Michigan Tech MAGAZINE

2018 • VOLUME 55 NUMBER 2

DIRE STRAITS

Six months, 41 researchers, two pipelines, 4,380 simulations, roughly 2 million gallons of oil, and more than 600 pages of science.

In an independent risk analysis of the Straits Pipelines, Michigan Tech led a team of experts to answer one question: **what's the worst that could happen?**

GLIMPSE THE UNIVERSE

At the High-Altitude Water Cherenkov Gamma-Ray Observatory in Mexico, scientists have discovered a new source of the highest-energy photons in the cosmos: a strange system known as a microquasar, located a neighborly 15,000 light years from Earth. The research team included Michigan Tech's Petra Huentemeyer, a professor of physics; postdoctoral research associate Henrike Fleischhack; and PhD candidates Chad Brisbois and Binita Hona. "These electrons are some of the highest-energy particles in our galaxy, and it's hard to explain how something that small got so much energy," Huentemeyer says. Studying the messengers from this microquasar could offer a glimpse into the secrets of their larger cousins, quasars, and some of the biggest, baddest phenomena in the known universe.

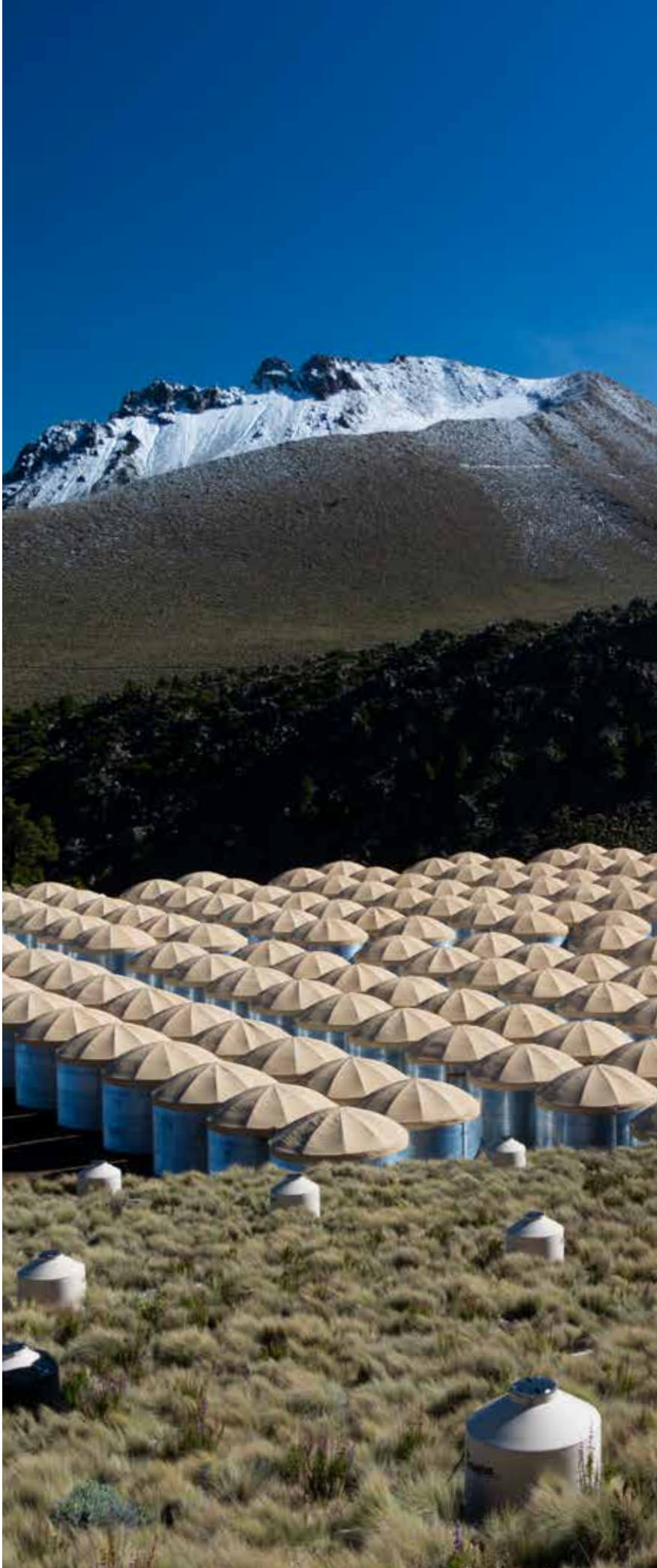

Photo by Jordan A. Goodman

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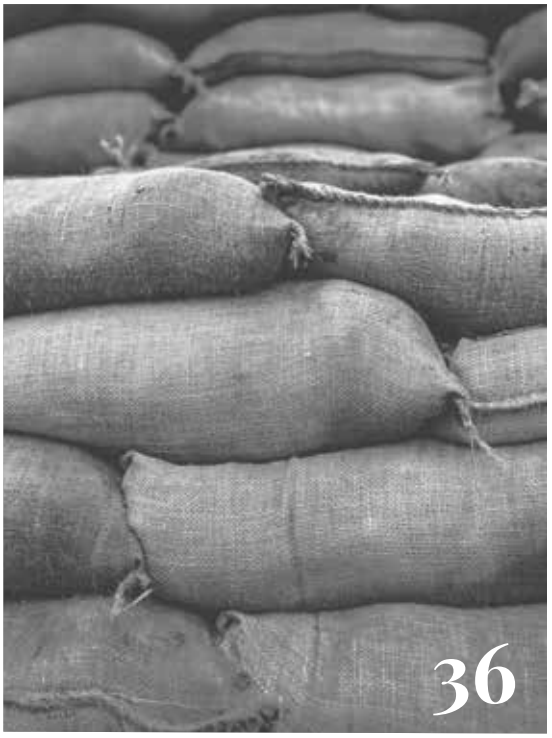

REGULAR FEATURES

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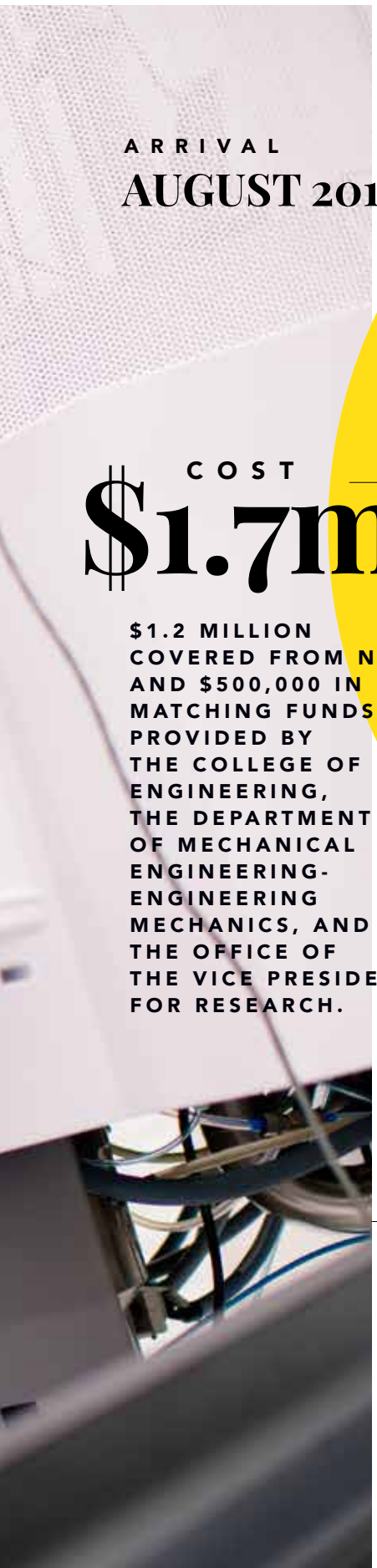
THE ANATOMY OF . . .
A SCANNING TRANSMISSION ELECTRON MICROSCOPE

THE FEI 200KV TITAN THEMIS SCANNING TRANSMISSION ELECTRON MICROSCOPE (STEM) is a window into the nanoscale. The microscope is one of two in Michigan. Its electron beam is smaller than a single atom and creates a digital image of the atomic structure of materials and chemicals including batteries, minerals, and alloys. It can also monitor atom-level interactions within samples. The microscope has six specialized specimen holders. To perform high-resolution STEM imaging, the University built a stand-alone facility to minimize temperature variations and mechanical vibrations generated both externally and internally that would adversely affect the resolution of the microscope. Analyzing STEM outputs means zooming in on the tiniest details to understand the big picture.

Michigan Tech's new Scanning Transmission Electron Microscope (STEM) lets researcher **Pinaki Mukherjee** zoom in to understand the big picture at the atomic scale. Read more at: **mtu.news/2oOUOCb**



ARRIVAL
AUGUST 2017

COST
$1.7m

$1.2 MILLION COVERED FROM NSF AND $500,000 IN MATCHING FUNDS PROVIDED BY THE COLLEGE OF ENGINEERING, THE DEPARTMENT OF MECHANICAL ENGINEERING-ENGINEERING MECHANICS, AND THE OFFICE OF THE VICE PRESIDENT FOR RESEARCH.

SAMPLE SIZE
50–70 nm thick

SIZE
~8'

FREQUENCY OF USE
DAILY

SPECIAL OPS
VIBRATION-FREE ROOM; EXTRA THREE ROOMS DEVOTED TO STORING BACKUP SYSTEMS

ON-HAND EXPERT
PINAKI MUKHERJEE, PHD, HIRED IN 2017 AS STEM SPECIALIST

LOCATION
APPLIED CHEMICAL AND MORPHOLOGICAL ANALYSIS LABORATORY

Michigan Tech's women's basketball team has the **highest GPA** in all of women's college basketball. The Huskies not only led all of NCAA Division II, but their average GPA of 3.796 makes them the top team across all divisions of collegiate women's basketball.

Support the tenants supporting the environment. Follow their blog or Facebook page:

aee-mtu.org/house
facebook.com/mtu.sdh

MICHIGAN TECH SUSTAINABILITY DEMONSTRATION HOUSE

21680 WOODLAND ROAD, HOUGHTON, MICHIGAN 49931

It's not your ordinary rental. A 5,000-square-foot, three-floor home built in 1953, with five bedrooms and six bathrooms, and an 8.6 watt solar array system bringing 10 kilowatts of renewable energy into the house. Aquaponics garden and composting system in the backyard; WiFi-controlled LED bulbs and induction cooktops in the kitchen. The first five tenants moved in last fall and were obliged to work on the home 20 hours per month in addition to paying rent. Tenants compost, mow, and clean solar panels as needed. They host two open houses per semester and contribute to the house's Facebook page and blog. Being environmental stewards: just another way our students show they're crazy smart.

IMPRESS-IVE HUSKIES

ENGINEERING TECHNOLOGY SCHOLARS IMPROVING RETENTION AND STUDENT SUCCESS

The School of Technology was awarded nearly $1 million from the National Science Foundation (NSF) for a five-year program, "Engineering Technology Scholars-IMProving Retention and Student Success" or ETS-IMPRESS.

The project aims to expand the number and diversity of people entering the engineering technology STEM pipeline, including underrepresented groups. "Impress-ive" Huskies—first-time undergraduate engineering technology students and students transferring from community colleges in Michigan and neighboring states—receive either four- or two-year scholarships (depending on their academic standing at time of enrollment).

School of Technology Professor and Program Chair Nasser Alaraje leads the project, helping choose and mentor nine students for the 2018-19 school year: five first-year undergraduates and four transfer students. Applications for the second year of the program opened in September 2018, and the application deadline is February 15, 2019. Impress-ive Huskies encouraged to apply!

mtu.edu/ets-impress

ON THE LIST?

GET TECH'S ENEWSLETTER DELIVERED TO YOUR INBOX

The Michigan Tech alumni enewsletter is delivered monthly to your inbox. For news and events from campus, alumni profiles, interesting history (or fun facts) from the archives, snowfall contests, alumni memories, and more, contact the Alumni House at alumni@mtu.edu or call 1-877-688-2586 to make sure you receive our monthly enewsletter. You can also update your email preferences by logging into the alumni portal MyMichiganTech.

MEET THE 2018 INDUCTEES

Seven new members of the Michigan Tech Sports Hall of Fame were inducted on October 12. Honorees included former hockey players Steve Coates '73 and Kip Noble '93, former men's basketball player Mike Kissman '98, former Nordic skier Kristina Owen '07, former football players Jim Peters '58 and Joe Berger '04, and former sports information director Dennis Hanks.

Berger, a former Husky All-American who retired earlier this year after a 13-year career in the National Football League, said, "It's a tremendous honor to be selected with this group. I think it says a lot about the coaches and players that I had the chance to play with over the years. Michigan Tech and the people I met there helped give me an opportunity to do things I never could have dreamed of. It will always be a special place for me."

Read more about Berger's time at Michigan Tech and in the NFL: *mtu.edu/magazine/2015-1/stories/field-engineer*

MASTER MINDS SPOTLIGHTS ONE OF MICHIGAN TECH'S 43 MASTER'S DEGREE PROGRAMS.
Visit *mtu.edu/gradschool/programs/degrees* to explore all programs.

MASTER MINDS:

A FINGER ON THE PULSE

MASTER OF SCIENCE IN BIOLOGICAL SCIENCES

Meditation, nitrogen in streams, aspen biofuel, protein misfolding, sugar-cancer interactions, and binge drinking: a few areas of study our interdisciplinary master's program in biological sciences offers.

In the recently opened Michigan Tech Sleep Research Laboratory, studies hinge on research into the effects of sleep on cardiovascular health, contributing to the broader field of sleep research—a field that is growing rapidly.

John Durocher '96 '04 '08, an assistant professor of biological science, measures alcohol's effects on sleep, blood pressure, and brain activity. His team recruited 80 participants aged 21 to 40 who will have their sleep assessed in the new two-bed research lab.

With a team of graduate student researchers, Amy Marcarelli, an associate professor in biological sciences, studies nitrogen cycles in streams. In the nitrogen cycle, the balance of nitrogen fixation and denitrification is not a perfect yin-yang.

Unbalanced systems can lead to more than just August pond scum; excess nitrogen is the main driver of the world's dead zones at major river deltas. Marcarelli's research, funded by an NSF CAREER grant, dives into the unexplored side of nitrogen fixation in streams.

"We are tackling cutting-edge, biological problems and contributing to the knowledge base as a group activity—as a community of scholars," says Chandrashekhar P. Joshi, department chair and professor of biological sciences.

With state-of-the-art equipment, and in updated labs, Huskies have their finger on the pulse of learning and research that counts. Want to get involved?

Apply for free:
mtu.edu/biological

Houghton small business owner, **Josh Jaehnig,** drew this lab-safety-practicing husky. Jaehnig owns and operates Houghton's Bramble & Stag Tattoo Parlour.

HUSKY TALES

SARAH JO MARTENS

Follow along:

I'm a fourth-year environmental engineering major with a minor in theatre arts. After I graduate in December, I will stay to get my master's in environmental engineering. I did theatre in high school, and when I was looking at colleges, it was the second-most important thing to me, just behind the degree program. I auditioned and was cast in a play the first week of classes.

I'm a huge advocate of science, technology, engineering, arts, and mathematics (STEAM). The theatre arts have a completely different mindset, but that's what I like about them. It's therapeutic for me to do engineering and art—and to switch from one to the other.

I'm also a tour guide on campus. My favorite part about the job is showing off Dow and all its interesting spaces and labs. The Rozsa Center is also a sweet spot for me; I could talk about it for hours.

I love the camaraderie here—everyone looks out for one another. So to future students interested in pursuing the arts at Michigan Tech: take the chance. It won't be easy, but it will be worthwhile.

STATE OF LAKE SUPERIOR

2018 CONFERENCE

Michigan Tech was the site of the 2018 State of Lake Superior Conference from October 9 to 12. Hosted by the International Association for Great Lakes Research, the conference was the second in an annual series of State of Lake conferences aimed at bringing together lake-specific research, policy development, management, education, and nonprofit organizations to broaden the discussion and provide diverse interaction among stakeholders. Nancy Langston, environmental history professor in the Department of Social Sciences and affiliated professor in Michigan Tech's School of Forest Resources and Environmental Science, was a plenary speaker.

AT HOME ON MARS

MICHIGAN TECH UNVEILED THE MARINE AUTONOMY RESEARCH SITE (MARS), THE FIRST FRESHWATER TESTBED OF ITS KIND, IN AUGUST 2018

The MARS testbed allows collaborations between technology developers, university researchers, resource managers, and industry to meet the future challenges in marine technology development, application, and workforce creation. At the August unveiling, US Representative Jack Bergman said, "This center puts us on the cutting edge. And if you're not on the cutting edge, you're behind."

Historic flash floods ripped through the Keweenaw in June. Nature's show of strength was met by another force to be reckoned with. Finns call it Sisu. Huskies call it tenacity. Our community calls it Copper Country Strong.

COPPER COUNTRY STRONG

It felt like the lightning strike at 5 AM hit the house. Huge crack. Explosion. The structure shook. It was still dark out, the power was out, and rain came down in sheets. "My wife and I hopped up and ran into the kitchen," Michigan Tech Career Services Director Steve Patchin '88 says. They stood in four inches of mud. By the light of their cell phones they saw 40-foot poplars protruding through the dining room walls of their Lower Point Mills Road home.

"We looked out into the road and the face of our house was looking back up at us." – *Steve Patchin*

Three feet of mud and water blocked the inward-opening doors leading to the walk-out basement in the garage. They grabbed necessities: insulin from the fridge, two dogs, and one cat (another named Jersey was missing). The family escaped out the side window; Patchin tossed a chair out first to help counter the steep drop. When they made their way to the front yard, they saw the opposite side of the house in the road. Colette Patchin '87 called 911, but the two-to-three-foot deep and 20-foot-wide torrent of water coming off the hill blocked the fire department. "We weren't sure what else was going to let go. We had to get out," says Patchin. They made their way across the flooded street and down the steps to their dock. They fired up the pontoon.

"It was surreal," says Patchin. "The lake was this apocalyptic scene." Houghton's Nara Nature Trail had blown out on the opposite shore. Four feet tall plots of grass drifted by like floating islands. "You saw boat seats, decks, all this debris, floating in the water. The water wasn't clear, and I'm just praying the motor doesn't suck it in."

They made it to the Dollar Bay boat launch. A fireman brought his wife's car for the family to use. At his in-laws' house, Patchin logged into Facebook to let folks know they were safe. "Facebook was lit up. That's when we realized the magnitude," he says.

The National Weather Service reports as much as seven inches of rain fell in the Copper Country between 11 PM Saturday, June 16, and 8 AM Sunday, June 17, with the majority of rainfall occurring from 2 AM to 5 AM Sunday. Roadways throughout the area washed out; homes and businesses were severely damaged or destroyed by mudslides, flooding, and cave-ins. One of the hardest hit areas was highway M-26, in the community of Ripley. Airport Road and Coal Dock Road were washed out.

Local firefighters were frustrated, Patchin says. "We were on this little island, and nobody could help anybody."

But those close to the Patchins could, when the family returned in daylight. A neighbor brought his backhoe and end-loader to move the house out of the road. Another used his backhoe to empty out the clogged drainage ditch. Other neighbors helped them move their cars out, and their possessions. Water. Food. Pickups. A local storage unit owner gave them the key to the place. "Use as much space as you need," Patchin recalls.

Their home's foundation was shattered. "That's when the thankfulness came in," says Patchin. "Thank God we're all right.

We were safe. We felt so lucky because we saw everything going on around us."

Across the Keweenaw, Huskies and their community rolled up their sleeves, grabbed boots, buckets, and shovels, and got to work.

Nobody wants to be called a hero. But actions speak louder than a word.

RISING TO THE CHALLENGE

Alumni, faculty, and staff used their skills to dispatch help and coordinate communications.

"The Yooper way is to jump right in, and of course a lot of people did that. My first question was who's coordinating these amazing volunteer efforts?" says Erin Smith, director of Michigan Tech's Humanities Digital Media Zone. She found the answer in the Volunteer Resource Center (VRC) that had been set up at Evangel Baptist Church on College Avenue. Smith offered to help with communications. The state volunteer response staff, who stayed in the area for a week, gratefully accepted; they'd been up until 2 AM responding to Facebook messages on the Houghton County Flood Volunteer Page.

"I can't say enough about how great Evangel was," Smith says.

Jill Johnson, Evangel administrative coordinator, helped develop, find resources, and operate the VRC. The quality that made the biggest impression on her post-flood was how quickly the Copper Country mobilized, from local residents to alumni across the nation.

"I was blown away at the rapid, tangible response. The energy in those early-response days was palpable," she says. "The way that so many people could come together with different experiences, different occupations, different places in life, and immediately work so excellently together without the benefit of training orientations, manuals, and mentoring was just magical. The VRC was a well-oiled machine and, in my opinion, this was God's miraculous blessing."

Other valuable community advocates gathered to build the Copper Country Strong website. The collaboration features photography from Adam Johnson '98, senior staff in the advancement office at Michigan Tech, who owns photography studio Brockit, Inc. Lynn Makela '07 and Jake Northey '04 offered their 101 Quincy Coworking space in Hancock to the group. VRC Coordinator Jon Stone and another Michigan Tech alumnus, Matt Monte of Monte Consulting '93, worked with Smith and STC grad Michael Babcock '08, director of marketing and communications at Finlandia University in Hancock, to provide reliable, comprehensive messaging.

"Erin and I were able to utilize the Copper Country Strong website to get messaging out to the community in a way that they could depend on. It was all-consuming for more than three weeks, but it was meaningful work—our community was able to count on an official source of information instead of going by rumors or guesses," says Babcock. "I was overwhelmed by the sense of community."

MORE HUSKIES AND FRIENDS TO THE RESCUE

With our own collections safe, staff of the Michigan Tech Archives at J. R. Van Pelt and Opie Library provided consultation and clean-up assistance at Houghton County Courthouse and Houghton County Historical Society, the latter located in one of the hardest hit communities, Lake Linden.

And this year, Michigan Tech Alumni didn't wait until early August to visit. They came up before Reunion to help with flood recovery efforts, collecting donations and sharing rides along the way. Those who couldn't come donated equipment, supplies, and money.

The companies that support Michigan Tech events like Career Fair and hire Michigan Tech graduates didn't ask if the area needed help. They just sent truckloads of it. 3M, Oshkosh, and many others delivered what was needed—including a semi-tractor of paper towels from Kimberly-Clark and many pallets worth thousands of dollars in supplies from Fleet Farm with help from the Appleton Beer Factory, Kick Ash Basket, and Fox Valley Chapter-Michigan Tech Alumni and Friends. A raffle at the Ford Pasty Picnic for Michigan Tech Alumni on July 19 included prizes donated by parents of current Michigan Tech students and raised $1,600 for flood relief efforts.

While there's no hard data at this time, a plethora of anecdotal evidence from regional and state rescue-assistance agencies indicates a faster-than-usual recovery time for natural disasters. The needs of the community rapidly changed, as the Keweenaw and campus returned to business. By June 26, no further supplies were needed, aside from dehumidifiers, box fans, and heavy equipment.

"Every organized relief group that came up was amazed at what our community did to help repair itself after the flood. Team Rubicon, a disaster relief group, even left early, because they said we had everything under control. It was inspiring." *– Brigitte Morin '06, Volunteer Resource Center, Michigan Tech faculty and alumna*

THE POWER OF SISU

Just 12 days after the flood, the Keweenaw received its first rain—it was not, as local weatherman John Dee reported, a "baby step." Cobalt altostratus clouds glided swiftly from the west, powered by 50-60 mph winds that whipped the stately trees along College Avenue, bringing waterlogged branches down. On the east side of campus, staff and students lined the highway-facing windows of Wadsworth Hall as day became dark as night. Looking out at the streetlights quivering over US-41, you could sense a collective shiver.

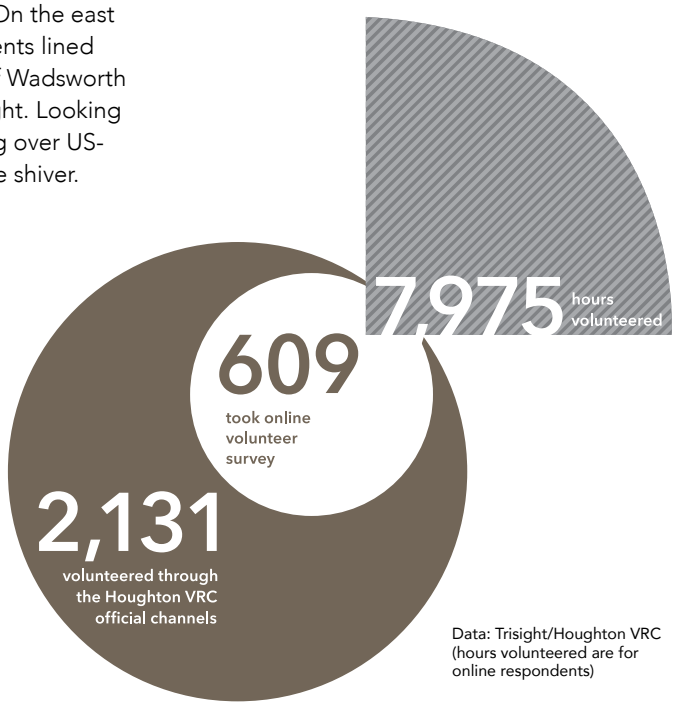
"I know it really had some folks on edge as it was approaching, but thankfully, it not only raced in, but through and out of our area," Dee wrote.

A couple days later, the cat Jersey once again meowed at the Patchins when they came to leave her food and water. She'd been meowing at them from the bushes every few days, and eating and drinking—but would not come close. The couple sat down in the mud. She crawled into their laps, purring. "I guess we'd finally earned her graces," says Patchin.

Grace—it's part of *Living on Sisu* author Deborah Frontiera's personal definition of sisu, a Finnish word with no direct English translation. It's a term many in the Keweenaw mark with honor, respect, and humor. "Sisu is true grit with grace," Frontiera says.

In the Keweenaw, our neighbors, friends, and community are the sisu that infuses Copper Country Strong.

Two days into the still-active flooding situation, Adam Johnson decided that he was tired of looking at destruction and set to work taking photos of hope, connection, and recovery. (Adam Johnson/Brockit, Inc.)



Data: Trisight/Houghton VRC (hours volunteered are for online respondents)

A JERSEY FOR THATCHER

There are no words adequate to express the sadness. But there are words to express the love.

Thatcher Markham loved life. He loved to be on the water—hanging out on the family dock or boat, a fishing pole in his hand. He also loved to be on the ice. The 12-year-old started playing with Copper Country Junior Hockey Association when he was five. He was a goalie, and a referee. In the Michigan Amateur Hockey Association (MAHA) remembrance of this promising young man, who died June 18, MAHA Vice President of Officials Judy Niemi, described him as a "gifted athlete with a forever smile."

> "Many of the people impacted by the flooding come to our games and support us. They are our biggest fans and now it is our turn to be theirs."
> *– Suzanne Sanregret, Michigan Tech Athletic Director*

Thatcher loved his family, and was joyfully carrying on a family tradition. The Markham name is as synonymous to Copper Country hockey as pasties are to the Upper Peninsula. The tradition has deep roots in Michigan Tech, where cousin Devin Kero is a goalie, one of many family members who's played for the Hockey Huskies.

On November 23, the Michigan Tech hockey team played a game especially for Thatcher—the team wore Copper Country Strong jerseys with his name on the back. The jerseys were auctioned off after the game, with proceeds going to the Portage Health Foundation's Flood with Love initiative.

"No words can ease the hearts of the many area residents who lost so much," says Head Hockey Coach Joe Shawhan. "The jersey auction helped raise funds for people in need, and being able to invite members of the community to the game who were on the front lines of the relief was also special. We're fortunate to be members of such an incredible community. We hope our efforts support the continued healing."

Michigan Tech Athletic Director Suzanne Sanregret says the idea for Athletics to be involved with the Copper Country Strong initiative came from student-athletes. "They recognize that we have a unique platform that allows us to be part of rebuilding and healing our community," she says. The Student-Athlete Advisory Council led event planning. Soccer, volleyball, football, and basketball teams wore and auctioned off Copper Country Strong T-shirts to contribute to flood relief.

NAVIGATING RISK

On January 15, 2018, the State of Michigan hired Michigan Technological University to lead an independent risk analysis of the Straits Pipelines portion of Line 5. With six months to complete the task, the University pulled together a 41-member team of experts to determine the costs of a worst-case scenario spill. Here's what they found.

The year was 1953. Dwight Eisenhower was president, Burt Lancaster and Deborah Kerr were rolling around on the beach in *From Here to Eternity*, and engineers in Flint, Michigan, put the finishing touches on the first-ever Chevrolet Corvette.

About 225 miles north, two parallel 20-inch pipelines were getting their first taste of crude oil on the bed of the Straits of Mackinac. Designed by the Bechtel Corporation—a company made famous by building the Hoover Dam 20 years prior—the Straits Pipelines stretch out for 4.5 miles, tethered to the bottom of the channel by screw anchors at depths ranging from 65 to 270 feet. They are part of a 645-mile pipeline system known simply as Line 5. Line 5 runs from Superior, Wisconsin, to Sarnia, Ontario, Canada, and is now owned and operated by multinational energy corporation Enbridge.

At the time of the Straits Pipelines' commissioning, the State of Michigan included language in the construction easement that required the pipelines' owner to maintain an adequate financial assurance mechanism—such as insurance, a trust fund, or a surety bond—to cover liability for all damages or losses in the event of a worst-case-scenario. The easement did not predict what such costs would be, other than to say they would total "at least" $1 million.

Fast forward to July 26, 2010, when Michigan experienced one of the largest inland oil spills in US history. A pipeline known as Line 6B burst and spilled heavy crude into a tributary of the Kalamazoo River. In the spill's wake, national attention focused on oil transportation safety, including that of Line 5.

In 2015, the Michigan Petroleum Pipeline Task Force, a state multi-agency group established after the 2010 spill, issued a report that made 13 recommendations, including the establishment of a Pipeline Safety Advisory Board (PSAB) and the commissioning of two studies: a risk analysis and an alternatives analysis for the Straits Pipelines portion of Line 5.

The final alternatives analysis was released in November 2017. But the independent risk analysis, which was scheduled to be completed at the same time, took a detour and arrived on Michigan Tech's doorstep.

COMPLEX FLOWS

In 2016, after an extensive request-for-proposal process, the State of Michigan hired Det Norske Veritas (DNV), a Norwegian company, to conduct an independent risk analysis of the Straits Pipelines. A few days before the release of DNV's draft report, however, the State terminated its contract, citing a conflict of interest. The public called for the immediate hire of a replacement contractor, and the State agreed.

At the time, Guy Meadows, director of Michigan Tech's Great Lakes Research Center (GLRC), served as the PSAB's state university representative. When looking to replace DNV, Meadows says, the State wanted to find an unbiased group that understood the full picture.

Michigan's universities were the answer.

"There was a suggestion that Michigan Tech should lead the process because of our extensive knowledge of the Straits of Mackinac region and its complex flows," Meadows says. When the University's name came up for consideration, Meadows recused himself from voting; on September 17, 2017, the PSAB voted unanimously to place Michigan Tech at the helm of a new risk analysis.

ALL HANDS ON DECK

For the next three months, Meadows, Elizabeth Hoy '96, assistant director of business and program development for the GLRC, and Amanda Grimm, research scientist and geospatial researcher at the Michigan Tech Research Institute (MTRI) in Ann Arbor, worked around the clock to assemble the risk analysis team and put together a proposal for the State's review.

"While Michigan Tech was asked to lead the project," Meadows says, "what the State wanted was for Michigan universities to work together to provide a science-based assessment of the true costs of a major spill."

A diver prepares to descend to the bottom of the Straits. Photo credit: Enbridge

"The scope of work required a broad distribution of people," Hoy says. "Michigan Tech's Vice President for Research Dave Reed, reached out to his counterparts at the other state universities, and we got some great responses. From there, we asked whether there were other capabilities and areas of expertise that we needed. We did some research and approached the experts. Very few people on the project knew each other beforehand."

The Line 5 pipeline runs for 645 miles.

It originates in Superior, Wisconsin, and travels through Michigan's Upper and Lower Peninsulas before terminating in Sarnia, Ontario, Canada. Under the Straits of Mackinac, Line 5 splits into two parallel pipelines that run for 4.5 miles at depths descending as far as 270 feet.

A crew conducts an external inspection of the Straits Pipelines. Photo credit: Enbridge

In keeping with the scope of work published by the State, the risk analysis team would be divided into groups to complete the following tasks:

Task A: Identify and analyze the duration and magnitude of a "worst-case" spill or release of oil or other products from the Straits Pipelines into the environment.

Task B: Analyze the likely environmental fate and transport of oil or other products released from the Straits Pipelines in a worst-case scenario.

Task C: Analyze how long it would take to contain and clean up the worst-case release.

Task D: Analyze the short- and long-term public health and safety impacts.

Task E: Analyze the short- and long-term ecological impacts.

Task F: Analyze potential measures to restore the affected natural resources and mitigate the ecological impacts.

Task G: Estimate the amount of natural resource damages that would result from a worst-case release.

Task H: Estimate the governmental costs that would be incurred as a result of a worst-case release.

Task I: Estimate all other economic damages, public and private, that would result from a worst-case release.

On December 11, 2017, Meadows gave the PSAB an overview of his proposal, built around a team of 41 researchers—21 from Michigan Tech and 20 from external organizations. Of the nine universities that would contribute to the analysis, seven were within the state of Michigan: Michigan Tech, the University of Michigan, Michigan State University, Wayne State University, Western Michigan University, Grand Valley State University, and Oakland University. The two out-of-state universities were North Dakota State University and Loyola University Chicago.

Three researchers on the project were from consulting organizations, and two were independent contractors. Two other contributors, both from the National Oceanic and Atmospheric Administration (NOAA) Great Lakes Environmental Research Laboratory, would donate their time and expertise in numerical modeling.

The State accepted the proposal, and the team officially began its work on January 15, 2018.

DEFINING THE WORST

In tackling the risk analysis, each section of the report had a section leader, a chief scientist, and at least two section authors. Grimm served as section lead for Task A, identifying the worst-case-scenario.

"By definition, the worst-case spill size is much larger than what would be expected under average or typical conditions," Grimm says. Researchers based their approach on an accumulation of worst-case assumptions that were consistent with the federal definition of "the largest foreseeable discharge of oil," found in Title 40, section 194.5 of the Federal Code of Regulations, to determine the maximum possible volume that could be released.

According to the draft report, the impacts of a spill depend on when it occurs and how meteorological conditions disperse the oil.

"A spill in the spring, just prior to the summer tourism season in the Straits, would have the largest economic impact overall," Grimm says. "We needed to follow one scenario all the way through various monetary costs that would be incurred to come up with the total amount of financial liability."

Because no oil spill as large as the scenarios analyzed in the report has ever occurred in the waters of the Great Lakes, researchers reviewed a selection of other events as analogs to evaluate the potential impacts of a Straits spill. The report also considers various modes of failure for the Straits Pipelines and separates these failures into five tiers. Under this model, discharge amounts range from 4,400 barrels of oil (bbl) to 58,000 bbl. With each bbl containing 42 US gallons, the discharge amount could reach nearly 2.5 million gallons of oil.

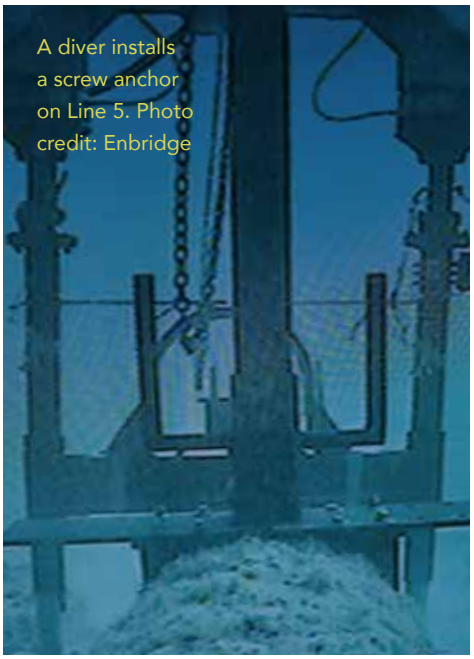
STRUNNELVISION

In May 2018, four Michigan Tech students presented state law- and policymakers with an idea to replace the aging Line 5: a 21-foot-diameter, 4.5-mile underwater utility corridor spanning the Straits of Mackinac. The "Strunnel" was a senior capstone project for 13 civil engineering and three construction management graduates. The four students representing the group presented the project to the tate's PBSA, and then to a joint meeting of the Senate Committee on Transportation and the House Transportation and Infrastructure Committee at the Michigan State Capitol.

A tunnel proposal isn't new—the State previously considered a smaller diameter corridor, which prompted the group to explore a larger, more adaptable infrastructure.

"I thought it important the Legislature hear that there are real alternatives for spanning the Straits with the utilities that are critical to the well-being of the Upper Peninsula—alternatives that are environmentally safe and may be economically viable," said Senate Transportation Chair Tom Casperson, R-Escanaba.

In October, the state of Michigan and Enbridge agreed to construct a utility corridor 100-feet below the lake bed to replace Line 5.



A diver installs a screw anchor on Line 5. Photo credit: Enbridge

"Guy Meadows and his team of researchers brought great professionalism and rigor to the independent risk analysis. Dr. Meadows led a team of top researchers from nine universities on this important task. Thanks to his leadership and effort, their work became a critical part of the State's evaluation of the Line 5 pipeline in the Straits of Mackinac, helping us to chart the best path forward for the Great Lakes and for Michigan."
– Keith Creagh, Director, Michigan Department of Natural Resources

ASSESSING THE WORST

In addition to her role as Task A's lead, Grimm wore two other hats, serving as the project's day-to-day coordinator and its data manager. Due to the project's short timeline, researchers would not have the time to accumulate new data, so Grimm tracked down more than 60 existing data sets, on everything from gill net surveys to Mackinac Bridge traffic volume. She and Ryan Williams, a geospatial research scientist at the GLRC and assistant director at the Michigan Tech geospatial research facility, worked with colleagues to create web maps that helped team members work together remotely. Some of the most critical existing data resided with researchers at NOAA—a hydrodynamics data set from 2016 that included water movement and meteorological conditions for the entire year. The information set was so extensive that the NOAA contributors had to purchase external hard drives, upload the data, and overnight the hard drives to Houghton.

"We received about two terabytes of data," Grimm says. "There just isn't cloud capacity for that amount of material." A terabyte is approximately one trillion bytes of data.

Michigan Tech's Pengfei Xue, chief scientist for Task B (analyzing the likely environmental fate and transport of oil or other products released from the Straits Pipelines in a worst-case scenario), used NOAA's hydrodynamics inputs and an oil dispersal model to run the more than 4,300 simulations of how a spill might affect the Straits.

Xue, who is the director of the GLRC's Numerical Geophysical Fluid Dynamics Laboratory and an assistant professor of civil and environmental engineering, was a co-developer of the original version of the hydrodynamic model and the particle-tracking model during his doctoral studies, so he felt right at home using it to model oil dispersal in the Great Lakes.

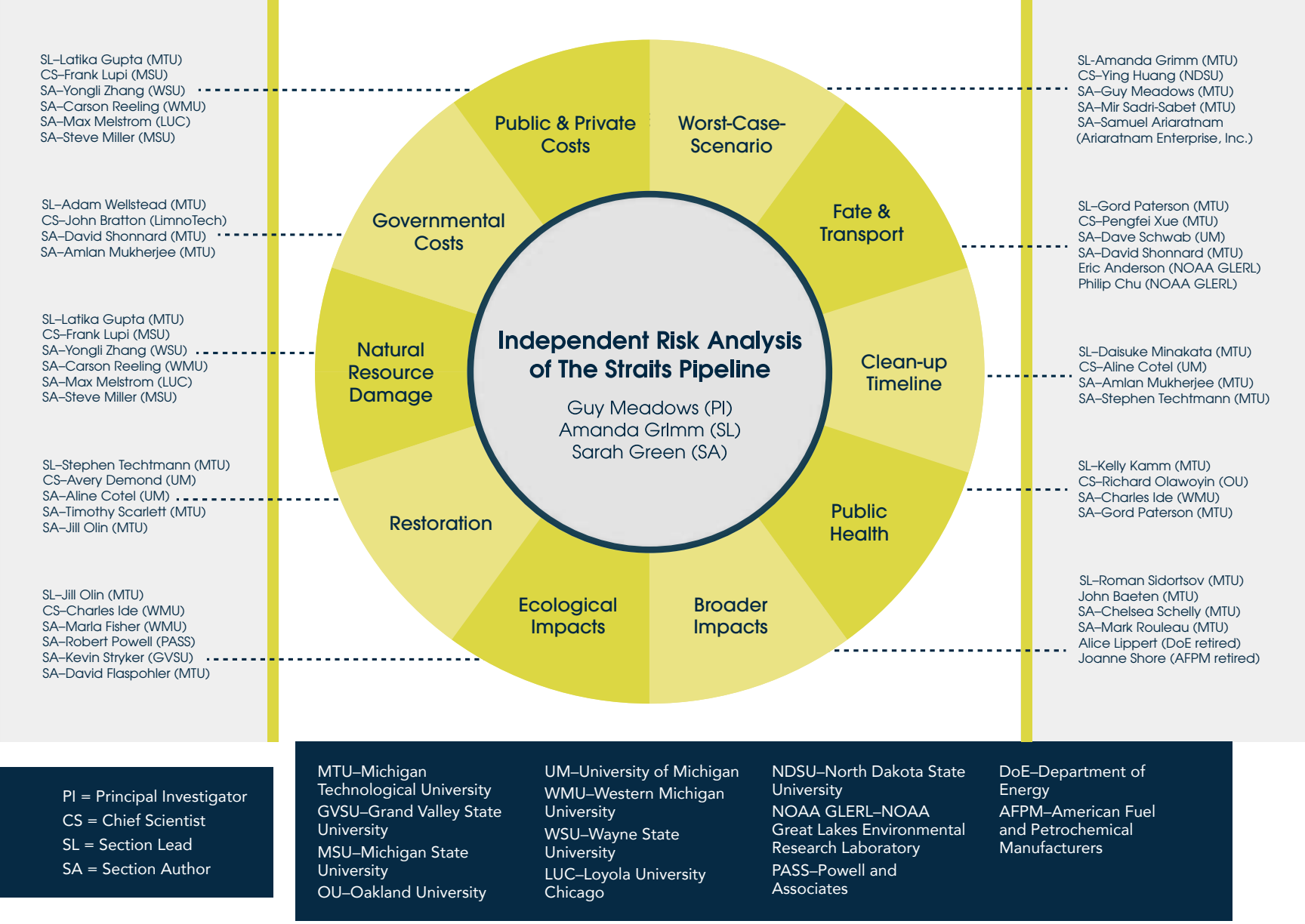
The Task B team ran their 4,380 simulations on Superior, the University's shared high-performing computing infrastructure (or

Michigan Tech monitoring buoys provide real-time environmental monitoring of water conditions in the Straits.

SOLVING FOR X

The risk analysis team went above and beyond the charge of duty by including a "broader impacts" section, referred to as Task X. The Task X team provided a comprehensive overview of risks that various affected communities perceive in connection with the Straits Pipelines. Affected groups included Indigenous communities; local, state, federal, and Canadian government officials; environmental and historic preservation groups; and tourism, fishing, and recreation industries.

"We analyzed nearly 44,000 public comments submitted in response to the alternatives analysis, and we reached out to a number of tribal and government actors to clarify and supplement our findings," says Roman Sidortsov, an assistant professor of energy policy at Michigan Tech who served as Task X's section lead. "The main goal of our section was to determine the extent to which key stakeholders are willing to tolerate and accept perceived risks of a potential petroleum release. We provided the State with legitimacy indicators to aid in making decisions related to the Straits Pipelines that reflect the will of the communities who live with the risks."



PI = Principal Investigator
CS = Chief Scientist
SL = Section Lead
SA = Section Author

MTU–Michigan Technological University
GVSU–Grand Valley State University
MSU–Michigan State University
OU–Oakland University
UM–University of Michigan
WMU–Western Michigan University
WSU–Wayne State University
LUC–Loyola University Chicago
NDSU–North Dakota State University
NOAA GLERL–NOAA Great Lakes Environmental Research Laboratory
PASS–Powell and Associates
DoE–Department of Energy
AFPM–American Fuel and Petrochemical Manufacturers

supercomputer cluster). Superior is one of the most powerful high-performance computer clusters in the region.

"Movement of oil in the water depends on the water itself, ice, wind conditions, and other weathering processes, such as evaporation," says Xue, explaining that in a Lagrangian particle-tracking model a cloud of numerical tracers represents an oil spill, and that cloud shifts and migrates depending on different conditions. "We ran each simulation with oil being allowed to disperse for a maximum of 60 days, at six-hour intervals throughout the whole year. From these simulations, we could examine scenarios under a set of metrics including length of oiled shoreline, area of oiled open water, and volume of beached oil. So each task team could choose worst-case scenarios best suited for their area of study."

When all was said and done, the Task B team produced approximately eight terabytes of data, repackaged visually for the rest of the team. The simulation results updated previous oil dispersal modeling capabilities for the Great Lakes to include potential effects of wind, ice-cover, and evaporation on oil dispersal.

Meadows and Xue explain that ice cover alters the trajectory of oil movements. In the winter, ice slows oil in reaching the shoreline and allows oil to stay in the water for a longer period of time. In the case of the Straits of Mackinac, this means a higher possibility that oil from a ruptured pipeline would reach both Lake Michigan and Lake Huron. While the effect of ice cover could allow more oil to be recovered before reaching the shoreline, it would also likely mean a longer response time and lengthier period of cleanup. The harsher the winter conditions, the harder it would be to clean up a spill. And if responders are unable to take immediate action, the oil would spread to an even greater extent.

Task B team member Dave Schwab, a world-renowned research scientist and hydrodynamic modeling expert from NOAA, now at the University of Michigan's Graham Sustainability Institute and MTRI, notes that the work done in relation to the risk analysis advanced the state of the art in numerical modeling for the Great Lakes. Schwab was one of the original designers of NOAA's Great Lakes

Coastal Forecasting System in the 1990s and says he has witnessed continuing remarkable improvements in computer modeling of the Great Lakes since then.

"Great Lakes monitoring and prediction systems, critical to the large percentage of US and Canadian populations in the region, often precede similar ocean monitoring systems by a decade," Schwab says. "As part of the Line 5 risk analysis, we were able to include the effect of ice cover on circulation in the Straits of Mackinac for the first time. This modeling improvement will also be incorporated into NOAA's operation Great Lakes forecasting system."

Michigan Tech's Great Lakes Research Center deploys, operates, and disseminates data from monitoring buoys for the benefit of all who use the waterway.

Xue notes that the models produced in this project served as a layer that impacted all the other tasks. Indeed, teams working on other sections of the report used the simulation results to run their own analyses, including public health and safety impacts, ecological impacts, and natural resource damages. Those impacts and damages provided the basis for the $1.8 billion figure the team's economists estimated total worst-case-scenario costs to be.

BEYOND THE STRAITS

The report has had an immediate impact on the Great Lakes region. It highlighted impacts on Ontario and Wisconsin in ways previous reports did not, and it factored heavily into the State of Michigan's October 3, 2018, agreement with Enbridge to permanently shut down the Straits Pipelines and construct a multi-use utility tunnel beneath the Straits.

Members of the risk analysis team believe the report's impact will also extend well beyond nearby shores.

"Our work pointed out knowledge gaps," Grimm says. "In some areas, we had to make assumptions about, for example, crude oil in a freshwater system because there was no historical open freshwater spill similar enough to use as a model. That kind of information gap has become a research need—how does oil behave in large freshwater systems? That should become more widely known."

Grimm also notes that the risk analysis can inform other governments as to what consequences to consider when proactively planning response efforts to smaller hydrocarbon spills.

Xue notes that visualizing model results helps create immediate understanding for a non-technical audience.

"People are becoming more familiar with what modeling is, how it works, and how it can help the public and state governments address the 'what if' question," he says, explaining that a visual "gives people a take-home message about how big the impact could be. Similar models can be used to help people understand and make decisions about things like climate change, and to study the transport and fate of other contaminants, like algal blooms."

COOPERATIVE COLLABORATION

Hoy and Meadows are amazed by what the researchers were able to accomplish in a six-month timeframe.

"This project came together quickly with little notice," Hoy says. "People took on the responsibility of their tasks and roles in addition to the things that they were already doing in their day job—teaching, research projects, etc. Everyone who participated stepped above and beyond to accommodate this important project." Meadows agrees. "The universities and NOAA, our federal partner, came together to provide a highly technical analysis of a very complex, multifaceted problem for the state of Michigan. The people who participated agreed with the purpose of the report. They were hardworking, and they did fine work."

Meadows also notes the key role that the State of Michigan and the public played in the process. "Their feedback and comments were an integral, important part of the process."

FIRE MOUNTAIN

Volcán de Fuego has been a Michigan Technological University research site for decades. When the Guatemalan volcano erupted in June, numerous faculty, alumni, and students mobilized to respond to the disaster.

It is perhaps fate that Rüdiger Escobar-Wolf would become a volcanologist.

He grew up in Quetzaltenango, Guatemala, a small city surrounded by volcanoes. From a young age, Volcán Santiaguito captivated him.

"I was aware of the eruptions, and we would get ash from the volcano when I was a kid," Escobar-Wolf '07 '13, research assistant professor in the Department of Geological and Mining Engineering and Sciences, says. "Two older brothers would hike on the volcano long before I was allowed to. It always lived in my imagination as a mysterious and a very interesting place."

When Escobar-Wolf was 12 years old, a group of family friends hiking on the volcano were killed in an eruption. It made such an impression on him, Escobar-Wolf knew he had to study volcanoes one day. But Guatemala, though a nation with many volcanoes, does not have a robust path toward studying volcanology, so Escobar-Wolf settled for civil engineering. Working as a contractor on a seismic risk project brought Escobar-Wolf into contact with another group of people—Michigan Tech researchers—working with Coordinadora Nacional para la Reducción de Desastres or CONRED, Guatemala's disaster response agency.

William Rose, professor emeritus, began working in Guatemala on volcanoes research in the 1960s. He says that until recently, almost all of the people he met on Guatemalan volcanoes were civil engineers.

"Rüdiger was a civil engineer. Civil engineers like bridges and bricks and buildings. They don't usually like rocks, the natural world, field work, and climbing volcanoes," Rose says. "But Rudiger did. His mom built such a strong feeling inside him for climbing that he was a civil engineer that just loved the mountains."

Collecting pyroclastic flow samples during an August visit to the volcano funded by an NSF RAPID grant.

Rose convinced Escobar-Wolf to earn his master's and PhD in geology at Michigan Tech, which Rose says is one of the best volcanology programs in the world.

"A lot of volcanology programs are laboratory oriented," Rose says. "They have labs where they do fluid dynamics, material science, and chemistry. They measure many things including hafnium isotopes."

> "We go to the field. The volcano is our experiment."

Michigan Tech's volcanology program participates in INVOGE, the International Geological Masters in Volcanology and Geotechniques, giving students opportunities to study in the US, Italy, and France. Tech's program is broad, including faculty who focus on seismology and geophysics, rock composition, gases, and landslides, with a healthy dose of engineering principles.

"We can tackle problems that are unusual because we have diverse specialties and connections all over the world," Rose says.

Federica Lanza '12 '16 participated in the INVOGE program as a master's degree student, and then decided to earn her doctorate at Michigan Tech. With fellow student Kyle Brill '11, she worked at Fuego under the direction of Greg Waite, associate professor of geological and mining engineering and sciences.

"Fuego's persistent activity makes it an excellent natural laboratory to study vulcanological processes in open vent systems," she says. "The proximity to numerous villages and to the populous Guatemala City puts Fuego in a high volcanic risk category, and therefore the scientific community has a high interest in studying the volcano in order to improve their knowledge on how and when the volcano could erupt."

Lanza says an understanding of precursory signals can lead to local warnings of explosions, giving scientists, tourists, and the local population time to evacuate. During her fieldwork on the mountain, she helped install seismometers and tiltmeters in close proximity of the summit in order to collect data on the seismicity and deformation occurring at the volcano.

The data collected by these temporary sensors strengthen the permanent seismic network deployed at the volcano and allow for the identification of earthquake patterns and a special type of seismic signal that contains low frequencies.

Lanza also worked with Ezequiel Medici, research assistant professor of mechanical engineering-engineering mechanics, to install infrasound sensors to measure shock waves produced by explosive eruptions human ears cannot hear and to study the characteristics of volcanic jets.

However, perhaps the source of the program's success is that research isn't focused solely on the technical aspects of volcanology, but also on the effects of volcanic eruptions on human communities.

"Our goals and research aren't just focused on scientific things like volcanic ash, gas emissions, remote sensing, and atmospheric science, but also on social aspects. We want to have a lasting input into the future in Guatemala," Rose says.

Chain of Fire

Guatemala's volcanoes track in a line from northwest to southeast, with the Pacific Ocean to the west and Guatemala City to the east. Volcán de Fuego rises 12,346 feet (3,763 meters) from the lush forests of the Guatemalan highlands. Near the peak, the mountain is smeared with deposits of debris, which give way to greenery. The length of the stratovolcano's haunches is marked by barrancas—deep channels cut into the sides of the mountain by runoff from Guatemala's long rainy season. Fuego's twin, Acatenango, sits just north.

"Guatemala is a magnificent tropical landscape, especially in the mountains. The natural vegetation is just gorgeous. There are orchids everywhere," Rose says. "But after the eruption, the mountain is denuded, dangerous, and horrific. The volcano has changed it into a series of deep gullies you can barely traverse."

Like many active volcanoes, Fuego has erupted multiple times in the past few decades. Escobar-Wolf surmises these small, frequent eruptions—as often as every month—may have led to a sense of complacency in the communities around the volcano and in the nation's emergency agencies.

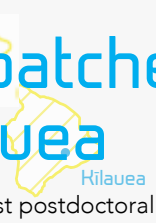
"Every time an eruption happened, there was always the question of whether people should be evacuated," Escobar-Wolf says. "As you might imagine, you can't evacuate 50,000 people every month. To some extent, myself included, we had become desensitized to the eruptions."

Fuego erupted Sunday, June 3. The first indication of the eruption's magnitude was the height of the eruptive cloud, which billowed nearly 15 kilometers (slightly more than 9 miles) into the sky—large enough to be seen by satellite despite the surrounding cloud cover. Fuego's last major eruption in 1974 caused an eruptive cloud about the same height.

Guatemala's National Institute for Seismology, Volcanology, Meteorology and Hydrology (INSIVUMEH) began sending alerts at 6:30 AM that Sunday. But it wasn't until his Twitter feed was filled with posts about the eruption from colleagues, friends, and others in the scientific community, that Escobar-Wolf said he knew, thousands of miles away in Houghton, something about the eruption was different and cause for great concern.

When the eruptive cloud collapsed under its own weight, the hot ash, gases, and debris came tumbling back to Earth, creating a pyroclastic flow. The flow roared down the mountainside, and the volume of the flow overwhelmed the barranca channels. Rather than channel toward the plain at the base of the mountain, the pyroclastic flow surged out of the Las Lajas barranca,

Dispatches from Kīlauea



Alumni, past postdoctoral researchers, and faculty all played a part in the Kīlauea eruption response during spring and summer 2018, including Greg Waite, John Lyons, David Schneider, Verity Flower, Tricia Nadeau, Jay Wellik, and Matt Patrick.

The volcano's eruption has been called a once-in-a-generation opportunity for scientific research, but it has also been hugely disruptive and damaging to communities and area tourism. The volcanologists, geologists, geochemists, and other scientists who have been called to Hawaii's Big Island provided aid to the state's emergency response team. They are also there to research volcanoes to improve future eruption response.

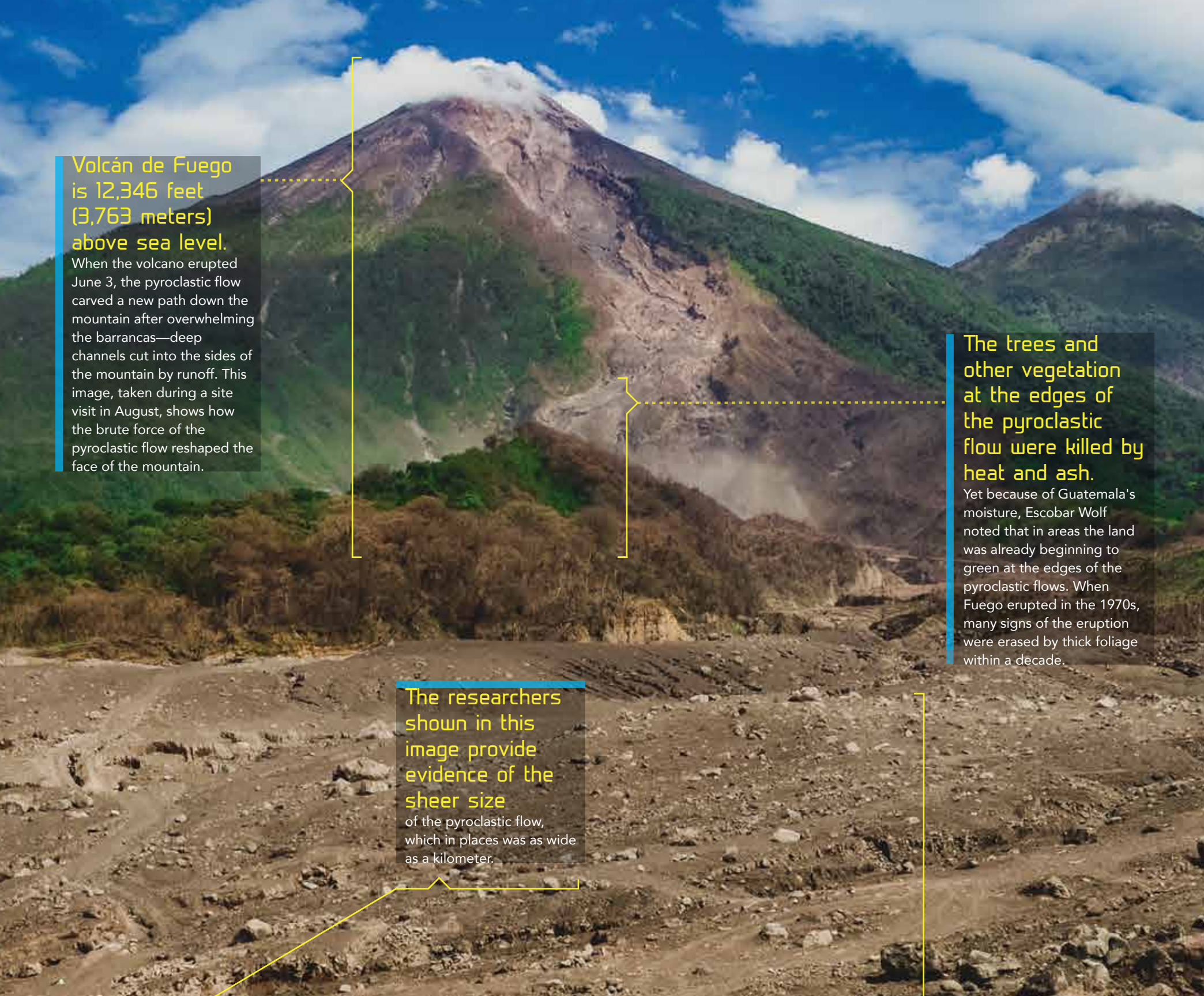
Responders reacted to two different eruptions—explosions and gas emissions. Ash is hazardous to aviation and health, as are sulfur gas emissions. Both air quality and encroaching lava created threats to private property and infrastructure, including a geothermal electric plant and cell phone towers.

The incredible amount of data scientists grapple with presents its own problem; processing data from sensors, satellites, and other measurements takes teams of people to create knowledge from information and apply it to a rapidly changing situation, which is part of the reason for the USAID-USGS VDAP.

The Kīlauea eruption, which has now quieted to low-level sulfur emissions, was more than lava fountains and ash clouds. Volcanoes are part of complex geophysical systems, and those who research them seek to learn more about how the systems interact. Kīlauea is particularly complex. It erupted from two areas that are 25 miles apart and the stresses within the crust at the different eruption sites were influenced by the magnitude 6.9 seismic event the Big Island experienced May 4.

"Earth scientists in general think a lot about processes," said Greg Waite, associate professor of geological and mining engineering and sciences. "We don't think of the Earth as a static body. This is a very complicated system underneath Kīlauea that takes people with many specialties working together to understand what's happening and how things are changing to try to determine what happens next. It's amazingly interesting trying to figure out what's going on and watching this unfold in real time."

Read the entire Kīlauea article on Michigan Tech's news website: *mtu.edu/news/stories/2018/june/dispatches-from-kilauea-reflections-on-the-eruption.html*



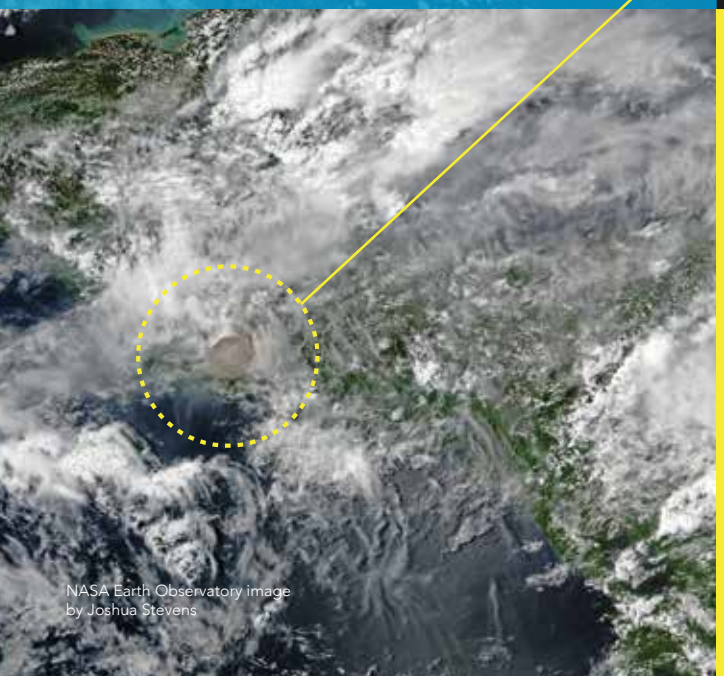
Volcán de Fuego is 12,346 feet (3,763 meters) above sea level.
When the volcano erupted June 3, the pyroclastic flow carved a new path down the mountain after overwhelming the barrancas—deep channels cut into the sides of the mountain by runoff. This image, taken during a site visit in August, shows how the brute force of the pyroclastic flow reshaped the face of the mountain.

The trees and other vegetation at the edges of the pyroclastic flow were killed by heat and ash.
Yet because of Guatemala's moisture, Escobar Wolf noted that in areas the land was already beginning to green at the edges of the pyroclastic flows. When Fuego erupted in the 1970s, many signs of the eruption were erased by thick foliage within a decade.

The researchers shown in this image provide evidence of the sheer size
of the pyroclastic flow, which in places was as wide as a kilometer.

Fuego's eruptive cloud (the brownish circle in the left center of the image) rose 15 kilometers (9 miles) into the troposphere, containing gases including sulfur dioxide. Large volcanic eruptions have in the past been credited with temporarily cooling the planet's climate when the gases in eruptive clouds react in the atmosphere to create aerosol particles. When sulfur dioxide reacts with water vapor in the atmosphere it also forms acid rain.

As Guatemala enters its rainy season, areas around the volcano are threatened by lahars–debris from the eruption mobilized once again that flows down the mountainside and into the barrancas. Since the June 3 eruption, INSIVUMEH and the USGS have been working together to install new equipment and software to help mitigate the hazard from lahars by allowing scientists to better forecast and detect such events.



NASA Earth Observatory image
by Joshua Stevens

William "Bill" Rose and Rüdiger Escobar-Wolf with a sample of volcanic rock.

destroyed a bridge, inundated a luxury golf resort, and swept toward the factory town of San Miguel Los Lotes, which has now been designated by the Guatemalan government as a national cemetery.

The luxury golf resort had a disaster plan in place and quickly evacuated. The majority of the people in San Miguel Los Lotes weren't so lucky.

"Later that night, reports started to emerge about a community directly hit by pyroclastic flow. That's when I knew things were really bad," Escobar-Wolf says. "In all the chaos, INSIVUMEH didn't initially know all that had happened and CONRED was overwhelmed."

Escobar-Wolf says INSIVUMEH contacted him and a group of volcanologists the agency has worked with through the years that included Michigan Tech alumni, the USAID-USGS Volcano Disaster Assistance Program (VDAP), and researchers at University of Bristol in the United Kingdom, National Autonomous University of Mexico, and University of Edinburgh. Together, these people created an informal advisory council technical panel to put technical advice and hazard maps rapidly into the hands of disaster responders.

The impacts from Fuego's eruption didn't stop after the eruption. As Guatemala enters its rainy season, areas around the volcano are threatened by lahars—debris from the eruption mobilized once again that flows down the mountainside and into the barrancas—and this time the government agencies want to be ready.

Responding to Disaster

In the wake of the eruption the USAID-USGS VDAP has been involved in aiding the INSIVUMEH. John Lyons '11 and Jay Wellik '14, both Michigan Tech alumni and USGS employees, have been involved in the response.

Wellik, now a seismologist with VDAP, is working with the Guatemalan agencies to provide training and assistance for installing and running alarm software to send automatic alerts to scientists and emergency managers if activity levels at the volcano increase. He first visited Guatemala as a Michigan Tech student to install a seismic array around Volcán de Pacaya. Since the June 3 eruption, INSIVUMEH and the USGS have been working together to install new equipment and software to help mitigate the hazard from lahars by allowing scientists to better forecast and detect such events.

And Escobar-Wolf has been a particularly important person in the response efforts for several reasons. First, his fluency in Spanish has allowed him to easily converse not only with Guatemalan agency personnel more easily, but he was able to give interviews to Guatemalan media and answer the public's questions about the eruption via Twitter.

Secondly, he applied for and received a National Science Foundation RAPID grant to study the eruption's pyroclastic flows to understand how the flows generated and to study why the flows were so mobile and covered such a large area.

Escobar-Wolf says that prior to the June 3 eruption the Las Lajas channel was vegetation-covered and deeply incised by water.

> "When I went to Guatemala in August, the landscape had changed completely. A pyroclastic flow is a big deposit of sand and rocks, a little like looking at a dry riverbed."

But the lush environment around the volcano cannot be set back for long.

"Already when we went there some areas had started to regrow," Escobar-Wolf says. "Eventually over the years everything will become green again. After the 1974 eruption things were rock and sand and ash. But five to 10 years later those areas had some vegetation again. We use that kind of information to infer when past volcanic deposits were placed. In areas where we don't see a big forest, we have an idea of how old the deposit is."

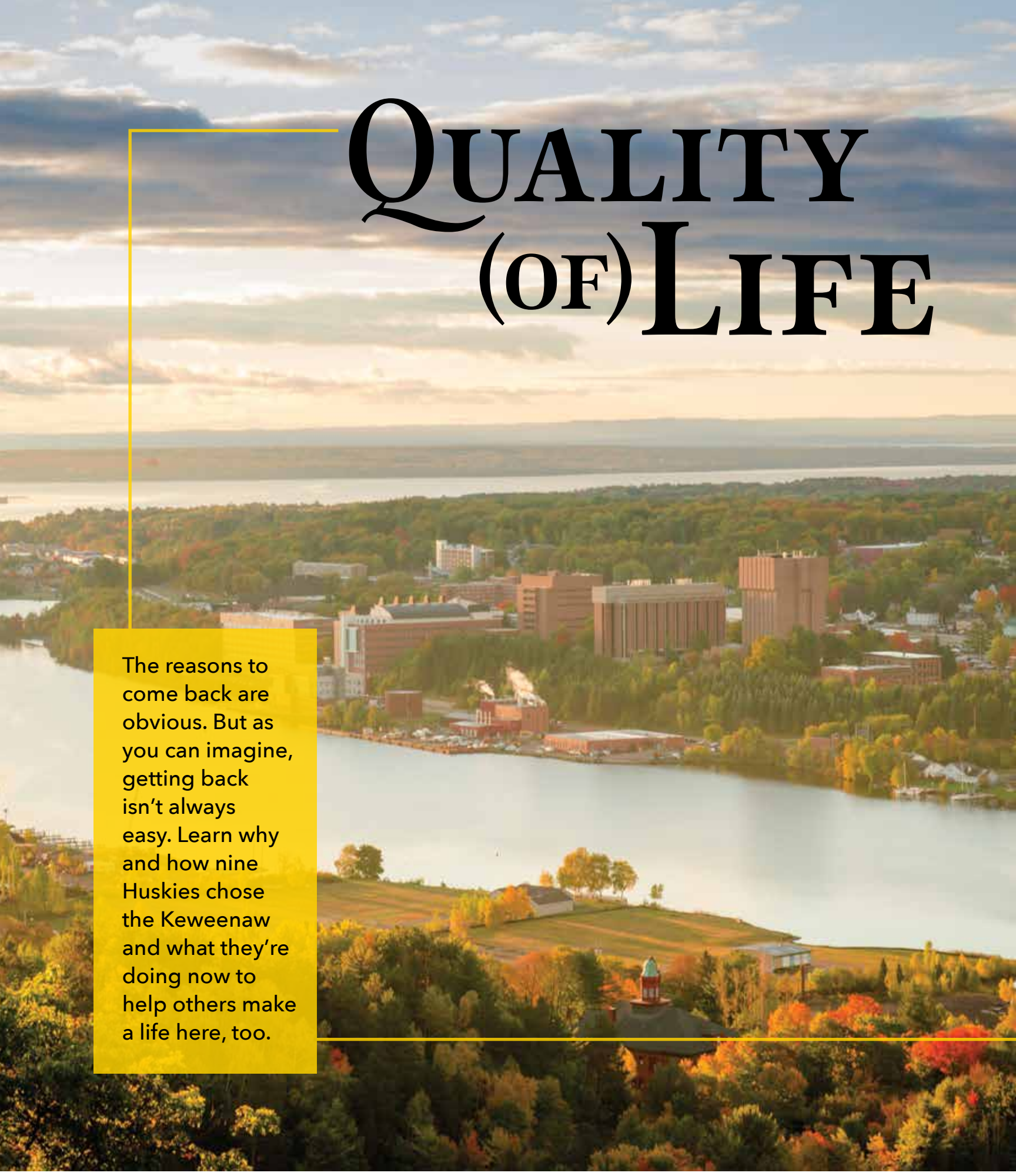
Escobar-Wolf's preliminary impression is that flows were caused both by the large eruptive column collapse as well as unstable slopes from previous pyroclastic flow deposits. Escobar-Wolf and a number of students who came with him on the trip took 200 kilograms (about 441 pounds) of samples from the flows, but are also using remote sensing data from Landsat, Sentinel-2, and Planet Labs satellites to compare slope composition before and after the eruption.

As part of the grant and his general involvement with the Fuego crisis, Escobar-Wolf will return to Guatemala several more times to participate in a workshop with government agencies to improve early warning systems, and to collect additional samples. His work will be made available to INSIVUMEH and CONRED to help those agencies build their capacity to respond to future eruptions.

"The bottom line is that something didn't work with early warning," Escobar-Wolf says. "Because the volcano was erupting for so many years, CONRED and INSIVUMEH had tried to put into place early warning, but perhaps since the volcano had already been erupting for many years, the system as a whole didn't work."

Escobar-Wolf believes if there had been better monitoring and communications systems in place, San Miguel Los Lotes could have evacuated in time. But mobilizing these systems requires years of planning and investing resources to be functional. He proposes doing just that.

"We need to invest time, money, and public resources," he says. "The communities also need to invest time and resources. We are focusing exclusively now on this incident as a learning opportunity to avoid this happening again. Whatever failed, let's fix it so it doesn't happen again."



Quality (of) Life

The reasons to come back are obvious. But as you can imagine, getting back isn't always easy. Learn why and how nine Huskies chose the Keweenaw and what they're doing now to help others make a life here, too.

Moved back: Fall 2015 From Houston

After graduation, Ryan and Katie moved to Wyoming for jobs in the oilfield service sector. In 2010, Katie found out she was expecting and transferred positions within her company, which entailed moving to Houston. Ryan was also able to transfer within his company. They made the move in 2011. In 2012, Ryan decided to get into the "family business" of beer making (his dad owns Keweenaw Brewing Company) by starting the online Electric Brewing Supply company; shortly thereafter, Katie found out she was expecting again.

Fast-forward to 2015 when Katie got laid off from her job and couldn't find work in Houston. During a road trip to visit both their parents in the Upper Peninsula (Katie's in Escanaba; Ryan's in Houghton), they made the decision to stay. The couple closed on their Chassell property in November, moving their family upstairs and their E-Brew Supply business downstairs. Katie works at Little Huskies and helps out with the family business; Ryan works full-time growing his company that now employs five people.

"When we were students up here," Ryan says, "the biggest complaint we had was that we had to graduate and leave. We were pretty set on coming back."

Ryan '07 and Katie (Richards) Gray '07

"Don't get me wrong, I loved the conveniences of Houston, but Houghton is home; this is where I want my kids to grow up."
– Katie Gray

Whitney Warstler '06 '11

Moved back: June 2016 From Cape Town, South Africa

Originally from Escanaba, Whitney studied business administration (BS '06) and marketing, as well as rhetoric, theory, and culture (MS '11) at Michigan Tech. She worked in Vietnam for a year in 2007; after receiving her master's, she jumped at the chance go to back to Southeast Asia and moved to Singapore. After a stint in Tanzania in 2012, Whitney moved to South Africa in 2013.

"I was there for three years. I was a head buyer at a big e-commerce site and I had a bar and a brewery," she says, "but I had to renew my visa and it was becoming difficult to do so. I thought, 'I'm going to be in a difficult position now or five or ten years from now, so I might as well rip off the band-aid and sell everything and go.' And so I did."

In June 2016, Warstler made the trek back to the Keweenaw. She is now director of the Keweenaw Peninsula Chamber of Commerce, a role she says she loves. "One of my goals at the Chamber is to create more opportunities for people to come back—more jobs that can support families." Mom to Hazel, Warstler helps young families thrive in the Keweenaw.

"My gut instinct is to say I'm from here even though it's not where I grew up; Houghton has always felt like home. And so, I really wanted to be able to come back. I didn't know if I was going to be given an opportunity or if I would have to make one."
– Whitney Warstler

Lynn (Czarnecki) '07 and Jason Makela '10

Moved back: August 2017
From Seattle

"We realized we were not city people. We were spending two to three hours a day in traffic, and it was not a lifestyle we were ready to commit to long-term. So when the opportunity came to move back to the Keweenaw, we took it," says Lynn Makela, who holds West Coast business hours as a digital marketing business development director from 101 Quincy Coworking, a business she cofounded in Hancock.

"What brought me back? The variety of things at your fingertips that are less than five miles away."
– ***Lynn Makela***

"But the community was a big part of it, too."
– ***Jason Makela***

Lynn had moved from Hancock to Oregon in 2013, but in 2017, she was fortunate enough to take her career across the country so that she could join her husband, Jason, who was given an opportunity only the 906 could offer. He explains, "There is a space propulsion technology that I am passionate about and an emerging market that I couldn't tap into out west, so when I had the opportunity to be on the ground floor of a startup company in the Copper Country that focused on those specific things, I was really stoked about making the move."

So the Makelas packed up their life and Jason took a position as vice president of engineering at Orbion Space Technology. He builds rockets for satellites during the day; after work, he, Lynn, and their dogs play fetch on their lakefront property. Lynn says, "We worked really hard to get here and we work really hard to stay here, but we feel really lucky to live here, too."

Jake Timmer '16

Moved back: Summer 2017
From Grand Rapids, Michigan

After graduating with a BS in computer science, Jake and a fellow Michigan Tech graduate started a software consulting company. They were living in Michigan's Grand Rapids area, but working with companies and partners online. "Based on the type of work we were doing," Timmer says, "we thought it would be best to move everything up to Houghton."

"If I were to go to Silicon Valley and be a programmer, I couldn't do all the stuff I really like."
– ***Jake Timmer***

Which they did, last summer. Their company, Superior Technologies, works in blockchain. They did a stint in the Michigan Tech Enterprise Corporation (MTEC) SmartZone Technology Business Incubator, and now rents an office in the MTEC SmartZone. Timmer insists moving back was best for business: "Basically, we do work in a specific subset of software and it requires a lot of low-level programmers with the types of skills Michigan Tech teaches students. I graduated from here, the other two business partners graduated from here, and now we hire Tech students as interns and employees."

Heather (Wright) ’06 ’07 and Caleb Wendel ’07

Moved back: May 2018
From Duluth, Minnesota

The Wendels have roots in the Keweenaw. Caleb’s began in the 90s when his family built their cabin and continued to grow when he co-founded The Bike Shop in downtown Houghton in 2006, which later became Rhythm Bike and Board Co. Even after Caleb and Heather moved away for work, they were drawn back various times each year for bike events, family, and friends, which is why Heather says, “We never really left.” But they did.

In fact, they lived four hours away in Duluth, Minnesota, for seven years. Just recently, the couple found their ideal spot to build a homestead, and Heather was able to convince her employer to let her work remotely (Caleb had been working remotely since 2017). During business hours, Heather is an environmental engineer, working for Barr Engineering. Caleb is a Midwest sales representative for Rocky Mountain Bicycles.

“We were spending a lot of our vacation time coming back to the area and we knew eventually we wanted to move back here,” Heather says.

> “We value living in an area that supports a more active and outdoor lifestyle so that we can make the most of our working years.”
> – ***Heather Wendel***

"Knowing your neighbors, deep friendships. Those are the kinds of things this area offers. When you move away, you realize what you left."

Marilyn Clark '73 '76

Michigan Tech SmartZone CEO

Moved back: 2005
From the United Kingdom

At the end of the year, Marilyn Clark will retire as CEO of the Michigan Tech SmartZone, a position she has held since 2011. She'll leave the work, but not the area. A native of the Copper Country, Clark graduated from Chassell High School before receiving a bachelor's degree in math and a master's degree in business from Michigan Tech. When she left, she was gone for 30 years, working for Cummins Engine Company in New York, Indiana, and the United Kingdom. She moved back to help a fellow Husky start a business. "It's been an exciting career," she says.

As CEO, she's had the opportunity to help many Tech alumni start or grow high-tech businesses on Innovation Shore. "This is a great environment to live and work; there's an opportunity for highly skilled people to get the resources to start a high-tech business, to get a high-tech job in the community, and enjoy our outdoor playground. It's so welcoming. We're very people focused here. It is a great place to live and work for that reason."

"This is a great environment to live and work . . . "
– *Marilyn Clark*

While these nine have moved back within the last decade and work off campus, other crazy smart alumni moved back more than a decade ago. Several are Michigan Tech faculty and staff, and others are successful local business owners. Many more Huskies had the tenacity to never leave town after commencement. All share the sentiment that the Keweenaw provides a quality life second to none.

Are you a Michigan Tech grad who moved back to the Keweenaw?

Share a photo and story on social media with the hashtag **#mtualumni** or email **alumni@mtu.edu**

A FAMILY AFFAIR

Michigan Tech is a part of Bill Bernard's family, and vice versa. His father and four of his five siblings, and son went to Tech. Last summer he gave back to the University he feels gave him so much.

On August 2, the Bernard Family Clock Tower was officially dedicated. Located between the Memorial Union and R. L. Smith buildings, the 37-foot tower with four clocks and a large bell, can be seen and heard, both on and off campus.

But, Bernard's commitment goes farther. In addition to the clock tower, his contribution established the William J. Bernard Jr. Family Endowed Scholarship Fund.

Bernard did more than provide funding for the clock tower project. He and his wife, Ilene, and their children were intimately involved with the tower's design and construction. "We wanted the design to tie in the history of the Copper Country," he said at the August dedication. "And, indeed it does."

The tower's design is reminiscent of railroad trestles from the region's copper mining heyday. The twin decks are a nod to the iconic lift bridge that links the University to the Keweenaw Peninsula. The base upon which the tower sits is constructed from Jacobsville sandstone that was reclaimed from the Power House, one of the structures built on the Michigan Tech campus that has since been demolished.

The William J. Bernard Jr. Family Endowed Scholarship Fund is awarded to a student enrolled in the Department of Materials Science and Engineering. Preference is given to students from–in order of preference–Houghton, Hancock, the Upper Peninsula, Michigan, Wisconsin, and Ohio. These locations represent where Bernard's family has lived throughout the years. The first recipient of the $4,000 scholarship is Matthew Thomas, a third-year materials science major from Jackson, Michigan. The renewable scholarship is a departmental scholarship, meaning students don't apply for it but rather the recipient is selected by the department.

Bernard, who said at the tower dedication that he is "proud to be a Yooper," is a Houghton native and a 1969 Michigan Tech graduate with a bachelor's degree in metallurgical engineering. He is now CEO and chairman of Surface Combustion, Inc. At the dedication he said, "I never thought I'd be in this position, to give this kind of gift." In an article earlier this year in Houghton's *Daily Mining Gazette*, Bernard elaborated on his gratitude: "I've had the opportunity to travel almost everywhere in the world doing business. Tech gave me a great foundation; that's the reason I want to support its legacy."

In an interview with Michigan Tech, Bernard said, especially, coming from a large family, he saw that people in the Copper Country and the UP in general are good to each other and help each other out. "My parents had a lot of good friends in Houghton, both in and out of the University. Those friends and relatives, they were good to us."

When asked what motivated him to include the endowed scholarship in the donation for the clock tower, he told a story that he says illustrates the friendliness of the people of Houghton.

Shortly after high school, Bernard and one of his brothers traveled "down south" to Saginaw, Michigan, to look for work. A business woman from Houghton asked them to deliver a knife that her brother had forgotten. Her brother was Art Karam, a 1942 Michigan Tech alumnus and former Huskies hockey player, who managed a foundry there. After a considerable wait, they finally met Karam, who would one day serve on the Michigan Tech Fund Board. Karam asked the boys if they had work. They did not, but were looking. In large part because they were from Houghton, the Bernard boys started working the midnight shift at the foundry the next day.

"That was a good memory," Bernard said. "Because people in Houghton help each other. And not just from Houghton, but throughout the UP, Michigan, Wisconsin, and Ohio. That's why we focus the scholarship to students from these areas."

The Bernard Family Clock Tower is the latest addition to Michigan Tech's Alumni Way project, which includes the John Rovano Plaza, between the Van Pelt and Opie Library and Rekhi Hall, and Husky Plaza. The next phase in the Alumni Way, is a proposed arch at the entrance to Alumni House. For information on naming opportunities in the Alumni Way, visit *mtu.edu/alumniway.*

The Bernard Family Clock Tower was formally dedicated on August 2. Bill and Ilene Bernard, pictured with Michigan Tech President Richard Koubek, were on hand for the festivities.

★★★★★

"We can never (and would not want to) replicate the full horror of trench warfare, but even an understanding of what it takes to get 'dug in' makes you appreciate the work it took for the combatants to try to stay alive."
—Steven Walton, associate professor of history, oversaw the final dressing-out of the trench

IN THE TRENCHES

The University answered the call for troops skilled in mining operations. Student soldiers lived and trained on campus.

The 11th hour of the 11th day of the 11th month—in November 2018, Michigan Tech paused with the world to mark a century since the battlefields of the Great War fell silent.

The centenary of the November 11, 1918 Armistice presented an opportunity to revisit a war that, despite its nickname, was eclipsed by the war to follow, as Doughboys were replaced by G.I.s and mother's letter from home gave way to Betty Grable pin-ups. It was an opportunity to find out more about Michigan Tech—then known as Michigan College of Mines—and the Copper Country's involvement in what H. G. Wells termed "the war that will end all wars."

Conceived by Sue Collins, associate professor of humanities and the project director, World War I & the Copper Country was an all-campus effort.

One hundred Michigan Tech football players filled 2,500 burlap sand bags for an immersive forward-firing trench along Highway US-41 next to Wadsworth Hall. The trench was designed by Stan Vitton '76 '79, a professor of civil engineering, and Gregg Richards '92, of Michigan Tech engineering services, along with Lt. Col. John O'Kane of Michigan Tech's Air Force ROTC. Construction was coordinated by Kris Mattila '80, associate professor of civil engineering, along with Collins. Steven Walton, associate professor of social sciences, provided historical input.

"History is full of interesting stories that come alive if you can experience some part of what the world was like 'back then.' Americans have largely forgotten World War I, partly because of the passing of a century, and certainly because of later wars that had much larger impacts here at home," says Walton. "I often joke that most people only know there was a WWI because there was a WWII that they *have* heard of!"

The trench project, an iconic element of the Western Front, brings home the feeling of being cut off from the landscape, Walton says. "One can imagine how trapped the soldiers must have felt. From the first day of construction it was cooler and quieter down there—more isolating—and we don't have bombardments and machine gun fire or poison gas to contend with."

The trench demonstrates the powerful result of doing experiential history, says Walton.

Unearthing the Past

Before trench excavation could begin, the University had to dig into its own history, at the site of two historic homes, including the Smith House, which later became Michigan Tech's first residential dormitory for women students. Both the Smith and the neighboring Nichols House were demolished when US-41 was widened. Undergraduate and graduate students from six universities completed an archaeological survey of the site in May under the direction of Tim Scarlett, associate professor of archaeology and anthropology. Students identified foundations and fragments in the backyards, but found no major historical features.

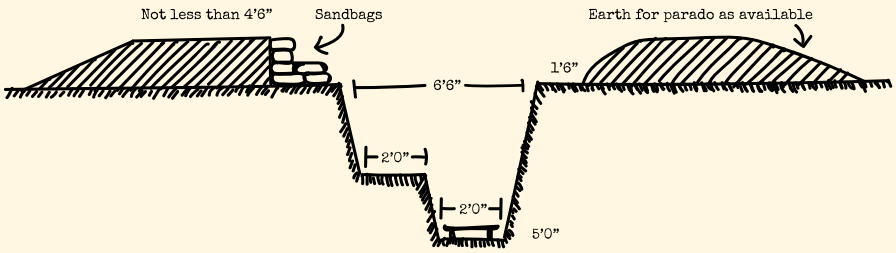
No Man's Land

The trench experience, complete with replica barbed wire, immerses visitors in a battle soundscape that includes soldier memoirs and war poetry. The installation was developed by Professor Christopher Plummer and Production Manager George Hommowun of Michigan Tech's Department of Visual and Performing Arts (VPA). Plummer, VPA Assistant Professor Kent Cyr, and sound design students, also brought "Shell-Shocked: Footage and Sounds of the Front," to the project, pairing historical photos with audio:

As you step into the circle of screens surrounded by black-and-white images, a train whistle shrieks at a crowded station so thick with people seeing the soldiers off that you can't see the sidewalk. So many people. They're waving hats and hands at the soldiers on trains, densely packed, too, and waving back. The screens shift to stark battle scenes—the real trenches of WWI. Bayonet exercises. Gas masks. A thump more felt than heard, reverberates deep on the breastbone. Artillery. Gunfire. A ship's horn. The low-pitched murmur of the harbor crowd, erupting into cheers. Our boys are home! Disfigured faces, missing parts hidden with masks. A soldier home from duty, hunched, hands over ears—the sounds of the battlefield emblazoned on his psyche.

Plummer originally planned to use video footage for the installation. "Videos make you feel like you're

Normal Section of a Fire Trench



seeing the real thing, which you never are," he says. "Still images give you more space. We become part of the process of looking at this history."

Other talks and multimedia presentations throughout autumn illustrated how WWI established precedents for everything from modern weaponry (machine guns and tanks in their infancy) to artful propaganda, including the fierce-yet-benevolent Uncle Sam. Created by James Montgomery Flag in 1916, the icon was born of desperation, explained Stefka Hristova, associate professor of humanities, during a gallery talk on French and American propaganda posters (a display curated by VPA undergraduate student Kassie Baril). Faced with no ideas and a tight deadline, Flag glimpsed his own visage in the mirror. Add whiskers, a tall tri-colored hat, and a bastion of patriotism is born.

War is Hell

While healthy debate abounded during the World War I & the Copper Country project, there was a consensus of respect and appreciation for all who have served, including area veterans honored at the project's closing ceremony November 11. One of the project's long-lasting aspects are the honor rolls of the fallen that have been compiled on the project website, a resource reminding future generations of the Great War and its profound impacts.

In Remembrance

★★★★★

Three dozen Michigan Tech alumni served in World War I. Five made the ultimate sacrifice:

Donald Francis Duncan 1909

Bernhardt Edward Heine 1917

Kenneth Ogilvie McEwen 1902

Ira Gladstone Penberthy 1907

William David Stevens 1915

National Archives photos

The Houle Report

Investigation was integral to the World War I & the Copper Country project. Military history expert Steven Walton discovered records of Michigan Tech's Military-Mining Training Course at the National Archives in Washington, DC. The 15-page document from Michigan College of Mines (MCM) instructor Albert Houle, is addressed to the National Committee on Education and Special Training in Washington, DC. Replete with photos and wry observances, the report describes the work with the first detachment to complete a six-week training block on mine safety and "mine running," a term for constructing mines, trained by the University and area copper mining companies.

"The boys took very keenly to the bayonet work, some of their avidity being, no doubt, the result of the desire to escape some of the 'close order' drill which was beginning to lose its novelty," writes Houle, who also led the MCM Battalion—the 1917-18 student volunteer corps—and the Student Army Training Corps (SATC; forerunner of ROTC), which began in fall 1918. "Second to the military work, the mine rescue work would be judged to be the most popular." Houle details marches along Portage Lake and through area communities, where soldiers were treated to local hospitality, including a lunch at the Calumet Armory hosted by the 553rd State Troops Infantry Company A.

World War I & the Copper Country is a Michigan Tech collaboration with Carnegie Museum of the Keweenaw and Finlandia University in Hancock. The event is made possible in part by a grant from the Michigan Humanities Council, an affiliate of the National Endowment for the Humanities. Explore more on the website: ww1cc.mtu.edu

Michigan Tech Women's Basketball Head Coach Sam Hoyt '13

Q+A

HOME COURT ADVANTAGE: ALUMNA SAM HOYT RETURNS TO SDC GYM AS HEAD COACH

As a student-athlete, Sam Hoyt found a home at Michigan Tech. As a graduate, she set a goal to return as a coach. When her dream job opened up, she jumped at the opportunity.

On May 29, Sam Hoyt became the ninth head coach of Michigan Tech Women's Basketball, a continuation of a relationship that began when she was recruited as a player in 2009. As a sophomore, the Arkansaw, Wisconsin, native led Michigan Tech to its first NCAA Division II National Championship appearance in 2011. The two-time CoSIDA Academic All-American, with a 3.96 grade-point average in math, was a two-time WBCA All-America Honorable Mention, and three-time All-GLIAC selection. She is Tech's seventh all-time leading scorer, amassing 1,434 career points, and owns the second highest career free throw percentage in program history, at 84.8 percent. The Huskies boasted an overall record of 103-22 during her career as a player.

At the press conference announcing Hoyt as head coach, Athletic Director Suzanne Sanregret '93 '06 said, "After graduating from Michigan Tech, Sam committed herself to learning from others with the goal of returning to Tech as a head coach. When I asked her why this was her goal, she replied, 'To give back to the program that gave me so much.' We are so excited to have her back."

Q: What did you do when you learned the head coaching job had opened up?

A: I screamed. My initial thought was that this is my dream job, and how can I get it? I called Suzanne right away.

Q: Talk about what your predecessor Kim Cameron did here at Tech.

A: She did an absolutely phenomenal job in all aspects of the program. The team won the GLIAC North last year and had the highest GPA in all NCAA divisions. That speaks so much to the type of student-athletes that she recruited. I think that was one of her best aspects, bringing in phenomenal players. She worked her butt off scouting and being prepared for her opponent, night in and night out. She put me in a great position coming in because I know that the student-athletes on the team are going to work really hard, be successful in the classroom, and be the type of student-athletes that I would recruit.

> **"I KNOW THAT THE STUDENT-ATHLETES ON THE TEAM ARE GOING TO WORK REALLY HARD, BE SUCCESSFUL IN THE CLASSROOM, AND BE THE TYPE OF STUDENT-ATHLETES THAT I WOULD RECRUIT."**

Q: What is your coaching style?

A: I'm going to try and play faster than what we've seen out of Michigan Tech teams in the past. I want to score in transition—when we have opportunities. Also, offensively, we'll run a four-out one-in motion (four players outside the three-point line and one inside) with a little bit different concepts. I'm also going to run some five-out motion (a "position-less" offense where players are spread out on the perimeter) so that'll be a little different.

Q: Is that based on what you want to do or this year's roster?

A: A little bit of both. Based on the roster, we have to run a four-out one-in offense. Zibby (Elizabeth Kelliher) is an incredible player. She shot 55 percent last year, and we have to get her touches in the post. As far as what I want to do and what I've recruited coming into the 2019 class and what we have left, I think a five-out better suits that personnel. We can play with a lot of pace that way.

Q: What is the main takeaway from each stop in your coaching career?

A: At Youngstown State under Coach John Barnes, I learned the importance of the little things and attention to detail. That was always so important to him, and that's why he's been successful everywhere he's been.

At Northwood under Jeff Curtis, I learned the importance of having quality relationships with your players and coaching staff and being very transparent. I think he was just an awesome person, and I was able to grow personally under him.

And then at the University of Sioux Falls with Coach Travis Traphagen, I learned to give players a little bit more freedom in their offense. He doesn't have very many sets or structure in his offense and was able to be very successful. I want to be able to incorporate as much of that as I can into Michigan Tech basketball because it's something we haven't traditionally done here. I want to give the players some freedom so that they take more ownership in our program.

Q: How did the Michigan Tech team that went to the national championship game come together?

A: It was a bunch of players who were biding their time. They went against some of the best players in the conference—and nation—as underclassmen. They were ready when their time came. There was an unbelievable team chemistry, which is one of the most important things, and I believe all Michigan Tech teams have that.

Coach Cameron was also trying to prove herself as a first-year coach. She had coached all those players when she was the assistant, so it was a pretty easy transition for her. They were a team and coach committed to a common goal, waiting to show everyone what they were capable of. We showed everyone that Michigan Tech basketball is more about the overall culture than any one individual player or team.

Q: How did you initially get to Michigan Tech?

A: There were a lot of Division III schools in Wisconsin and Minnesota that were interested in me. Other than Tech, there were no other Division II schools recruiting me, but there was one Division I school in New Jersey. I'm from small-town Wisconsin—I wasn't going to New Jersey. When I came to Houghton it just felt like home. I like the small town with the great community support. There were just so many aspects about this school and program that I was looking for during that process.

Q: What did you want to do when you graduated high school?

A: I was going to be a math teacher so I could coach basketball. All the coaches I knew growing up were teachers. Coach Barnes reached out to me about a graduate assistant position at Youngstown after I graduated from Tech, and I thought that was a great opportunity because all I really wanted to do was coach basketball. All the doors have opened for me, and I'm blessed with how it's played out.

Q: What makes Michigan Tech basketball fans some of the best?

A: There really is no comparison. I've been in a lot of gyms in a lot of different conferences and there's no atmosphere like the SDC Gym. What makes it so different is that the people in the stands know and care about you. They aren't just random people out there. You have relationships with them and they come to games consistently. You add in the Pep Band and the atmosphere is second to none.

> "WHEN I CAME TO HOUGHTON IT JUST FELT LIKE HOME. I LIKE THE SMALL TOWN WITH THE GREAT COMMUNITY SUPPORT."

Q: What are your goals for this job?

A: My immediate goals are to make an impact on the lives of my student-athletes. I want to be a good role model for them and prepare them for life, most importantly. As far as basketball goals, I want to continue the winning tradition of being at the top of the conference and consistently making the NCAA Tournament. I also want to make deep runs in the NCAA Tournament. It's a goal to win a national championship. Having lost in that game as a player, there's nothing more I want than to come back as a coach and win it for this school, this program, and this great fan base.

Favorite place in the Keweenaw:
Copper Harbor

Favorite basketball player growing up:
Michael Jordan

Biggest career influence:
My dad

Favorite sport other than basketball:
Volleyball or softball

Favorite (non-sport) TV show:
Friends

Pregame ritual:
Listen to country music

PCA INDUCTS 20TH CLASS OF LEADERS

Michigan Tech's Presidential Council of Alumnae (PCA) honors some of Tech's most successful women alumnae and recognizes them for their personal and professional achievements.

In September, 13 new members were inducted into the Council. They are:

Jessica S. Chlopek '06 BS Business Administration

Kristina M. Fields '96 BS Civil Engineering, '98 MS Civil Engineering; '06 PhD Civil Engineering

Raine L. Gardner '05 BS Civil Engineering

Joan M. Heil '83 BS Mechanical Engineering

Caryn L. Heldt '01 BS Chemical Engineering

Mary A. Herrmann-Foley '83 BS Geological Engineering

Loree K. Kalliainen '87 BS Biological Sciences

Emily C. McDonald '12 BS Environmental Engineering

Brenda M. Moyer '84 BS Mechanical Engineering

Heidi A. Mueller '83 BS Mechanical Engineering

Danielle K. Rickert '04 BS Materials Science and Engineering

Jennifer J. Shute '96 BS Mechanical Engineering

Linda S. Vanasupa '85 BS Metallurgical and Materials Engineering

OUTSTANDING ALUMNI AND FRIENDS HONORED

The following outstanding alumni and friends were recognized by the Alumni Board of Directors:

Outstanding Young Alumni Award—

Capt. Amanda (Taylor) Nerg '10 BS Business Administration, Chief of the Contracting Office, Maron Air Base, Spain

Presented to alumni under the age of 35 who have distinguished themselves in their careers. The award recognizes the achievement of a position or some distinction noteworthy for one so recently graduated.

Outstanding Service Award—

Sally Heidtke '81 Chemical Engineering, Body Code Practitioner, Iron Mountain, Michigan

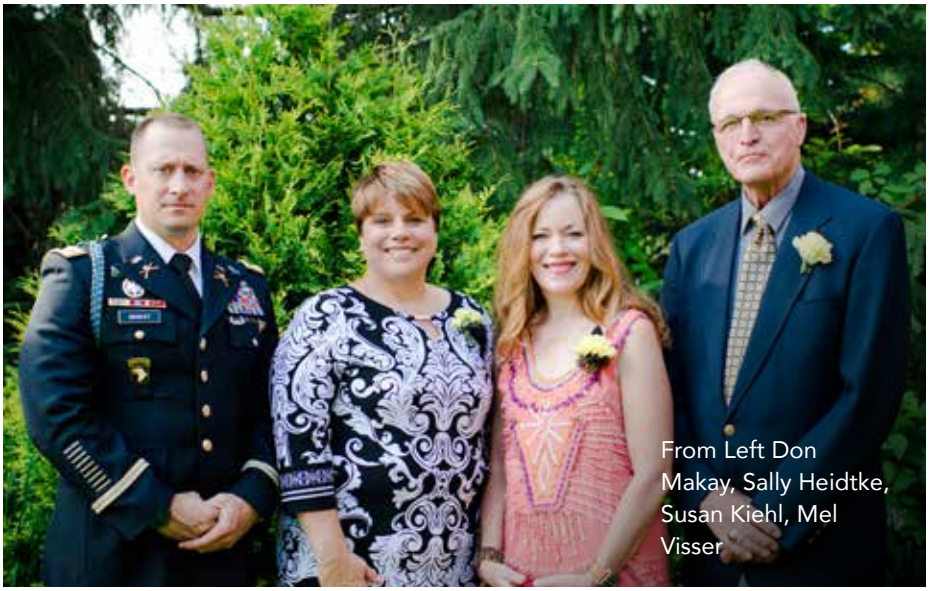
Presented to alumni and friends making significant contributions to the success of the Alumni Board of Directors and/or the University.

Distinguished Alumni Award—

Susan Kiehl '83 Metallurgical Engineering, Vice President Product Development, Lockheed Martin Aeronautics, Retired, Grand Haven, Michigan

Mel Visser '59 Chemical Engineering, Vice President Pharmacia Corp., Retired, Author, Portage, Michigan

Presented to alumni who have made outstanding contributions both in their career and to Michigan Tech over a number of years.



From Left Don Makay, Sally Heidtke, Susan Kiehl, Mel Visser

Humanitarian Award—

Lt. Col. Don Makay '99 Electrical Engineering Technology, Scientific and Technical Communications, Director New York Army National Guard 1st Battalion, 42nd Infantry

Presented to those alumni and friends who, through their outstanding involvement and dedication, have made a significant contribution of volunteer leadership or service which has improved or enriched the lives of others and the welfare of humanity, and whose accomplishments reflect admirably on or bring honor to their Alma Mater.

The Honorary Alumni Award—

Dr. Igor Kliakhandler, former Professor of Mathematical Sciences, Michigan Tech, Houston, Texas

This award honors individuals who have provided service and support of the university characteristic of dedicated alumni. The Alumni Board of Directors reserves this award to recognize the strongest non-alumni supporters of Michigan Tech. For additional information, please contact Alumni Engagement at alumni@mtu.edu.

More details about these individuals are available at *mtu.edu/alumni/recognition/profiles*

Alumna Anna Uhl '10 works as a veterinarian in a small-animal general practice in Seattle.

PREPPING THE FOUNDATION.

ANNA UHL BS 2010, BIOLOGICAL SCIENCES

Anna Uhl chose Michigan Tech after spending time on campus as a Summer Youth Program participant.

"That week solidified my decision to go to Michigan Tech," she says, noting her appreciation for the beauty of the UP, a university culture focused on academics, close ties with students and faculty, and opportunities in a variety of student organizations.

Uhl graduated from Tech with a degree in biological sciences and a minor in ecological sciences. She then worked as a veterinary assistant in a small-animal general practice for two years before pursuing veterinary medical school at the University of Wisconsin. She now lives in Seattle, Washington, and works as a veterinarian in a small-animal general practice.

Uhl says her anatomy and physiology, organic chemistry, biochemistry, and genetics classes and professors "reinforced my academic passions and taught me to think like a scientist."

And that's one of the reasons why she supports Michigan Tech. "I truly loved my time as a student. Those years were crucial to my academic and personal development," she says. "I feel the need to give back in some small way to the University for all it did for me."

When Uhl learned about Tech's newest giving opportunity for young alumni, the 906 Club, she decided to make a gift. The 906 Club honors the UP and University. Gifts are based on graduation year and come with a membership sticker.

"Donating through the 906 Club helps set the wheels in motion so when I am more financially stable I can make even more meaningful contributions," she says. "I don't make it back to the UP much now that I live in the Pacific Northwest, so being involved as a donor still allows me to have a small connection."

Uhl says her education not only provided her with a foundation in biological sciences, but also taught her the value and fun of having an inquisitive mind.

"My degree gave me the freedom to choose between a variety of postgraduate programs. Tech taught me how to balance academic studies with organizational involvement. The connections I developed and the passions I explored while a leader in student organizations made the largest impacts on my career."

Outside of the classroom, Uhl has fond memories of Winter Carnival: making ice detail pieces for snow statues, writing and performing in skits with Delta Zeta sorority sisters, being cheered on by Mitch's Misfits hockey student section on the Zamboni as Winter Carnival Queen, dancing in blizzards near the giant snow speaker system on campus, and showing the beautiful campus to friends and family who visited during the festivities.

She says being a veterinarian is enjoyable because she helps people and their companion animals while putting together medical puzzle pieces by implementing diagnostic and treatment plans. "The human-animal bond is a beautiful

relationship, and preserving that bond is something I take very seriously every day."

Outside of work, Uhl volunteers in her community as a Big Sister in Big Brothers Big Sisters Puget Sound, the philanthropy coordinator for an alumnae group of national sorority women, an active member of the Greater Seattle Alumnae Chapter of Delta Zeta, and an active volunteer in veterinary medicine-related organizations.

As a student, Uhl studied abroad in Costa Rica and learned the phrase "pura vida," which means pure life. "Living a pure life means appreciating the beauty in the simple things in this world, being optimistic and looking for the good in people, having fun when life calls for a celebration, being present in your surroundings, working hard at the things that make you happy, and embracing the uncertainty of change." Learn more about the 906 Club at *mtu.edu/giving*

BOCCE BALL RETURNS TO MICHIGAN TECH

Thanks to the efforts of alumni, the Athletics Department, Housing and Residential Life, Inter-Residence Hall Council, and Facilities Management, bocce ball has returned to Michigan Tech. The court was completed over the summer and stands between Douglass Houghton Hall and the Minerals and Materials Engineering Building (M&M). A dedication was held August 3, with President Koubek throwing the inaugural ball. More than 30 alumni contributed to the court's construction, along with matching gifts from 3M Company and Kimberly-Clark, and funding support from Michigan Tech Housing and Residential Life.

210 INCHES. 180 INCHES. 176 INCHES.

That's the amount of snow that has fallen the past three years at Michigan Tech. How much snow will we get this year? Enter our monthly and annual snowfall contests to predict how much snow will fall this winter. Make your guess at *mtu.edu/alumni/favorites/snowfall*

HELP US FIND MORE HUSKIES . . . LIKE YOU!

In a recent *Wall Street Journal* college and university ranking publication, Michigan Tech scored No. 1 in the country for students attending a public institution who felt they made the "right choice." And how do these students, who are more satisfied with their choice than students at any other public institution, find Michigan Tech? When asked, they tell us, "I was referred to Tech by someone I know." And, 99 percent of alumni say they would recommend an academically-qualified student to Tech.

Referring a capable, hard-working, motivated student to Michigan Tech ensures the value of the Michigan Tech diploma continues to remain strong. Tell us who you think has Husky potential.

Visit *mtu.edu/refer*

MARK YOUR CALENDARS, HUSKIES!

- Great Lakes Invitational 2018
  December 30-31
- Winter Carnival 2019
  February 6-9
- Reunion 2019
  August 1-3


Michigan Tech

Our students are back!

And so it begins.

Campus is hopping and fall is in the air! The students are back and from the energy exuded it's clear they are ready for another exciting year at Tech. We welcomed over 1400 new students with an action-packed Orientation Week (including an introduction to pickled eggs and other Tech Traditions), enjoyed K-Day at a new location in Chassell, hosted two Career Fest industry days in preparation for the fall Career Fair on October 3, and celebrated our inaugural 906 Day with activities throughout campus and on social media. And we celebrated big wins for Tech Football over Truman State and Hillsdale, Volleyball upsetting #1 ranked Minnesota Duluth and opening wins for Soccer and Women's Tennis. Fall is a special time on any campus but I think even more so at Tech. As we celebrate all of the good on campus, our ROTC

WHAT YOU SAID . . . SHARING YOUR MEMORIES AND MORE ABOUT TECH.

Don't miss the new feature in next month's alumni enewsletter. Coming to you monthly in your inbox.

CLASS NOTES

Share your news! Post your class note and photo online at MyMichiganTech or email to alumni@mtu.edu. New addition in your family? Let us know. They will receive a special gift from Blizzard T. Husky.

1950s

Lawrence Golin '58 (Forestry) received the American Physical Therapy Association's Humanitarian Award in June 2018. Golin was recognized for establishing a small rehabilitation center at Memorial Christian Hospital in Cox's Bazaar, Bangladesh and his 11 trips to various countries on medical mission trips. He is retired, but still involved as a physical therapy consultant licensed in Michigan.

1960s

Dennis Wiitanen '63 (Electrical and Computer Engineering) was inducted into Michigan Tech's Electrical and Computer Engineering Academy August 1, 2018.

Peter E. Sohlden '65 (Metallurgical Engineering) was inducted into Michigan Tech's Materials Science and Engineering Academy October 12, 2018.

1970s

Timothy Bohrer '71 (Chemical Engineering) was named to the Packaging and Processing Hall of Fame by the Packaging Machinery Manufacturers Institute. Bohrer is the founder of Pac Advantage Consulting LLC. Among his accomplishments, Bohrer led the team that developed the packaging used for microwave popcorn.

Calvin L. White '74 (Metallurgical Engineering) Materials Science and Engineering professor emeritus, was inducted into Michigan Tech's Materials Science and Engineering Academy October 12, 2018.

Iver E. Anderson '75 (Metallurgical Engineering) was inducted into Michigan Tech's Materials Science and Engineering Academy October 12, 2018.

1980s

John Frambach '80 (Liberal Arts) was presented the Frank J. Ward Memorial History Award at the Berrien County Historical Association annual meeting on April 17, 2018 in Berrien Springs, Michigan. The award is presented annually to an individual, organization, or business that advances the cause of local history through research, writing, historic preservation, or programming.

Stephen Mashl '80 '87 '95 (Metallurgical and Materials Engineering) was named a 2018 APMI Fellow. APMI International is a nonprofit professional society which promotes the advancement of powder metallurgy and particulate materials as a science.

Mark Rich '80 (Electrical and Computer Engineering) was inducted into Michigan Tech's Electrical and Computer Engineering Academy August 1, 2018. Tragically, Rich was killed in a plane crash in Oregon last August. His wife, Laura, accepted the posthumous induction in his honor.

David H. Gelwicks '82 (Metallurgical Engineering) was inducted into Michigan Tech's Materials Science and Engineering Academy October 12, 2018.

Boyd A. Mueller '82 (Metallurgical Engineering) was inducted into Michigan Tech's Materials Science and Engineering Academy October 12, 2018.

M. Margaret Cobb '83 (Mechanical Engineering) was inducted into Michigan Tech's Mechanical Engineering-Engineering Mechanics Academy October 20, 2018.

Susan B. (Brechting) Kiehl '83 (Metallurgical Engineering), was inducted into Michigan Tech's Materials Science and Engineering Academy October 12, 2018.

Jeffery W. Feldt '84 (Electrical and Computer Engineering) was inducted into Michigan Tech's Electrical and Computer Engineering Academy August 1, 2018.

Brian Krinock '85 (Mechanical Engineering) was inducted into Michigan Tech's Mechanical Engineering-Engineering Mechanics Academy October 20, 2018.

Tony Altobelli '86 (Mechanical Engineering) was inducted into Michigan Tech's Mechanical Engineering-Engineering Mechanics Academy October 20, 2018.

Paul W. Juodawlkis '86 (Electrical and Computer Engineering) was inducted into Michigan Tech's Electrical and Computer Engineering Academy August 1, 2018.

Michael A. Pulick Jr. '86 (Electrical and Computer Engineering) was inducted into Michigan Tech's Electrical and Computer Engineering Academy August 1, 2018.

Peter M. Eick '87 (Geology) was granted his 50th United States Patent. The patents cover a range of seismic techniques for geological and geophysical data acquisitions in use in the oil and gas industry. Peter and his wife, **Carrie (Duckert) Eick '86,** (Geological Engineering) manage Serenity Geophysical Consultants based in San Antonio, Texas.

Ruth I. (Schultz) Kramer '87 (Geology) was inducted into Michigan Tech's Materials Science and Engineering Academy October 12, 2018.

Joseph M. Nowosad '87 (Metallurgical Engineering) was inducted into Michigan Tech's Materials Science and Engineering Academy October 12, 2018.

1990s

Jon E. Jipping '91 (Electrical and Computer Engineering) was inducted into Michigan Tech's Electrical and Computer Engineering Academy August 1, 2018.

Arjang Roshan-Rouz '92 (Electrical and Computer Engineering) was inducted into Michigan Tech's Electrical and Computer Engineering Academy August 1, 2018.

Denise Junker '97 (Computer Science) received her MDiv from Colgate Rochester Crozer Divinity School in Rochester, New York, in 2014.

Robert E. Smith '99 '02 '12 (Mechanical Engineering) is co-author of War Game Introduces Early Synthetic Prototyping, published by the US Army. Smith is a research engineer in the US Army Tank Automotive Research, Development and Engineering Center, Detroit Arsenal.

2000s

Todd Brewer '00 (Mechanical Engineering) authored the story "Bearing Technology Changes in the Fluid Handling Industry," in Flow Control. Brewer is an application engineer with NSK.

Donald Churchill '02 (Forestry) is the plant health care manager for Garpiel Group in Saginaw, Michigan. In February, he earned the board-certified master arborist credential through the International Society of Arboriculture. This is the highest certification available for arborists. He is one of 10 in the state of Michigan to hold this certification.

Raine Gardner '05 (Civil Engineering) is one of the recipients of the 2018 Young Professional of the Year Awards by the American Council of Engineering Companies. Gardner is a senior project engineer with MSA Professional Services, Inc. in Baraboo, Wisconsin. **Brian Saintonge '05** (Civil Engineering) and his wife, Anne, welcomed baby boy, Noah Friedrich William Saintonge on January 10, 2018.

1 **Kevin Kusiak '07** (Electrical Engineering) and Meghan Jacobs were married in Beaver Creek, Colorado, on September 9, 2018.

2 **Walter Rathbun '08** (Geological Engineering), Leanne Rathbun, and big brother, Paxton, welcomed daughter, Twyla Marie. She was born June 2, 2018 weighing seven pounds 12 ounces. The family lives in Parksville, British Columbia, Canada. Her proud family of Huskies include grandparents **Shawn '82** and **Jim '81 Rathbun**, uncles **Matthew Rathbun '12** and **Luke Tofte '12,** and aunt **Aimee Rathbun '05.**

2010s

3 **Amanda (Vogt) Conner '10** (Finance) and Blake Conner were married in Windermere, Florida, on March 17, 2018.

Kyle Brill '11 (Geology) is co-author of the article "Foundations for forecasting: Defining baseline seismicity at Fuego volcano, Guatemala," published in Frontiers in Earth Science.

4 **Jennifer (Bush) Simonetta '11** (Applied Ecology and Environmental Sciences) and **Corey Simonetta '11** (Mechanical Engineering) announce the birth of their first son, Ellis Orso Simonetta. He was born June 7, 2018, weighing eight pounds four ounces and 21 inches long.

5 **Kipp Vaughn '11** (Business Administration) and Stephanie Vaughn, welcomed a son, Kacen, in January and plan to make him a fellow Tech alumnus in the coming years. Kipp also accepted the human resources manager position for Michigan's iconic Mackinac Bridge in March.

6 **Amanda Taylor '12** (Chemical Engineering) Process Safety Specialist at BASF, was recognized nationally through the Manufacturing Institute's 2018 STEP Ahead Awards. Focusing on science, technology, engineering, and production (STEP), the program honors women leaders for their advocacy, mentorship, engagement, and leadership.

7 **Kyle Myszka '15** (Materials Science and Engineering) and **Amber (Kaufman) Myszka '15** (English) welcomed their son, Arthur Kyle Myszka, on February 21, 2018. He weighed eight pounds, three ounces and was 21.75 inches long.


1


2


3


4


5

6


7


SHERMAN FIELD

FIRST DOWN

Michigan Tech's Sherman Field has never looked better—or been more fan-friendly. The bleachers Huskies have been sitting on since 1968 were replaced and upgraded to accommodate 2,100 fans. The improvements, which also included accessible parking and a paved VIP pavilion, were completed in August as the first phase of a multi-stage football stadium renovation project. The additional phases include expanded press and coaching boxes, more bleachers, restrooms, and concessions.

Alumni Fred Guenther '75, Todd Hamar '83, Alex Kowalski '01, and Clay Willman '60 made cornerstone gifts instrumental to phase-one completion. Fundraising for the next phase is well underway, with the goal to start construction in April 2019.

Go for (Phase) Two—make a gift to support the second stage of stadium improvements: *mtu.edu/giving/athletics/priorities/football*

IN MEMORIAM

1938
Frank E. Pavlis

1945
Charles E. Foertmeyer

1948
Robert Heinrich

1949
Dr. John D. Brule
Robert E. Green

1950
Leonard A. Carlson
Donald A. Kangas
Peter E. Kotila
Elwood A. Lohela
Louis E. Wuelpern

1951
Thomas E. Fearnside
Dr. William M. Glazier
Kenneth L. Kojola
Robert G. Vernon, PE

1952
James R. Brooks
Fred J. Huston Jr.
Rod L. Villeneuve

1953
Robert P. Cappeart
Dino H. Pirolo

1954
Robert G. Johnson
Ross M. Wolfe

1955
James R. Sack

1956
Reino E. Alanen
Rodney L. Baker
Prof. Edward J. Koepel
John E. Kroneck
Gary D. Lundin
Gerald J. Schwark

1957
John E. Christophersen Sr.
Bernard J. Mayer

1958
Rollin A. Jones
Martin W. Lutz

1959
Donald E. Ameen
Richard H. Seegert
John B. Taylor III

1960
Roger C. Lasanen

1961
Dr. Albert F. Puttlitz
James L. Radawski

1962
Dr. John S. Berkes

1963
Lester J. Barancin
Clarence G. Funk Jr.

1964
Martin H. Betzing
Lee E. Gotcher
James W. Hostman

1966
Bruce H. Dunn

1968
Raymond E. Beauchamp
Ronald M. Leachman

1970
Timothy W. Cox

1971
Kathleen H. Van Weelden

1972
Kenneth D. Wade

1973
Bansidhar Panda

1974
E. Dale Rennells

1975
Paul A. Brewer
Debra R. Link

1977
Stephen A. Johnson

1980
Mary J. Briggs
James D. Tellam

1981
Terry J. Schmidt
Priscilla M. Young

1982
John M. Keeley

1986
Dawn E. Belding
Kyle D. Wilson

1987
Daniel M. Morley

1990
Timothy J. Gerdeen
Kurt J. Talsma
Steven D. Weinfurter

1991
Andrew M. Kaczmarek

You give back to Michigan Tech. You make an impact. **Thank you!**

"We created the scholarship to honor the memory of 2LT Anthony Marchinda, USMC, who died during a tragic training accident in 1991. He was a proud graduate of Michigan Tech, as am I, so it is important to give back to support current and future Tech students."

–DR. TIMOTHY BRANNAN '89

"I want to see Michigan Tech continue to grow and to be successful. Tech is also a major contributor to economic and cultural vitality in the Copper Country. I want to see that continue."

–SCOTT AND ERICA DIEHL
DONATED TO TECH WITH STOCK, SUPPORTS LITTLE HUSKIES, THE DEPARTMENTS OF COMPUTER SCIENCE AND GEOLOGICAL AND MINING ENGINEERING AND SCIENCES

"Sponsoring Student Enterprise projects satisfies our charitable desires to enhance the University's capability of serving the elderly. From helping a neighbor with ALS use a computer through eyeball movement to creating a ride scheduling program for the elderly, the surface of what Enterprise can do has barely been scratched. This is just one way in which alumni charity is leveraged through Michigan Tech and Copper Country creativity."

–MEL '59 AND GLORIA VISSER
DONATED TO TECH WITH AN IRA

Many ways to give. One goal.
Help our students create the future.

mtu.edu/supporthuskies

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Robot Helps With Early Screening for Alzheimer's Patients

Using a Kinarm End-Point Lab module, researcher Kevin Trewartha investigates how technology can improve earlier diagnosis of Alzheimer's. The current task: screen patients with robotic platforms to create more sensitive motor skills tests. The end goal: make early screening for Alzheimer's as simple as a smartphone game.

Tomorrow needs Kevin Trewartha. Tomorrow needs Michigan Tech.

mtu.edu/tomorrow-needs