

Geologically Speaking

A Michigan Section AIPG Publication

Inside This Issue:
Field Trip Guide to Southeast Iron County
2020 Golf Outing
Regulatory Roundup
Special Feature:
ZVI Permeable Reactive Barrier

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Section Officers

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PRESIDENT

Sara Pearson, CPG
EGLE
Tel. (517) 420-3219
pearsons@michigan.gov



VICE PRESIDENT

Bill Mitchell, CPG
EGLE
Tel. (269) 873-5549
mitchellvickybill@sbcglobal.net



TREASURER

Mellisa Powers-Taylor
EGLE
Tel. (517) 388-0795
powerstaylorm@michigan.gov



SECRETARY

Kalan Briggs
ARCADIS
Tel. (248) 635-4576
kalan.briggs@arcadis.com



PAST PRESIDENT

Amy Hoeksema, CPG
Consumers Energy
Tel. (517) 788-1985
Amy.Hoeksema@cmsenergy.com



NEWSLETTER EDITOR

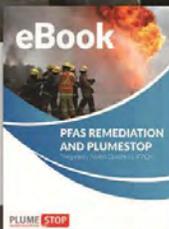
Adam Heft, CPG
WSP USA
Tel. (517) 886-7400
adam.heft@wsp.com



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From the President's Desk

Time.

We mark and measure time based on minutes, hours, days, years, anniversaries, events, glaciations, epochs, and many other milestones. Who could have predicted a year ago that many of us would have spent seven months and counting working from home due to the pandemic? Would you have guessed that we would spend more time video conferencing than meeting in person? I have lost count of the virtual meetings that I have attended. We learned quickly to adapt and transition to working from home and within new social guidelines that not only covers mask wearing and distancing in public places, but etiquette for virtual platforms.

We spend so much time in front of our screens absorbing, deflecting, and missing information from our networks because of the sheer volume and speed at which information travels. It becomes easy to get wrapped up in what is happening and going on in the world as it is delivered via screen. Sometimes we feel empowered, indifferent, or even helpless. Sometimes it is just plain mind-numbing. Before you know it hours, days, and months have gone by, and when I stop and think about all that has transpired... It becomes a blur.

Because the whirlwind of activity does not stop and gets clouded by distractions, the Michigan Section Executive Committee's desire to provide meaningful value for your

time and support you, our members, remains our mission. We also seek to partner and support our colleagues in the complementary disciplines with whom we work every day. The Michigan Section has sought out ways to adapt to this alternate normal following the trend of virtual outreach and learning with the webinar series, revamping the newsletter, and proposing updates to our bylaws.

We have hosted two successful lunch and learn virtual platform events featuring experts in [Natural Source Zone Depletion](#) and [Establishing Soil Background for Metals](#). We hosted the live events inviting not only our members, but all professionals interested in the topics to join us. We offered continuing education credits and because of the virtual platform, professionals from other states as well as other countries tuned in. It was great to hear feedback, not only from our members here at home, but from members across the country. If you missed these events, we did record them, and they are available on the Michigan Section's YouTube channel by following the links on the titles above. We are currently in the process of planning more.

We also realize that while knowledge sharing events are valuable, partnership building, and networking are also critical elements of our professional world. The social guidelines that we are operating under make this challenging, but we adapted. We were able to hold a fun, socially distanced golf outing in August. Thank you, Bob



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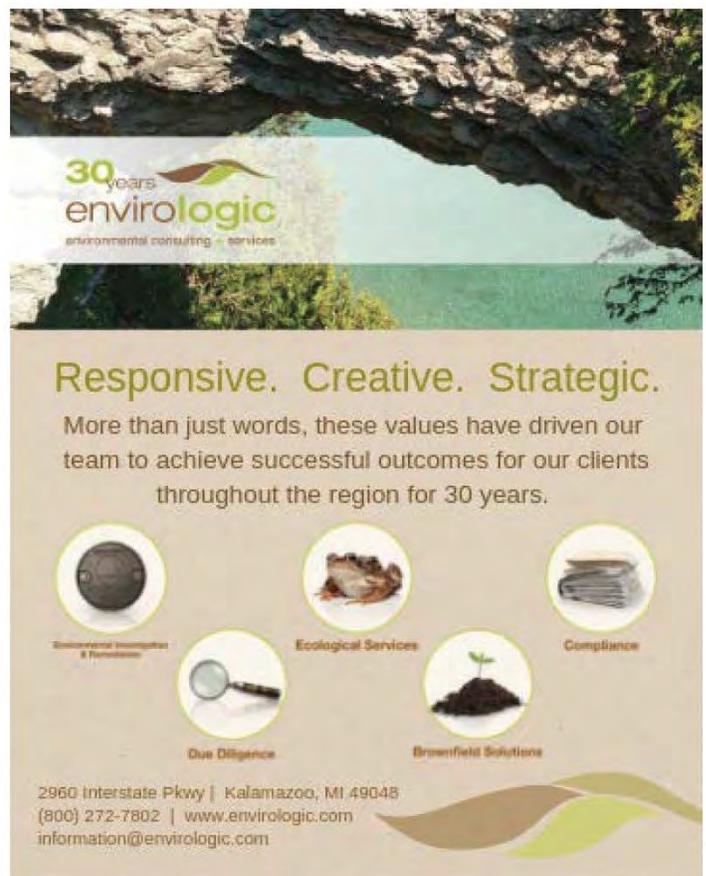
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Reichenbach and everyone who participated!

In recent years, we have partnered with the Michigan Association of Environmental Professionals and enjoyed an evening of networking and professional development. This year has a twist. We are still hosting an event and moving to Zoom as our online platform. We are hosting a happy hour that you can join from the comfort of your living room followed by our spotlight for the evening on Eastern Michigan University showcasing a virtual tour of their newly renovated geology and environmental sciences building and the latest on their programs, research efforts, and student activities. After the presentation, we invite you to stay and play trivia, join the conversation on student career advice, or just hang out and network with people you have not seen in a while. Registration is open. <https://maep.org/event-3975384>

In addition to changing up our meeting formats, we revamped the newsletter and named it Geologically Speaking. The intent is to provide more useful and interesting content that we hope you will enjoy. I have heard that some members have checked out the destinations in the mini field guides. We hope you had a great time if you went to one of the destinations. Be sure to check out the latest field guide in this issue. If you have something that you would like to add to our Michigan publication, please reach out to Adam Heft. We are always seeking content. How about a case study featuring a great project, partnership, or learning opportunity like we present at the workshop?

Speaking of the workshop, I cannot tell you how much I missed it this year. I am hopeful that we will be holding it next June. We have the dates reserved at the Ralph A.

MacMillan Conference Center in Roscommon. Fingers-crossed that it will be safe to hold the event! If you have attended the workshop, you know how much we stress partnership and relationship building amongst professionals.

In the past year, we have been looking at how to expand on partnership and relationship building to encourage participation by early career professionals and students. We created the ECP/Student Liaison committee to help support our students in the chapters across the state and help them find their career path. This is particularly critical right now with most students isolated by e-learning. Our committee is reaching out to the student chapters to offer support and connection and encourage them to stay engaged with our organization and members. Additionally, this committee has been formed to establish a foundation for proposed changes to the bylaws adding an Early Career Professional (ECP) position to the executive committee following the lead of National. Later this year, we plan to present proposed bylaws changes for your vote with the biggest change being the addition of an ECP position to the board to bring fresh perspectives and point of view of those just starting their career. A main function of the ECP will be establishing relationships with the students and providing the ECP with the support of the newly formed committee is a way to promote strong partnership building in AIPG leadership.

Through this committee and other future activities in the Michigan Section, we plan to continue to seek ways to promote relationship building coupled with promoting diversity and inclusion to further strengthen our professional community.

There are such great possibilities for the future. We encourage you to take some time away from the whirlwind and join us in these efforts and to consider running for Secretary in our upcoming election.

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2020 Golf Outing — Not Virtual!



We pulled it off! August 25, 2020 was another great day with perfect weather for our 16th Annual AIPG Michigan Chapter Golf Outing. Fifty-two players enjoyed a day of golf and camaraderie for this year's event at Lyon Oaks Golf Course. It was nice to see everyone after a long hiatus due to the pandemic. As always, the proceeds from this year's event go to support of our K-12 educational grants. The winning golf team, Walton, finished 12 under par.

The Grand Prize, a Fit Bit Versa 2 was won by Rick Dunkin, and the Sony Noise Canceling Headphones was won by Jeff Lanier. The 50/50 Raffle was won by Dan Capone. Skill prize winners were Sam LaTurner/Cheri DeLyon (Long Drive awards) and Ryan Walton (Closest to Pin).

A very big thanks to our primary sponsors:



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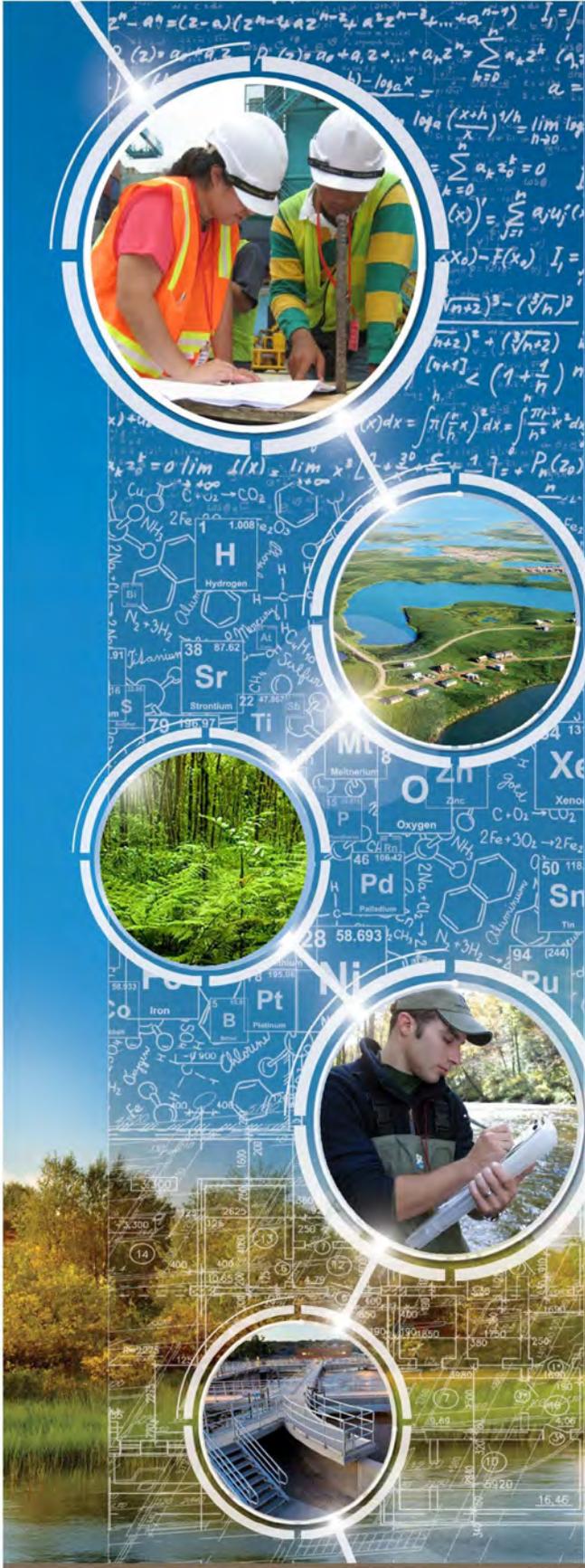
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- Article continues on Page 19 -



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Did You Know?

This article is intended to remind members of various aspects of AIPG and benefits of membership. If there is something you would like to see featured in this column, please contact the Editor...

Section 7.2 of the National Bylaws states:

7.2 Authority of Sections

7.2.1 Operations

A Section may conduct its own affairs so long as they are not in conflict with the Bylaws and policies of the Institute. The Bylaws of Sections shall not conflict with those of the Institute and shall, insofar as is practicable, conform to the recommendations of the Executive Committee. Any changes therein shall take effect only upon approval of the Executive Committee of the Institute. No Section shall have the power to bind or make statements on behalf of the Institute by its action without specific written authority from the Executive Committee or the President of the Institute. If a Section fails to elect, or fill vacancies among, its officers, the President of the Institute may appoint such officers to serve until their successors are elected or appointed. In the event of a failure to comply strictly with the Bylaws and policies of the Institute, the Executive Committee may immediately replace the officers of the Section, revoke its charter and invite a reorganization of the Section, or take other corrective action as it may deem appropriate.

7.2.2. Section Offices and Committees Requiring Certified Membership

A Section may specify in its Bylaws that specified Section Officers must be Certified Professional Geologists.[3]

7.2.3. Section and Local Meetings

Section and local meetings may be organized to suit local needs, provided such meetings do not conflict with meetings of the Institute.

7.2.4. Fiscal Matters

In order to permit the Institute to comply with applicable legal requirements, Sections shall report all receipts, expenditures, and fund balances to the Executive Committee or the Treasurer in the manner and form required. No Section shall engage in any activity or expend any funds for purposes that could create a significant liability exposure for the Institute, or that could threaten the Institute's status as a tax-exempt organization or that conflict with policies of the Institute or of directives of the Executive Committee. In the event of a failure to comply strictly with these requirements, the Executive Committee may immediately replace the officers of the Section, revoke its charter and invite a reorganization of the Section, or take other corrective action as it may deem appropriate.

7.2.5. Section Screening Committee

Applications for Certification as a Professional Geologist should be reviewed by a Section Screening Committee whose members must be Certified Professional Geologists. The Section Screening Committee will act in accordance with procedures adopted by the National Screening Committee.

7.2.6. Other Matters

Sections, as parts of the Institute, shall remain subject to the Institute's Bylaws, policies, and procedures, and to the directives of the Executive Committee.

Section Website Reminders

The Michigan Section has created a database of geologic photographs on our website. Please submit photographs that you are willing to share to Adam Heft at adam.heft@wsp.com. Don't forget to include your name and a short explanation of what the photograph depicts. The photographs will be uploaded to the website periodically.

If you have suggestions on other items that should be included on the History page, please let a member of the Section Executive Committee know.

Minerals for Sale!

Long-time Michigan mineral collector and dealer, Bill Micols, is selling his lifetime collection of material. Bill is in Milford. For additional details, please see the full-page flyer on the following page.

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Where in Michigan?

The July 2020 edition of *Geologically Speaking* featured a photograph of Harvey Quarry, which is just south of Marquette along the west side of US-41. The photograph shows the Mona Schist, Enchantment Lake Formation, and Mesnard Quartzite, all of Precambrian age. Dan Wiitala was the first to correctly identify the photograph.

This edition of *Geologically Speaking* features a new photograph **at right** - not the photo on the cover page. The first person to correctly identify what the photograph depicts (feature name, location, formation, and age) will win AIPG swag! Submit your entry to the editor; only one per person per issue please.

Don't forget to check out the feature article "Geology in Michigan" in this issue (as well as the last two editions) that presents a geologic feature of interest within Michigan as a mini field guide. One of the best parts about being a geologist is field trips, and we are hoping that in your travels around the state you include these featured spots as a stop. Why not incorporate them into a family vacation or bring friends who may not be geologists and share these locations that make Michigan unique? We hope you enjoy reading about it, and more importantly, go see it in person! We invite you to share unique geologic features that you know about and submit a "mini field guide" to share with our members in future editions.



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Regulatory Roundup

New per- and polyfluoroalkyl substances (PFAS) criteria, vapor intrusion screening levels, and virtual conferences are the latest news topics to share from the Michigan Department of Environment, Great Lakes, and Energy.

NEW PFAS Stricter Drinking Water Standards

EGLE announced the promulgation of new PFAS drinking water criteria effective August 3, 2020. The state drinking water standards are also commonly referred to as maximum contaminant levels. They are developed under section 5 of the State Drinking Water Act, 1976 PA 299 [MCL 325.1005]. The drinking water standards are for seven PFAS compounds listed in the table below.

PFAS	CAS Registry Number	State Drinking Water Standard	
		ng/L	µg/L
Perfluorooctanoic acid (PFOA)	335-67-1	8	0.008
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	16	0.016
Perfluorononanoic acid (PFNA)	375-95-1	6	0.006
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	51	0.051
Perfluorohexanoic acid (PFHxA)	307-24-4	400,000	400
Perfluorobutane sulfonic acid (PFBS)	375-73-5	420	0.420
Hexafluoropropylene oxide dimer acid (HFPO-DA)	13252-13-6	370	0.370

The criteria above replace the January 10, 2018 residential and non-residential value established for PFOA and PFOS of 70 ng/L combined for groundwater used as drinking water. As established under Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended [MCL 324.20120a(5)], the state drinking water standards become the PFOA and PFOS generic cleanup criteria for groundwater used as drinking water.

The target detection limits for PFOA and PFOS have been lowered to 5 ng/L also.

The remaining established PFAS state drinking water standards do not currently have respective generic cleanup criteria. EGLE must follow the process set forth by

statute and rule to establish criteria because there are no criteria currently for these substances. That process will be initiated shortly and announced separately.

Governor Gretchen Whitmer stated, “Michigan is once again leading the way nationally in fighting PFAS contamination by setting our own science-based drinking water standard. As a result, we will be better protecting Michiganders across our state.”

“Under the direction of Governor Whitmer, we’ve reached this critical milestone for the safety of Michigan’s drinking water,” said EGLE Director Liesl Clark. “These rules represent the input from a diverse group of stakeholders who helped us shape regulations that are practi-

cal, science-driven and, most importantly, protective of public health. We remain committed to working together to root out PFAS contamination, protect at-risk populations and drive down exposure levels.”

Michigan’s first-ever regulations limiting seven PFAS chemicals in drinking water will cover roughly 2,700 public water supplies around the state and exceed the current US Environmental Protection Agency (EPA) guidance on the chemicals.

For more information: [Michigan’s PFAS response](#)

2020 Volatilization to Indoor Air Screening Levels

Effective September 11, 2020, EGLE’s Remediation and Redevelopment Division (RRD) released the new

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2020 Volatilization to Indoor Air Pathway (VIAP) Screening Levels.

The screening levels are published in Appendix D.1 of the [2013 Guidance Document for the Vapor Intrusion Pathway \(2013 VI Guidance\)](#). The previously published screening levels were rescinded in June 2017 and have been replaced with the new 2020 screening levels after receiving stakeholder input.

On June 2, 2020 RRD announced proposed modifications to Appendix D and accepted comments through July 2, 2020. RRD has reviewed the comments received and revised to clarify areas noted by the comments. [A summary of the comments received and RRD's response is available.](#)

EGLE's announcement of the new VIAP screening levels stated, "The VIAP screening levels are provided as a voluntary tool that may be used to determine that site conditions do not present a risk and allow a quick regulatory closure or that site conditions warrant a more site-specific evaluation, at common residential and nonresidential sites. The residential scenario represents a home with a basement and the nonresidential scenario represents an average-sized commercial building with slab-on-grade construction (e.g., gas station convenience store).

The availability of the VIAP screening levels do not affect the ability of a person to use the Part 201 generic cleanup criteria or Part 213 risk-based screening levels when appropriate and applicable, or to develop Part 201 site-specific volatilization to indoor air criteria (SSVIAC) or Part 213 site-specific target levels (SSTLs) under Section 20120b for the department's review and approval. The availability of the screening levels will not change the validity of any SSVIAC or SSTLs that have been previously provided or approved by RRD. These remain valid for the conditions their development was based on and can still be used.

When site conditions are appropriate, these screening levels may be voluntarily proposed for use as Part 201 SSVIAC or Part 213 SSTLs. The use of the screening levels as Part 201 SSVIAC or Part 213 SSTLs requires documentation that the site conditions are appropriate for use. Therefore:

- Any document submitted under Part 201 that relies on the screening levels as SSVIAC including a Baseline Environmental Assessment, Documentation of Due Care Compliance, a Response Activity Plan, No Further Action Report, or any other document that is submitted for department review and approval must include the documentation.
- Any document submitted under Part 213 that relies on the screening levels as SSTLs including a Baseline Environmental Assessment, Documentation of Due Care Compliance, Final Assessment Report, or Closure Report submitted for department review and approval must include the documentation.

The addition of Appendix C.7 – Checklist for Determining if the Volatilization to Indoor Air Pathway Screening Levels Apply

A checklist for conditions that are not consistent with the development of the VIAP screening levels has been

drafted to evaluate when Part 201 site-specific criteria or Part 213 SSTLs may need to be developed. This checklist will also be available to use to document site conditions are appropriate to voluntarily use of the screening levels as Part 201 SSVIAC or Part 213 SSTLs and may be included with submittals to RRD continues to pursue the development of an on-line calculator that can assist in developing Part 201 SSVIAC or Part 213 SSTLs for scenarios where the screening levels do not apply, or where site conditions can be modified to produce more representative SSVIAC or SSTLs. Until the calculator is available, the department will continue to assist in developing SSVIAC and SSTLs for this pathway. Requests for assistance in their development may be made using the [questionnaire](#) available [on the RRD Resource Materials web page](#). Alternatively, a person may develop SSVIAC or SSTLs using any of the options available in Section 20120b and submit the necessary information to the department for review and approval.

For questions regarding the development and/or use of the VIAP screening levels, please contact Dr. Shane Morrison, RRD Toxicologist, at morrisons5@michigan.gov, or the VI Technical Assistance and Program Support (TAPS) Points of Contact (POC) for the district where a site is located."

Virtual Conferences Take Center Stage

As we are continuing into the seventh month of our alternate normal, virtual communications have become the primary means of outreach replacing large in-person events with apps, screen sharing, and video conferencing. In September, EGLE hosted its first large-scale virtual event, Michigan Environmental Compliance Week, replacing the Michigan Environmental Compliance Conference. The event featured five days of presentations by EGLE staff covering topics from all divisions including IT modernization, regulatory updates, program implementation and more. Registrations exceeded 2,000 for the event.

The next virtual event is the Great Lakes Virtual PFAS Summit taking place October 26-30, 2020. This weeklong event will feature experts presenting in more than 30 sessions on the following topics:

- Rules and Regulations
- Public Health and Communication
- Pollution Prevention
- Materials Management
- Sampling and Analytical
- Treatment Technology
- PFAS in Agriculture and Natural Resources

[Conference Agenda](#)

This event is also featuring exhibitors creating a unique opportunity to connect with the scientific community. [Exhibitor Information and Registration](#)

Participants may include local, state, and federal government officials; environmental consultants and vendors; academic researchers and students; industries



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managing PFAS contamination; and community organizations.

Registration is \$50. Professional development hours will be available. Registration closes on October 22, 2020. [Register here.](#)

For more information on all of EGLE's virtual events, go to Michigan.gov/EGLEEvents.

News releases, program information, and MI Environment, the Department's blog, are also accessible via the homepage. During these times of great uncertainty, we recommend visiting the homepage frequently to find the latest information and Departmental activities.

Be sure to stay safe, follow CDC guidelines, and observe social distancing practicing and hopefully, we can limit the spread of the virus.

Proposed Rules

Natural Resources and Environmental Protection Act, PA 451 of 1994, as amended, bill search

Safe Drinking Water Act, PA 399 of 1976, as amended, bill search

Gas Safety Standards, PA 165 of 1969, as amended, bill search

In Memoriam



The AIPG Michigan Section would like to share the sad news of the passing of fellow Geologist John Zawiskie. John was an adjunct faculty member in the Wayne State University's Department of Geology, teaching Historical Geology for many years. He touched the lives of countless geology and environmental science students with his captivating stories of geological research trips to Antarctica, passionate discussions of meteorites and fossils, and his overall enthusi-

asm for geological education. John served as the Cranbrook Institute of Science Curator of Earth and Life Science at his passing, and held other roles at Cranbrook including Institute geologist and paleontologist, and Curator of Meteorites. He will be greatly missed.

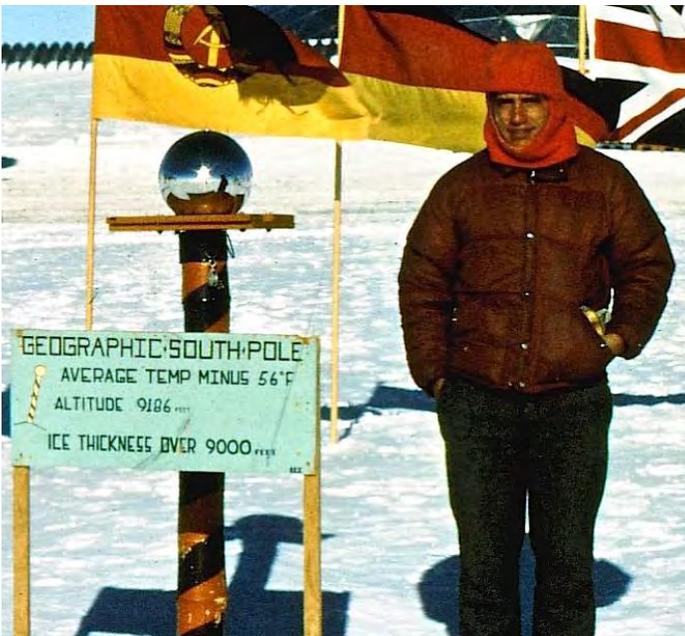


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Thank you to all our sponsors, without whom, this event would not be possible. Additionally, thanks to the volunteers that make this event happen; Cheri DeLyon (Fibertec) for assisting with registration and raffles, Gail Carr (Eurofins US, TestAmerica) for administering the putting contest, Peggy Straub and Alan Reichenbach (ERG) for helping with the hole-in-one grand prize hole and team photographs. Craig Marlow (CEMCOR), Shawn Kriesch (SK Environmental), Roger Pendry (JSS), and Laura Lambert (ERG) also assisted with the set-up, raffles, and awards presentation. I also like to thank the staff at Lyon Oaks Golf Course for the service provided for our event.

Thanks to all attendees. Hope to see you again in May 2021!

Bob Reichenbach, Golf Outing Chairman

Editor's Addition: Thank you Bob, for all you have done over the years in making the Golf Outings fun and successful events!

Photo at right: Tom Cok (Minnik Smith Group) driving for that elusive hole-in-one.



A large advertisement for Weston Solutions. The background is a photograph of a construction site with a stream and trees. In the foreground, two workers wearing hard hats and high-visibility vests are looking at a set of plans. The Weston Solutions logo is prominently displayed in the upper left, and a blue banner with the slogan "TRUST - PERFORMANCE - PEOPLE" is centered. The website "WestonSolutions.com" is in the bottom right corner.



The photo at left shows prominent glacial grooves incised in an exposure of the Precambrian Portage Lake Volcanics. This outcrop is located behind the CLK Schools complex in Calumet (Houghton County).

Photo credit: David Adler

Students - Reminder

Your student Chapter Reports are due by May 1 each year. Send a copy to Dorothy Combs at National at aipg@aipg.org and to Adam Heft at adam.heft@wsp.com.

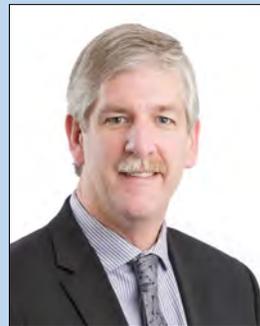
Invitation to Our Members!

Do you have a case study to share?

The Michigan Section AIPG promotes knowledge sharing and would like to showcase case studies from projects where others may benefit from successes as well as lessons learned. We feel as professionals that learning from each other is a great opportunity that AIPG offers our members. AIPG offers connection with other professionals and their experiences in the work we do every day. This case study represents what we would like to offer more to our members, not only as a way to solve problems, but unify us as professional geologists. Additionally, do you have a suggestion for other types of information to share that would be of interest to our membership?

Please send your case studies and suggestions for future publication in upcoming editions of *Geologically Speaking* to the Editor.

Adam Heft is the New AIPG National Editor!



Adam Heft, Michigan Section's Newsletter Editor, has been elected National Editor of *The Professional Geologist (TPG)* for 2021-22.

I would like to thank all of you who voted in this year's National election and helped me to attain the position of Editor.

Although my term begins on January 1, 2021, I will be working closely with the current Editor, John Berry of Texas, to prepare the first edition of 2021 late this year. Starting now, I encourage ALL of our members to consider submitting a technical or professional article or opinion piece for publication. The deadline for submittal is two months before the start of the quarter for which the TPG edition is published. Thus, November 1 is the deadline for the Jan/Feb/March edition.

Please submit your articles of no more than 3,200 words in MS Word format to Dorothy Combs at National Headquarters at aipg@aipg.org. All graphics (photos, figures, or tables) should be submitted in .jpg, .tiff or other standard format at 300 dpi. Please ensure your graphics are clean and easy to read to make things easier for the editorial staff. Complete information on submitting an article may be found on National's website under Resources.

Reminder: The Jan/Feb/Mar edition is the student edition. We welcome articles by students ranging from technical research papers to fun, feature articles.

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Geology in Michigan – Southeast Iron County

Part 1: Paint River Dam and Downstream Outcrops

Latitude: 46°06'22"N; Longitude: 88°20'07"W

Section 20, T43N, R32W, Iron County

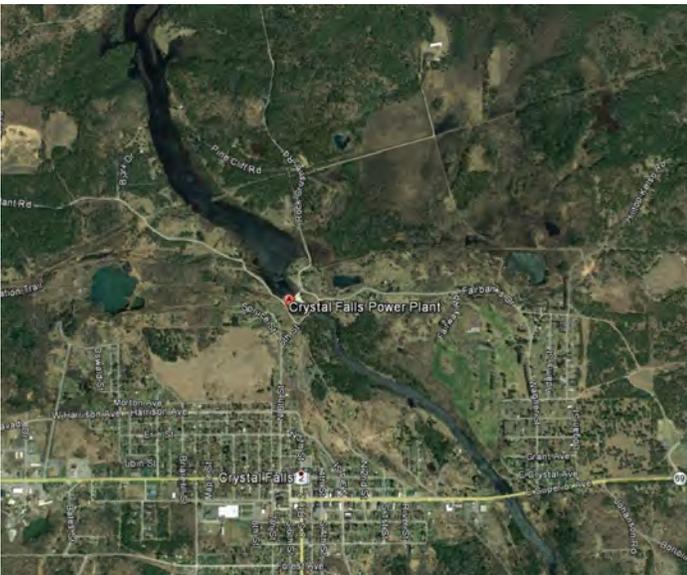


Figure 1: Map showing the location of the Paint River Dam in relation to Crystal Falls. Source: Google Earth Pro.

Directions

From the M-69/US-2 intersection in Crystal Falls, go north and west on US-2 around the turn to the left, and turn right (north) onto 6th Street. Follow 6th Street north through town, and bear right at the fork. Stay right and cross the Paint River. The dam and powerhouse are on the left. Immediately after crossing the river, turn left into the parking lot of the city park.

Paint River Dam and Power Plant

The Paint River dam and power plant were originally constructed in 1891 by the village of Crystal Falls. The construction of the dam submerged the rapids that gave Crystal Falls its name. The power plant and dam were upgraded multiple times from 1902 through 1931, and included replacing and expanding the power plant building and replacing the original dam with the existing one. The power plant is still operational, and is believed to be the oldest hydro-electric plant still in operation in the Upper Peninsula.



Figure 2: Early 1880s photo of the “falls” prior to construction of the power house and dam. Source: Wayback Machine Internet Archive.

The dam spanning the Paint River is approximately 75 feet long and 15 feet high, and has four spillways. The power plant for the dam provides about one-third of the electrical demand of the residents of Crystal Falls.



Figure 3: Photo of the power house and dam with one spillway gate open. Source: Sara Pearson photograph taken July 28, 2020.

Geology

The bedrock in the Crystal Falls area is comprised of Precambrian age rocks of the Paint River Group. These rocks include (from oldest to youngest) the Dunn Creek Slate, Riverton Iron Formation, Hiawatha Graywacke, Stambaugh Formation, and Fortune Lakes Slate.

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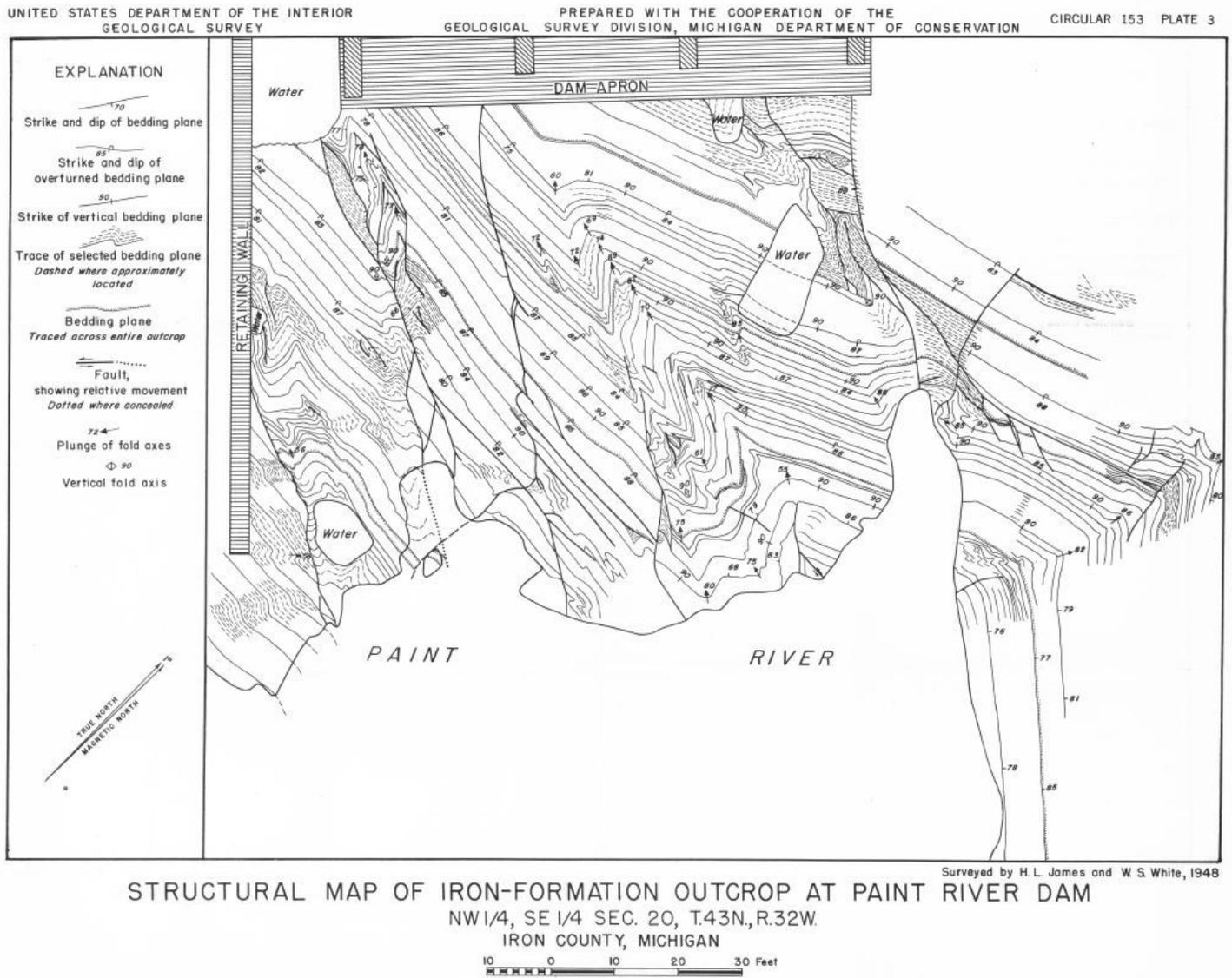


Figure 4: Map showing the Riverton Iron Formation at the Paint River Dam. Source: Pettijohn, 1952, Geology of the Northern Crystal Falls Area, Iron County, Michigan, Plate 3.

The outcrop on the immediate downstream side of the Paint River dam is the Precambrian age Riverton Iron Formation. As can be observed from Figure 4, the layers of this formation are highly contorted, with plunging folds and overturned bedding. The contorted nature of the rocks in this area is further seen in Figure 5 (shown in pink) and the way the mapped rocks in the group are deformed together.

Progressing downstream from the Paint River dam and the Sixth Street bridge, the next formation encountered is the Hiawatha Graywacke (olive green). This is a clastic unit comprised primarily of dark gray massive graywacke, but also includes slate and siltstone as well as a breccia with a graywacke matrix. The breccia is well exposed along the Paint River; the breccia clasts are angular fragments of chert, which are derived from the underlying Riverton Iron Formation.

After a thin band of the Hiawatha Graywacke, a wider layer of the Stambaugh Formation (brown and orange brown) exists. This formation is referred to as a magnetic slate; however, it has three members of different charac-

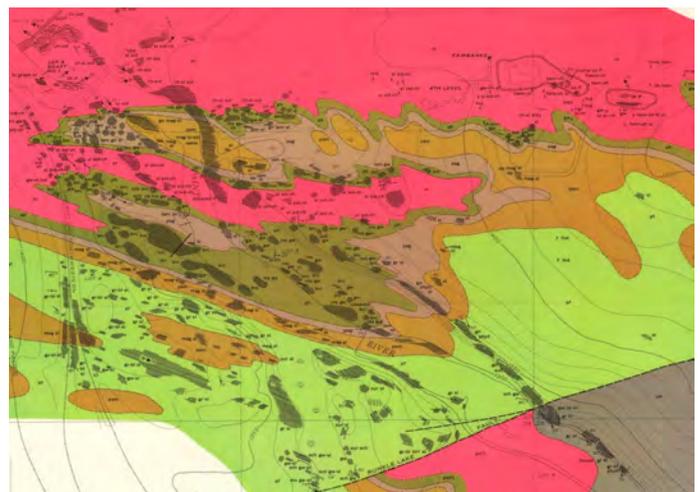


Figure 5: Geologic map of the Paint River Outcrop Area. Source: Pettijohn, 1952, Geology of the Northern Crystal Falls Area, Iron County, Michigan, Plate 2.

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ter. These members include a basal, waxy green delicately laminated nonmagnetic slate, a strongly magnetic gray, flinty thinly laminated slate with layers of mixed chert and carbonate, and olive drab mudstone interbedded with 2- to 4-inch thick layers of laminated white to dark gray porcelanite.

The youngest formation of the Paint River Group is the Fortune Lakes Slate. Although the formation is comprised of about 75 percent slate and 25 percent graywacke, about half of the outcrops are graywacke. Most exposed rock is light to dark gray, with fresh surfaces a glistening gray black.

The oldest formation of the Paint River Group is the Dunn Creek Slate (gray), which is exposed farthest downstream of the Paint River dam of the five formations that comprise the group. It is exposed proximate to the Fortune Lakes Slate (lime green) but separated by the Runkle Lake Fault. Shown on Figure 5, this formation is located farthest downstream from the Paint River Dam. This formation comprises all strata between the Badwater Greenstone and the Riverton Iron formation; however, different portions of the Dunn Creek Slate have different aspects. The upper portion is a distinctive graphitic pyritic slate that is underlain by gray sericitic slate and siltstone. The lower four-fifths of the formation is subdivided into four gradational members. From oldest to youngest, they include cherty black slate, slaty iron formation, laminated slates, and another slaty iron formation.

Part 2: Peavy Pond Dam and Gorge

Latitude: 45°59'25"N; Longitude: 88°12'36"W

Section 32, T42N, R31W, Iron County



Figure 6: The Peavy Pond dam and gorge. Source: Adam Heft photograph taken July 27, 2020.

Editor's Note: *The Peavy Pond dam and gorge is private property owned by WE Energy. Permission **must** be obtained prior to accessing this location and descending into the gorge below the dam.*

Directions

From the M-69/US-2 intersection in Crystal Falls, go

east through Mansfield to Camp 5 Road. Head south on Camp 5 Road to Upper Dam Road. Follow the road west to the parking lot east of the Peavy Pond dam.

Local Geology

The rock in the gorge is part of the metamorphosed Michigamme Slate series, which overlies the iron formations mined in the area. The rock is highly quartzose, with some lenses of recrystallized chert. Predominant joint sets strike S10E, dipping 50 degrees east. A secondary joint set strikes N85E, dipping vertically. Joints are generally closed and tight. Bedding is also nearly vertical, striking N85E and dipping between 85 degrees north and 85 degrees south. Bedding planes are also tight.



Figure 7: Rocks exhibiting multiple joint sets. Source: Sara Pearson photograph taken July 27, 2020.



Figure 8: Small Scale quartz boudins. Field of view is about 18 inches. Source: Sara Pearson photograph taken July 27, 2020.

Quartz pods and boudins are common in the rocks below the dam. On some blocks with edges formed by jointing, the boudin structure may be observed in three dimensions. Interestingly, the frequency of boudins in one face of the rock is typically two or even three times that in the third dimension. And in some areas, there may be multiple parallel layers of boudins closely spaced, while in other areas, the boudined layers are many feet apart.

Boudins form under extensional stress, where a rigid tabular body (such as quartz) is stretched and deformed within less competent rock, in this case, slate. The boudins at this location are oriented parallel to bedding.

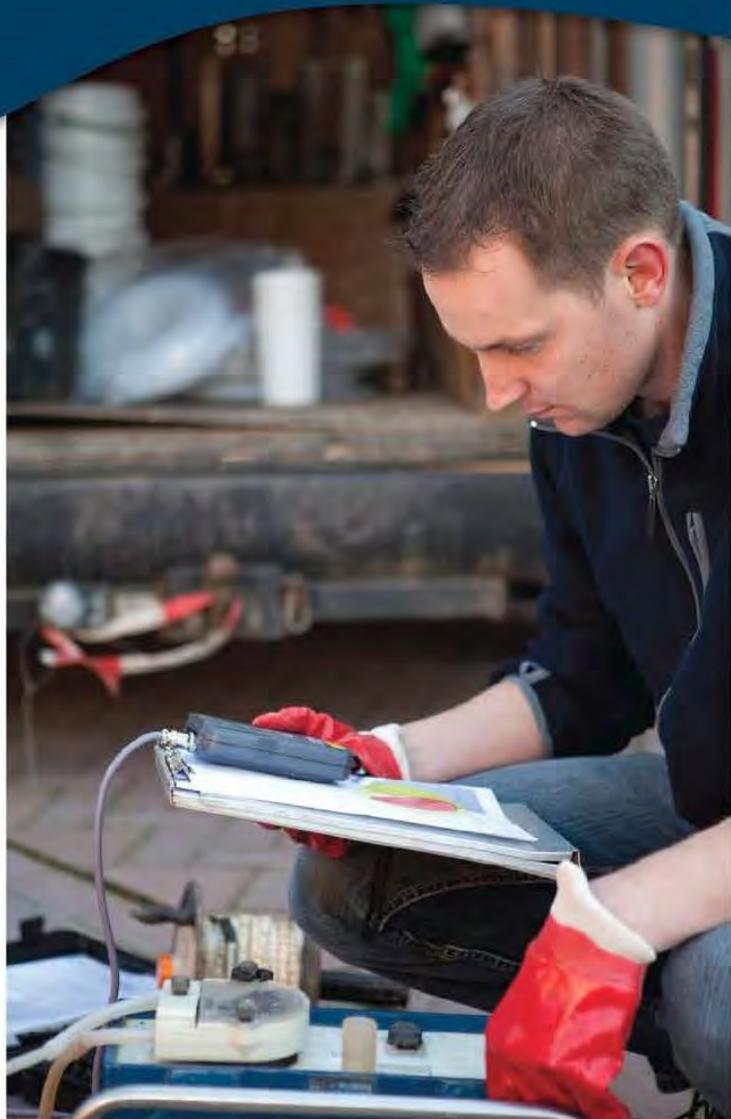


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Figure 9 (at left): Boudins in three dimensions. Note that the pods along the top surface are about twice as close as the vertical. Source: Adam Heft photograph taken July 27, 2020.

Chatter holes of various sizes may also be observed in the rocks. Some still contain the rock that formed them, while others have had the rock washed out.



Figure 10: Filled and unfilled chatter holes. Source: Sara Pearson and Adam Heft photographs taken July 27, 2020.

Regional Geology

The Peavy Pond area is part of the Peavy node of regional metamorphism. The rocks at this location have been metamorphosed to the sillimanite grade while deeply buried where heat and pressures were great.

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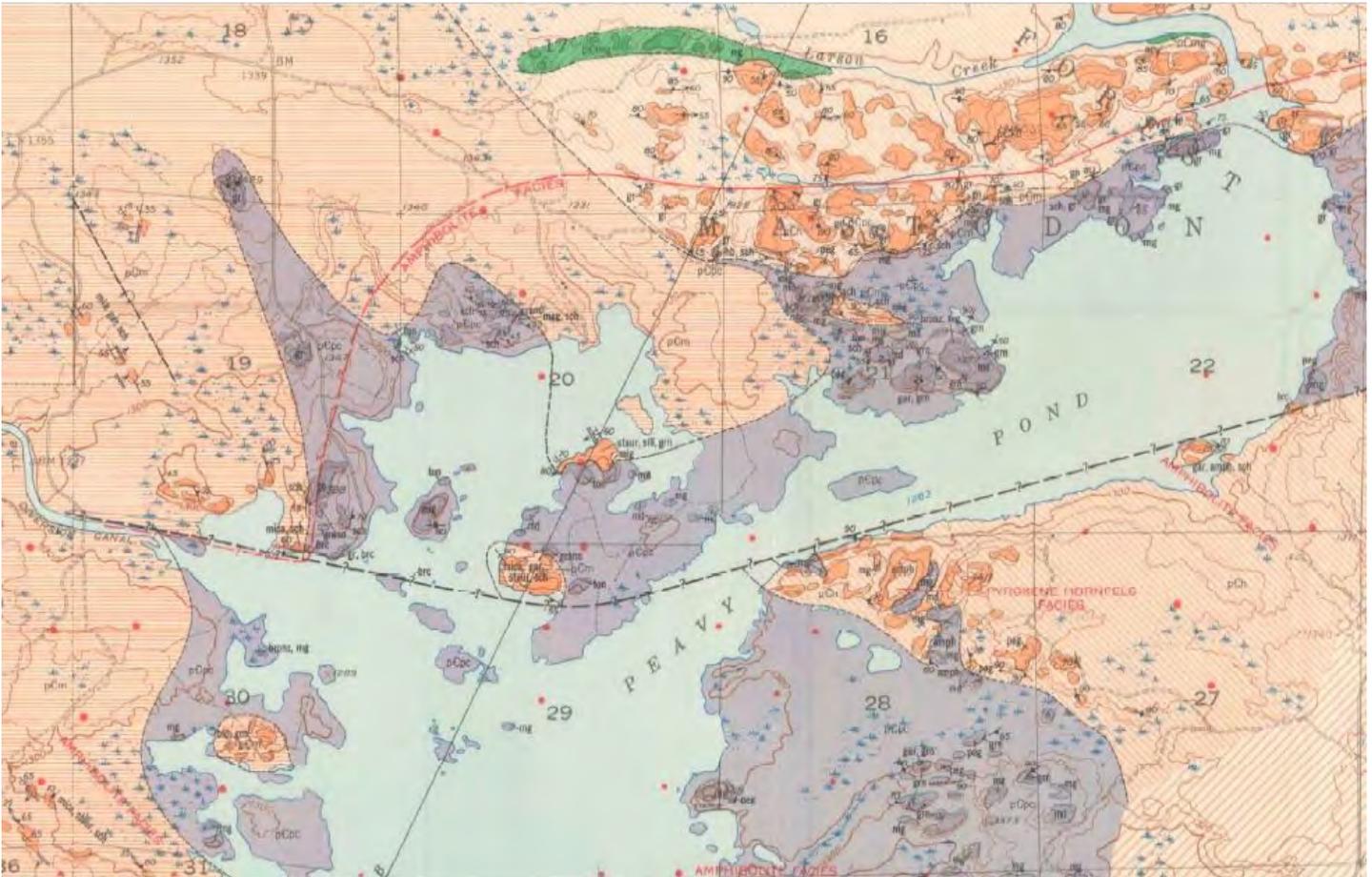


Figure 11: A portion of the Lake Mary Quadrangle Map Depicting the northern portion of Peavy Pond. And the Bush Lake Fault. Note that the Peavy Pond Dam is off the bottom of the map. Source: Bayley, 1959, Plate 1.

The rocks comprising the Peavy Pond Complex are a syntectonic igneous body, composed of gabbro and minor ultramafic parts and are fringed with granite, granodiorite, and tonalite that was intruded into the Hemlock and Michigamme formations during the post-Middle Precambrian orogeny.

The rocks have also undergone at least two visibly distinct phases of deformation. One of these phases is the development of isoclinal folds; the other is the presence of rotated boudins. The deformation culminated in major faulting during which the formations were dislocated and some of the granite of the complex was brecciated.

Peavy Pond Powerhouse and Dam

Peavy Pond covers approximately 2,400 acres, and was created with the construction of the dam and powerhouse in 1943. This hydroelectric power plant generates a maximum of 12,000 kilowatts.

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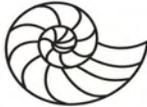
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Welcome New Members

The Michigan Section is continuing to grow. Please welcome the following new CPGs, Professional Members, Early Career Professionals, Associate Members, and Students:

Grace Borst, SA-10574; Emily Clor, ECP-0624; Hailey Waldron, SA-10567; Morgan Bergren, SA-10580; Karlee Foster, SA-10581; Michael Sandusky, SA-10590; Brandon St. Aubin, SA-10584; Autumn Burns, SA-10593; Benjamin Moyer, SA-

10633; Ryann Scott, MEM-3171; Shawn Steckenfinger, SA-10660; Kristen Foley, SA-10705; Mark Erickson, MEM-3178; Bruce Bilgreen, SA-10697; Olivia Salvaggio, SA-10698; Patrick Howe, ECP-0655; Kathryn Strohauser, MEM-3181.

To each of our new members, welcome to our Section. We encourage you to attend Section meetings and other events. You are also invited to provide information for the Member's Corner articles.

Member's Corner

The Member's Corner includes information about the Section's membership. This is your chance to provide information on where you are and what you are doing. Simply send the information to the Editor for inclusion in this section.

No Member's Corner articles were received for this edition of *Geologically Speaking*.

Interesting Geology Links

The Editor has received links to various interesting geology-related sites. Some of the more interesting links are included here. If you have any links to geology-related sites that you would like to share, please forward them (with a citation, if applicable) to the Editor.

Thanks to Mark Francek of Central Michigan University for sharing via the "Earth Science Site of the Week" emails. This edition features a few "fun" links

Manipulate an interactive globe to see what earth looked like all the way back to 750 mya: <https://dinosaurpictures.org/ancient-earth#170>

Urban Soil Survey – A Story Map: <https://nrms.maps.arcgis.com/apps/MapJournal/index.html?appid=b38d8cc57afa4a2f88bc5dd65791c7c2>

Michigan Dam Failure Caught on Video: https://www.youtube.com/watch?v=Hc3u_CHVHJ8



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ASBOG Exam Update

Twenty-four individuals took the ASBOG FG exam at Central Michigan University last Friday, October 2nd. Registration is now open for the next exam, which will be administered on March 19, 2021. Relevant dates for taking the exam this March are:

- January 14 – apply to CMU

- January 24 – register with ASBOG
- March 19 – FG exam at CMU

Details are available at: se.cmich.edu/asbog and will be provided in the next edition of *Geologically Speaking*.

Member Input Sought

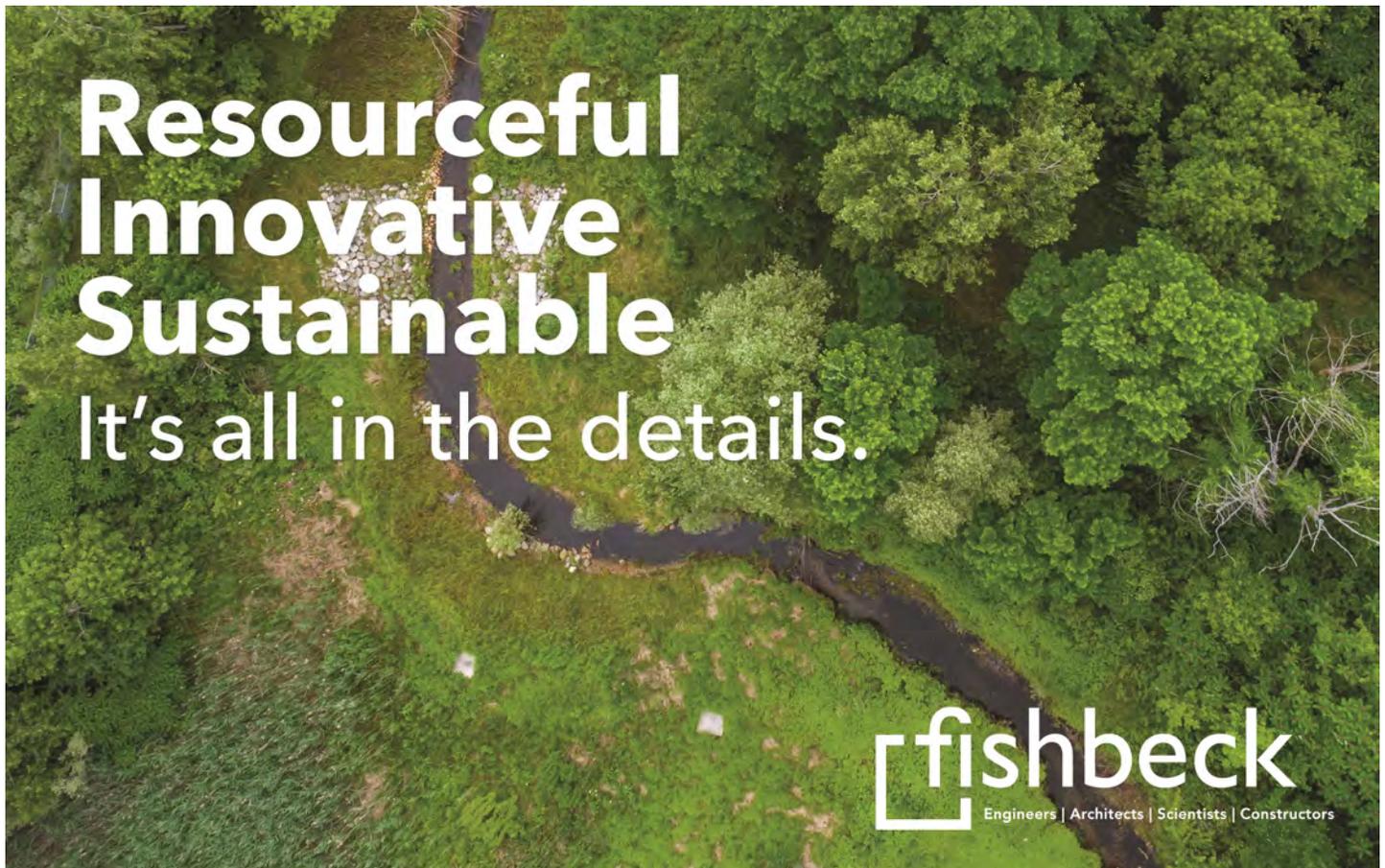
The Section Executive Committee is seeking input from members on a variety of topics. Do you have any suggestions regarding speakers/presentation topics that you would like to hear? What about field trips or other events? Some place you'd like to see us go, or something you think the membership would enjoy doing?

Then make your voice heard; please send your suggestions to one of the members of the Executive Committee; any of the six members would be glad to hear from you. AIPG is your organization. Please help keep it relevant and interesting for all by participating.

Support our Sponsors!

The Section Executive Committee would like to remind its members to support the companies advertising in this publication. Consider working with these compa-

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Annual Meeting Planning

The Michigan Section AIPG will be hosting the 2022 Annual Meeting in Marquette on August 6-9, 2022. The planning committee is growing but needs your help! The committee is co-chaired by Adam Heft and Sara Pearson. If you are interested in helping with the planning of the 2022 Annual Meeting or would like to be on the planning committee, please email either Adam or Sara at adam.heft@wsp.com or pearsons@michigan.gov.

As one of the most active AIPG Sections, Michigan

wants to have an exciting program and a highly successful Annual Meeting with many attendees. If you have any suggestions or ideas that will make the 2022 Annual Meeting one to remember, please pass them along.

Look for periodic updates on the status of the Annual Meeting planning in future editions of *Geologically Speaking!*

Update Your Information!

Please be sure that you continue to receive the Section's *Geologically Speaking* publication and other announcements. Submit an updated e-mail address to Adam Heft at adam.heft@wsp.com. If you move or change places of employment, don't forget to send your new contact information to both the Section and to National. If you are not receiving announcements directly from the Editor, it is because your email address is not

up to date with the Michigan Section.

Please help the Editor by making sure that your email address doesn't bounce when the next announcement is sent. And be sure to cc Dorothy Combs, National AIPG Membership Director at aipg@aipg.org when you update your contact information. Thank you!



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Coming Events

October 9-11, 2020: Detroit Gem, Mineral & Fossil Show. Macomb Community College Expo Center, South Campus, 14500 East 12 Mile Road, Warren.

October 11-17, 2020: Earth Science Week (www.earthsciweek.org).

October 12, 2020: Global Minerals Day (<http://www.earthsciweek.org/minerals-day>).

October 14, 2020: AIPG and MAEP Virtual Joint Meeting (<https://www.maep.org/event-3975384>).

October 26-30, 2020: Great Lakes Virtual PFAS Summit, https://www.michigan.gov/egle/0,9429,7-135-3308_3333-518324--,00.html.

December 1-3, 2020: Great Lakes Water Infrastructure Conference, Novi. Info at: https://www.michigan.gov/egle/0,9429,7-135-3308_3333-500683--,00.html.

December 3, 2020: Michigan Section Annual Meeting, Weber's Inn, Ann Arbor.

RESCHEDULED:

June 14-16, 2021: Michigan Section's 10th Annual Environmental Risk Management Workshop: "The Data Tell the Story" at the Ralph A. MacMullan Conference Center, Roscommon, Michigan.

October 23-26, 2021: Rescheduled 57th Annual AIPG Meeting to be held in Sacramento, California. The Role of Geoscientists for Resiliency, Sustainability and Opportunities in a Changing Environment. The meeting venue will be the Hilton Sacramento Arden West.

August 6-9, 2022: 58th Annual AIPG Meeting to be held in Marquette, Michigan. See article in this edition of *Geologically Speaking* regarding meeting planning.



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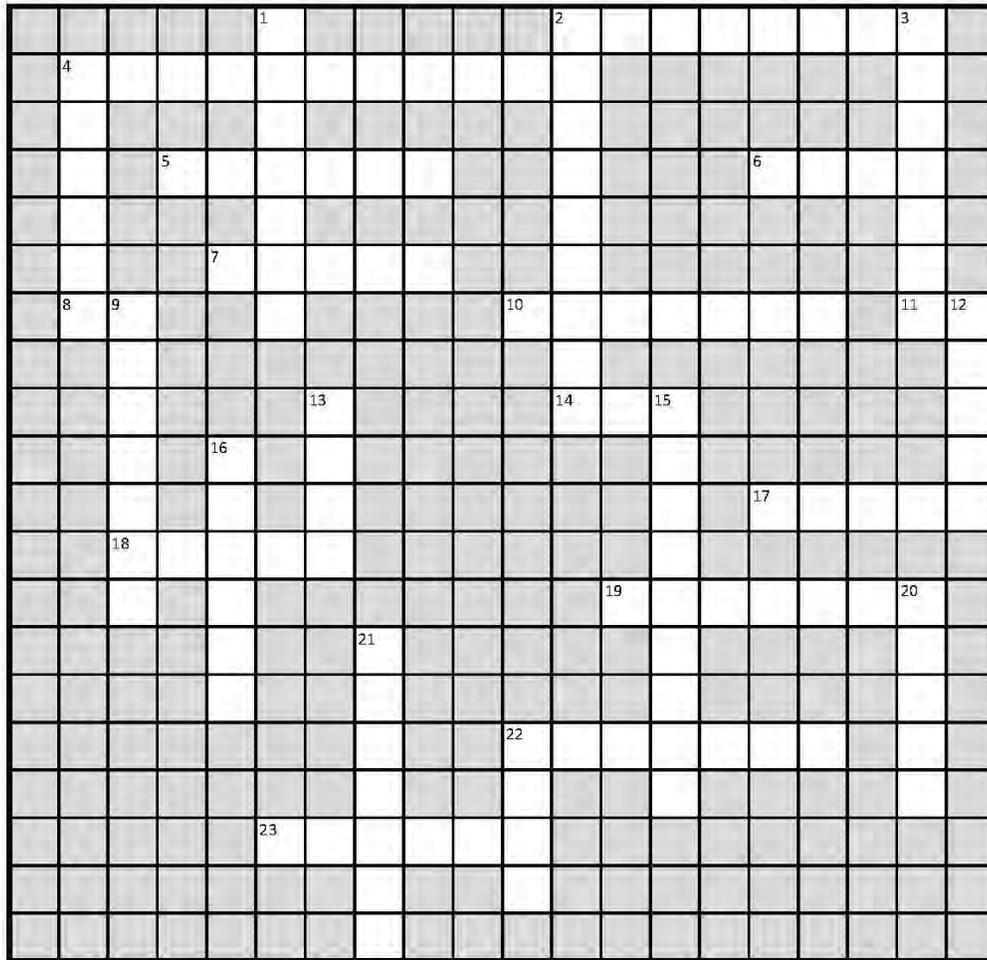
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Across

- 2 Plumbers action
- 4 Highest metamorphic grade
- 5 Semi precious gem
- 6 County or element
- 7 Topples
- 8 Letter addressee
- 10 Extensional deformation feature
- 11 Out of or like
- 14 Inpoundment feature
- 17 var. silica
- 18 Michigamme rock
- 19 Compressional deformation feature
- 22 Black mica
- 23 Doobie

Down

- 1 Ultramafic sill
- 2 Man-made lake
- 3 Felsic intrusive rock
- 4 Mid-range metamorphic
- 9 Glacial deposit
- 12 Geological break
- 13 Water body
- 15 $KAl_2[(OH,F)_2 | AlSi_3O_{10}]$
- 16 Residual magma fluid
- 20 To stuff oneself
- 21 Material reduction
- 22 A shrubbery

*The solution to this geology crossword will be included in the next edition of *Geologically Speaking*.

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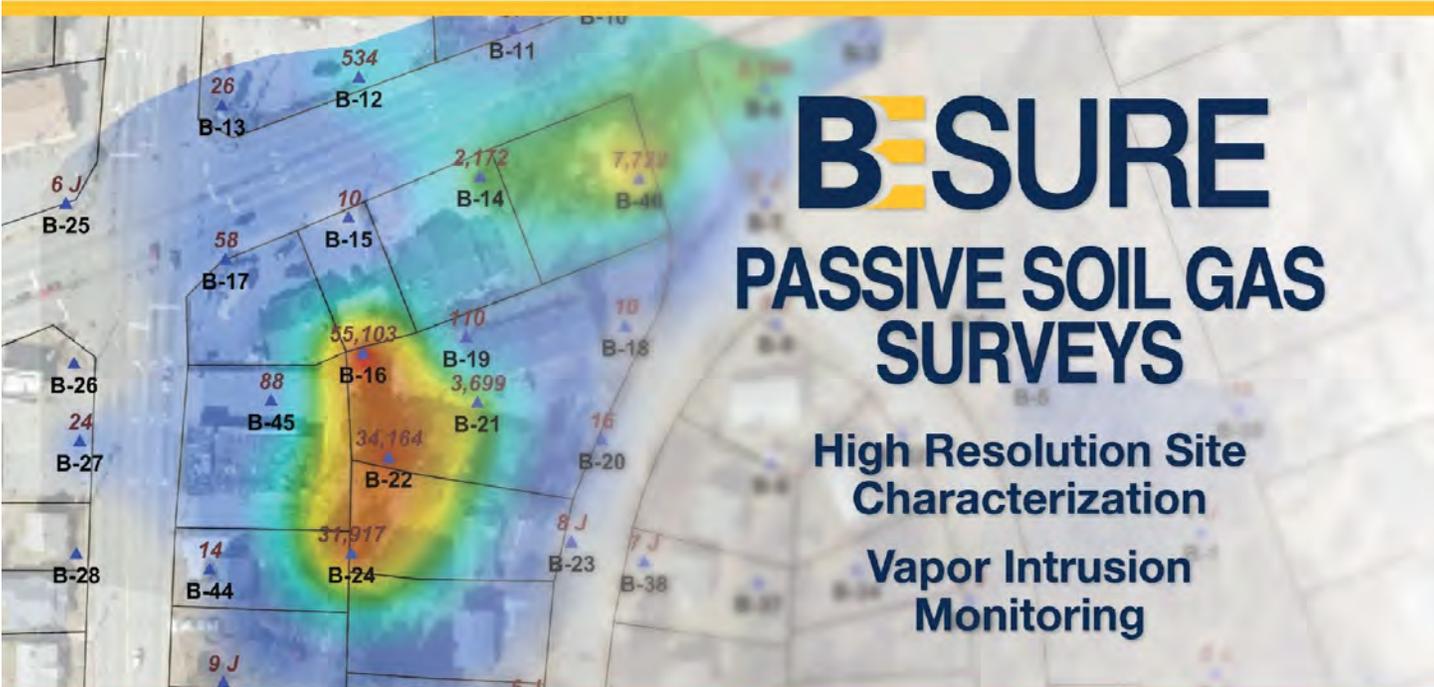


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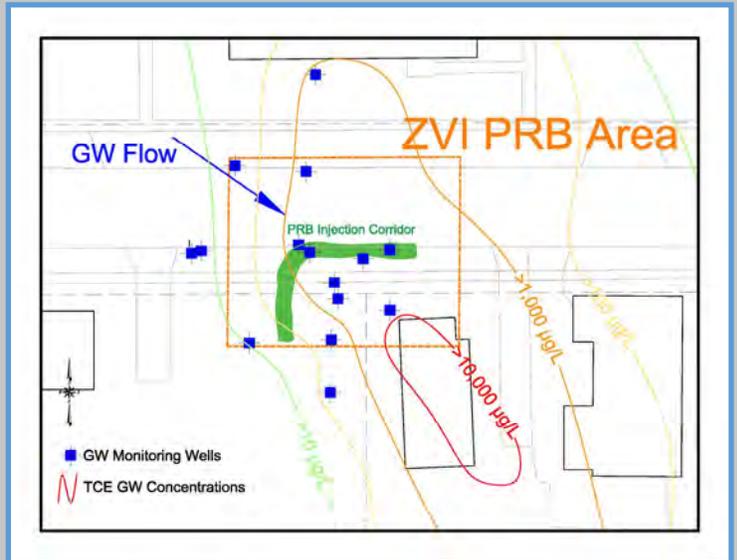
Laboratory - DoD ELAP, NELAP, & ISO/IEC 17025
Sampling - TNI NEFAP | Soil gas & air sampling

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ZVI PERMEABLE REACTIVE BARRIER CVOC PLUME

PROJECT HIGHLIGHTS

- Challenging residential setting with VI risk reduction goal
- Challenging hydrogeologic setting (Mason Esker) with fast moving (> 1'/d) oxic groundwater (~3 mg/L in treatment area)
- Groundwater sourcing vapor plume in residential area (>10,000 µg/L Total CVOCs)
- Design data acquisition—passive flux meters to optimize design and target zones of greatest contaminant mass-flux
- Utilized a unique combination of chemical reduction, physical sequestration, and biological reduction
- Cut-off plume from upgradient source area (chemical plant)
- PRB deployment in City ROW and on residential property



Passive Flux Meter Sampling



KEY PERSONNEL

- Joel Parker, M.S.
- Doug Spencer
- Abigail Varner, P.E.

KEY COLLABORATORS

- Michigan Department of Environment, Great Lakes & Energy
- REGENESIS



Remedial Injection



Remedial Injection

ZVI PERMEABLE REACTIVE BARRIER CVOC PLUME

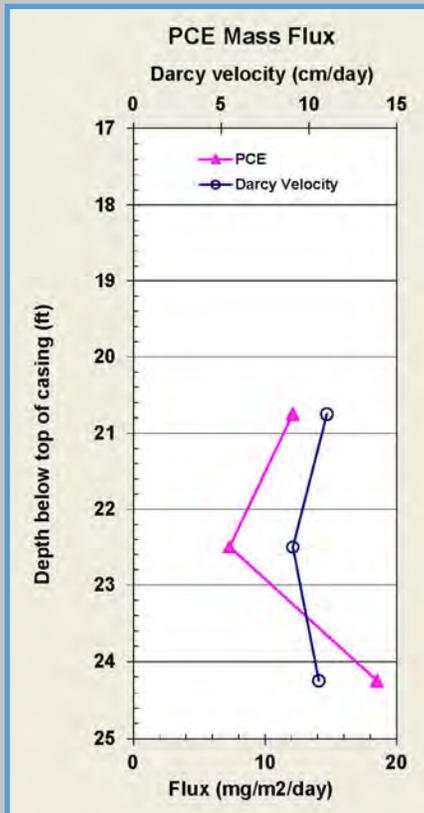
PROJECT SUMMARY

A groundwater plume with concentrations of CVOCs greater than 10,000 µg/L was causing a vapor plume directly affecting residential properties. The plume emanated from an upgradient source caused by systemic releases from historic chemical manufacturing. The geological setting (Mason Esker and ≈1 foot/day Darcy velocity) contributed to off-site migration of high concentration CVOCs in groundwater affecting a nearby residential neighborhood.

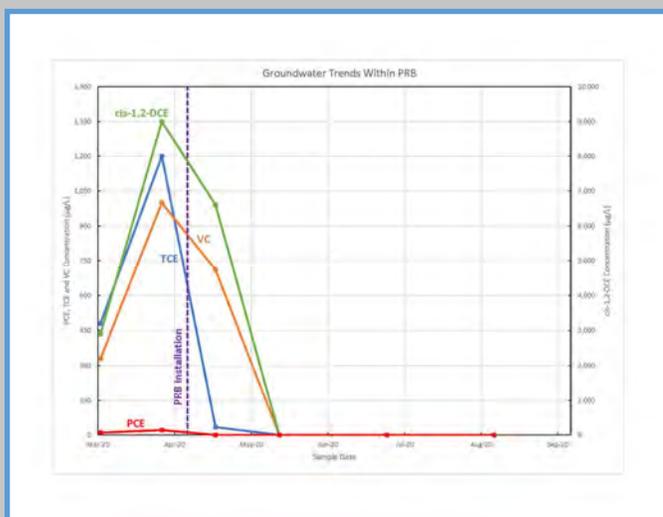
Passive Flux Meters (PFMs) were used to determine mass flux throughout the upper 10 feet of aquifer at two spatial locations within the proposed treatment area. PFM outputs (at left) were used to target design dosages of remediation compounds.

Oxic conditions (>3 mg/L DO) and positive oxidation-reduction potentials (ORP) existed in the aquifer due to its position in the highly permeable Mason Esker. Published research by others and field observations by HMA have demonstrated that oxic conditions may only slightly reduce the effectiveness of Sulfidated ZVI under oxic and positive ORP conditions. ITRC* guidance for PRBs suggests that groundwater environments with less than 4 mg/L of oxygen provides ideal conditions for ZVI remediation.

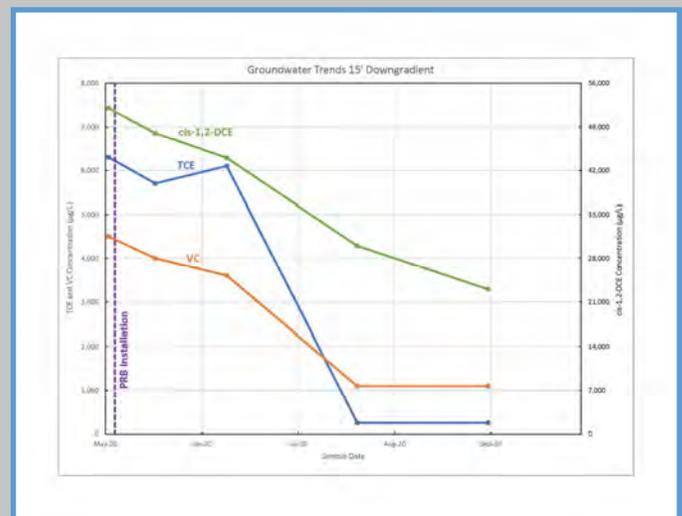
The design approach included injection of a combination of PlumeStop Liquid Activated Carbon® (PlumeStop), Sulfidated Micro-ZVI® (SMZVI), Extended Hydrogen Release Compound® (HRC), Merichlor Dehalos® (a consortium of *dehalococcoides* bacterium), and calcium chloride as a parking agent. The PlumeStop provides physical sequestration and adsorption of the CVOCs to the carbon matrix for more efficient chemical reduction and biodegradation, which results in immediate declines of aqueous CVOCs. The ZVI acts as a reducing agent and provides electrons for direct contaminant degradation. The HRC provides extended release of electron donor material to further stimulate anaerobic biodegradation. Significant reductions in CVOCs (and increases in dissolved ethene and ethane) were observed within 2-3 months of delivery, even as far as 15-20 feet downgradient of the PRB. In addition, DOs and ORPs in the treatment area reflect the shift to reduced conditions conducive to the chemical and biological reduction pathways being sought.



Passive Flux Meter Output



CVOC Trends within PRB



CVOC Trends 15' Downgradient

*ITRC (Interstate Technology and Regulatory Council). 2011. *Permeable Reactive Barrier: Technology Update*. PRB-5. Washington D. C.: Interstate Technology and Regulatory Council, PRB: Technology Update Team. www.itrcweb.org.