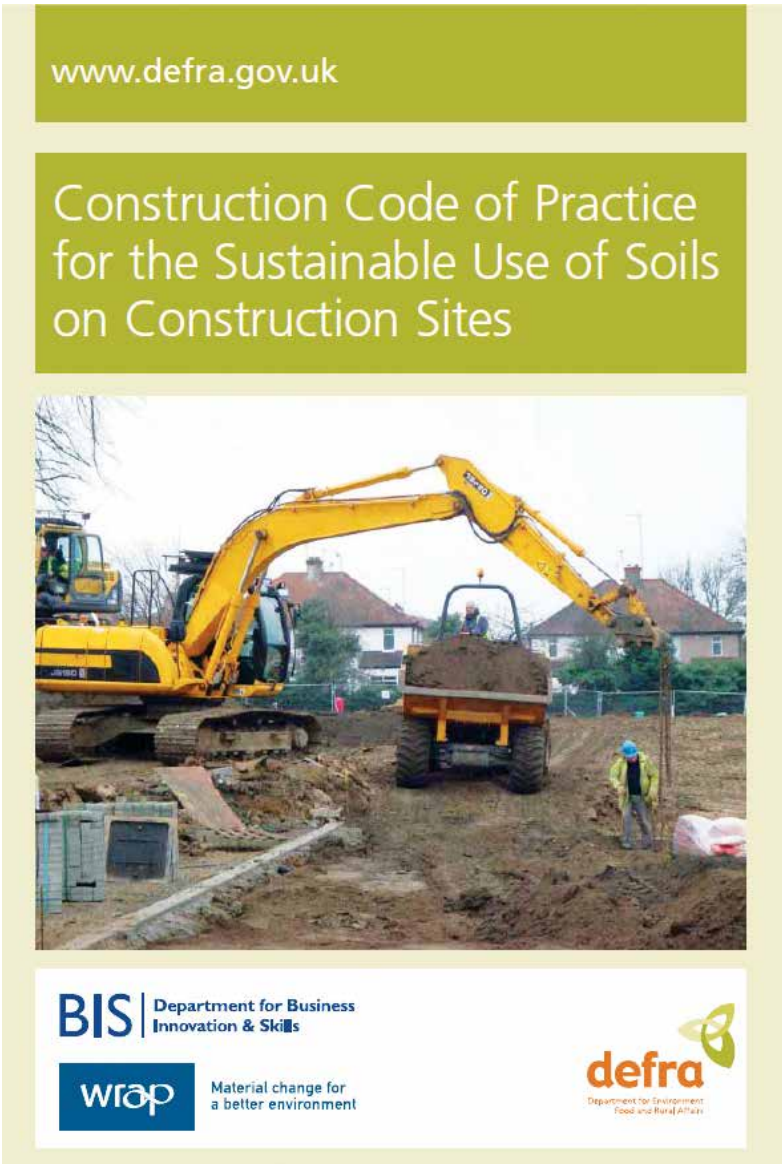

Figure 2. Image of DEFRA Code of Practice document.

should be more proactive to ensure sources of knowledge, such as archives, are known, utilized, referenced, and made readily available. Various ways of acknowledging and refreshing our memories of such documents are possible.

- One type of archiving was initiated by the American Society of Mining and Reclamation (ASMR) in its efforts to keep apprised of all mining and reclamation studies. One of our ASMR members, Jim Gusek, has a list of over 6,000 papers on a spreadsheet and it is available and searchable on the Sovereign Consulting web site. http://www.sovcon.com/index.php/resources/sovereign-mining-resource-database-march-2017
- Perhaps a session at an upcoming ASMR meeting could cover key knowledge areas and identify and highlight past guidance

Figure 3. Examples of an almost forgotten knowledge base.

documents that were prepared and published on that topic. Such a session could be done at regular time intervals.

- Another way to remember is to carefully cite guidance documents in our references when we present our new research so that these guidance documents are not forgotten.
- A fourth way may be to have a web site or a link on ASMR's site entitled "Reclamation History" providing references and links (if available) to these old documents. Now that there is 80 years of accumulated reclamation experience with guidance documents and handbooks, ASMR could be a list source with links to these guidance documents. Some of these documents have been scanned and are available on the internet, but they are hard to find without the proper key words. Knowledge is less likely to be forgotten and lost if it is regularly highlighted and accessible.

It would be to our advantage and to upcoming reclamation professionals that we guard against losses of knowledge and to ensure that organizations and individuals are regularly briefed as to this danger. ASMR may be well positioned to coordinate such an initiative and to take responsibility for preserving and archiving these valuable resources. An organization, rather than a person, should take ownership to ensure that these resources survive political changes and employment/retirement cycles.

We feel this topic is critical to preserving important historical documents and too important to leave hanging without doing something. We hope that others with similar concerns can provide some ideas and actions that would prevent the loss of critical reclamation knowledge.

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This article is based on a paper presented at the 2018 National Meeting of the American Society of Mining and Reclamation, St Louis, MO, June 32 – 7, 2018, Reclamation Session 8C.

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Flight 93 National Memorial Reforestation Project

Native Woody Plant Survival on Reclaimed Mineland

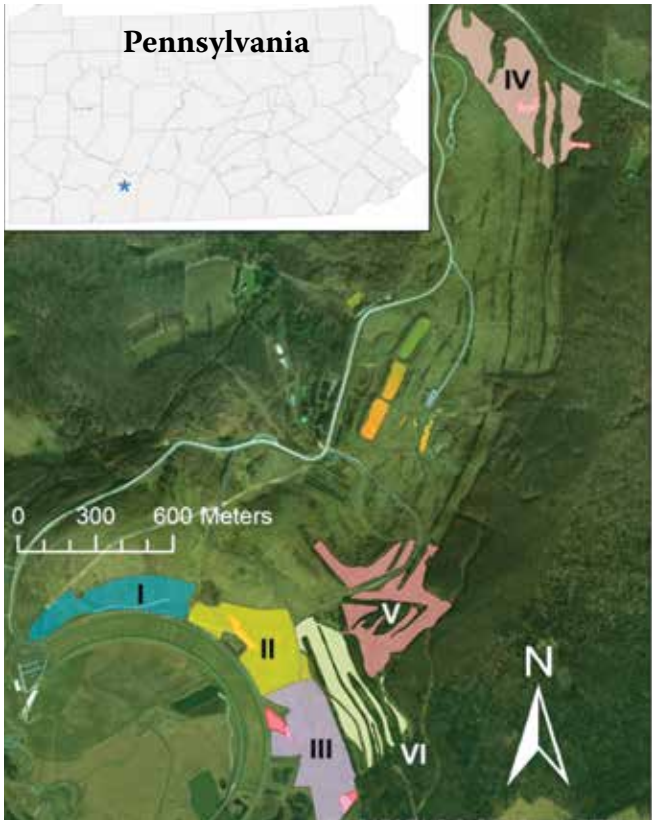
By Michael C. Tyree, Jeffrey L. Larkin, Scott D. Eggerud, Patrick N Angel, Michael E. French, and Chris D. Barton

This article is a short synopsis and draws heavily from the work published in the 2018 Volume 7, Issue 2 of the Journal of The American Society of Mining and Reclamation *(DOI: http://dx.doi.org/10.21000/JASMR08020035)*

The Flight 93 National Memorial is located in Somerset County, PA (Map 1; blue asterisk). The memorial was created to commemorate the 40 passengers and crew members of United Airlines Flight 93, who gave their lives to save others during the terrorist attacks on September 11, 2001. Passengers and the crew of Flight 93 forced the terrorists to crash the plane on a reclaimed surface mine, thwarting an attack on our nation's capital. The memorial site was officially dedicated and opened to the public on September 10, 2011.

Prior to becoming a national memorial, the site was surface mined starting in the 1950s until the mid-1990s. During reclamation, much of the 890 ha of reclaimed surface mine land was re-contoured and seeded with a mix of grasses, herbaceous plants, and planted with exotic conifers and hardwoods to prevent erosion and provide wildlife habitat in accordance with the federal Surface Mine Reclamation Act of 1977. The site continued to be deep mined until 2002.

Starting in spring 2012, the National Park Service, the Office of Surface Mining Reclamation and Enforcement, Green Forests Work, and others began reforesting selected sections using native, woody trees and shrubs. Reforestation began in 2012 with Phase I and each spring another planting phase was added with all phases (I-VI) totaling 57.1 ha. The six phases had been planted by thousands of volunteers covering 57 ha of land (Photo



Map 1. The Flight 93 National Memorial located near Shanksville, P.A. Colored polygons represent the six reforestation planning phases.

Photo 1. Volunteer tree planters working in Planting Phase IV. Courtesy: National Park Service, 2014

Photo 2. (Left) Indiana University of Pennsylvania students measuring plant abundance and growth in planting phase V (June 2017). (Right) blight-resistant American chestnut hybrid backcross being measured.

Photo 3. Tall competing vegetation (Solidago spp.) five months following site preporation in Phase IV. Photo taken during 2015 inventory.

1). A total of 102,393 woody trees and shrubs representing 34 native species were planted between 2012 and 2017, equating to about 1,792 trees per hectare; however, each year, the relative number of woody plants ranged from 1,593 to 1,968 plants ha-^{1}.

The designation of this site as a national memorial greatly increases the site's visibility and accessibility. Further, the wide diversity of native trees and shrubs planted, and the annual addition of new planting phases makes the Flight 93 National Memorial a powerful demonstration site for mine-land reforestation in northern Appalachia. During the summer of 2015, the Flight 93 National Memorial Reforestation Monitoring Project was established to evaluate reforestation success, track forest development, and provide data to drive future management decisions.

During the summer of 2017, the Indiana University of Pennsylvania, Department of Biology inventory crew advanced this work by remeasuring woody plant abundance, health, and plant growth in phases I-IV while adding planting phases V and VI, (Map 1; plant phases I-VI). In total, 216 permanent plots were established randomly throughout the six planting phases with the goal to maintain a minimum target sampling intensity of 10 percent of the entire area. Plant survival, growth, deer browse, and competition data were collected for all planted trees and shrubs within the sampling plots (Photo 2).

Across all six planting phases, total percent tree survival was 74.5 percent, however, within individual planting phases it ranged from 40 to greater than 100 percent with Phase V showing the greatest number of trees due to a large number of plants that naturally regenerated. Phase III had the lowest number of trees because it has been observed to be the wettest of the six planting phases, which may have contributed to the low survival.

Deer browse was extremely low across the site with only about 10 percent of the trees showing slight browse. Our low rates of deer browse are somewhat unique among other reforestation sites, which is likely a result of the advanced competing vegetation. All planting phases were ripped prior to planting leading to a bare planting surface (Photo 1); however, no chemical control or fertilization was added following planting. Competing vegetation across all six planting phases was dominated by grasses, sedges, and herbaceous dicots which quickly occupied the site (Photo 2). Some planting phases had considerably more competing vegetation which likely constitutes the largest limitation to tree survival and growth, however, may also be protecting woody seedlings from deer browse (Photo 3).

Across all six phases measured in 2017, pitch pine *(P. rigida Mill.)* and white pine *(Pinus strobus L.)* had significantly ($p < 0.05$) greater survival relative to the other conifers planted (Figure 1; blue bars). Among the deciduous trees we found that oaks *(Quercus spp. L.),* maples *(Acer spp. L.),* and aspen *(Populus spp. L.)* performed better then black walnut *(Juglans nigra L.)* and hickory *(Carya spp. Nutt.)* species (Figure 1: pink bars). Red maple *(Acer rubrum L.),* black locust *(Robinia pseudoacacia L.),* and black cherry *(Prunus serotina L.)* showed a high degree of natural regeneration (Fig. 1; black bars), which has also been

noted by others as common regenerating species. Interestingly, American chestnut showed similar rates of abundance to other mid-successional, mast-producing species such as oaks.

Wildlife shrubs are more difficult to compare. The makeup of wildlife shrubs was more determined by availability and as such was less consistent among planting phases. This led to greater variation among species (Figure 1; green bars).

Average plant height increased, expectedly, with time since planting among our six Phases (Figure 2; left panel) with a slight decrease in Phase III, which also showed the lowest survival. Greatest plant height was observed among conifer species with pitch pine and white pine outperforming all other planted conifer species (Figure 2; center panel). Deciduous plants showed less overall height growth relative to planted conifers, however, we consistently observed black locust and aspen showing the greatest height (Figure 2; right panel).

Tree survival and height growth at the Flight 93 National Memorial were consistent with reforestation studies at other sites and the recommendations using the Forestry Reclamation Approach produced good results for reforestation success. Advanced competing vegetation is the number one limitation to plant success on this site and will continue to shape the species makeup throughout establishment. This site offers an exciting opportunity for outreach and demonstration of successful surface mine reclamation and will continue to do so throughout forest development.

Special thanks go to Leroy Renninger and MaryEllen Snyder from the National Park Service. Thanks to Shannon Johns, Caleb Brady, Aaron Wolfe, Cassandra Forte, Ian Forte, and Kathryn Coates for their exceptional work in the field. We acknowledge the support of King Laughlin, the Appalachian Regional Commission, and the National Fish and Wildlife Foundation. ■

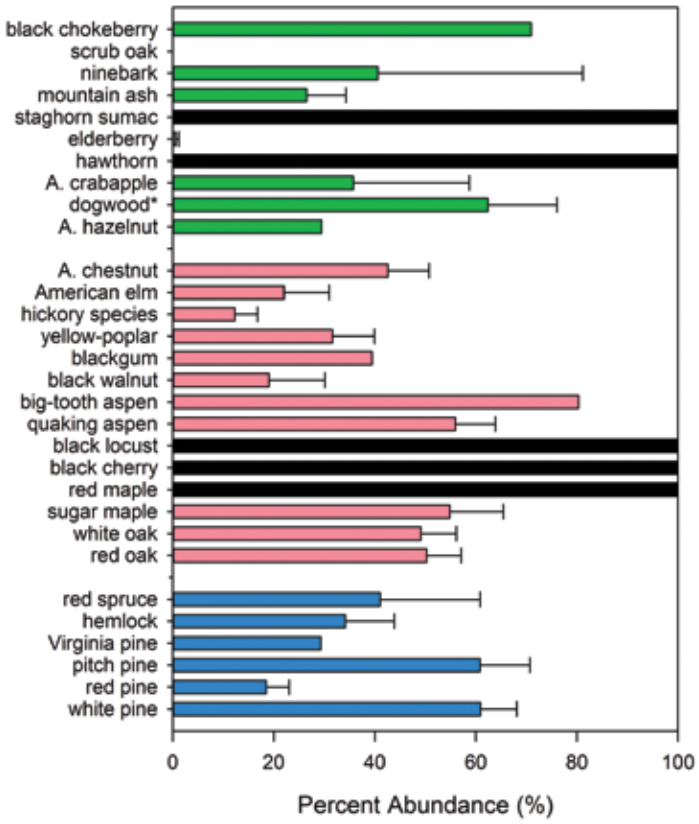


Figure 1. Percent stocking (survival) across all six planting phases. Plants were classified as either wildlife shrubs, deciduous trees, or conifers, which are represented by green, pink, and blue bars, respectively. Black bars indicate greater than 100% stocking due to natural regeneration.

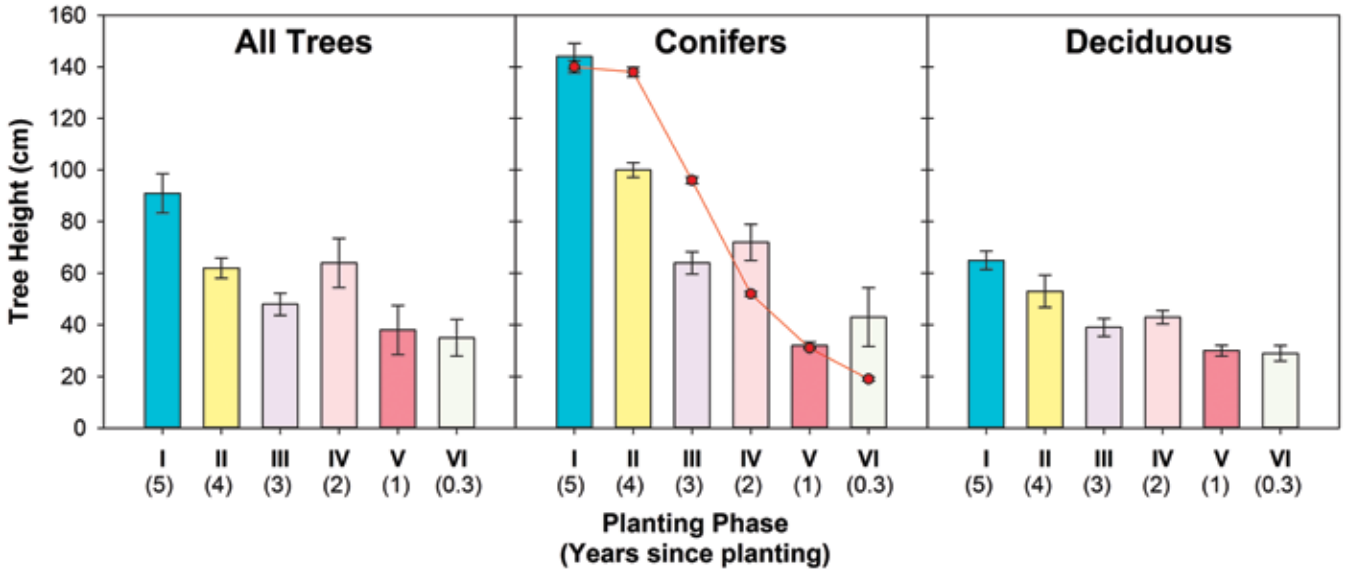
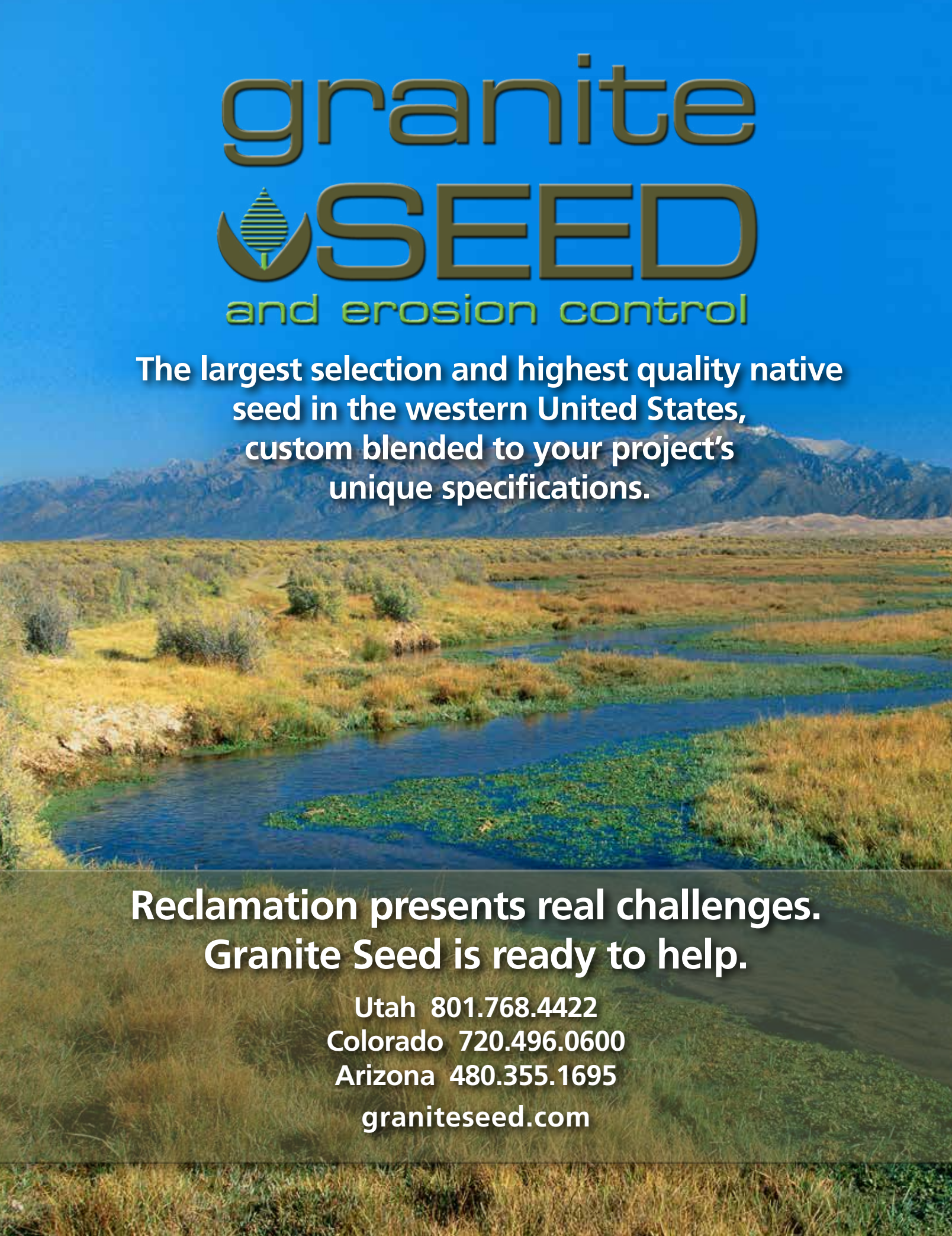


Figure 2. Average height for all planted trees (left panel), conifer trees only (center panel), and deciduous trees only (right panel). Red points and line show average height of white pine only and error bars represent ± 1 standard error from the mean.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