

Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst

April 12-16, 2021 San Juan, Puerto Rico Sheraton Old San Juan Hotel www.sinkholeconference.com







american geosciences institute science, and people







Photograph of Empalme Sinkhole (Cueva Clara) of the Rio Camuy System

## **CONFERENCE HIGHLIGHTS**

The 16th Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst (aka, The Sinkhole Conference) will be held in beautiful and historic San Juan, Puerto Rico. Unlike some of our previous conference locations, this is someplace your family will love and where you'll want to stay longer beyond the conference. Puerto Rico offers fabulously vibrant cultural scenes and spectacular karst landscapes unseen in the continental part of the US. As for the conference, here is a preview of the following pages:

- Monday, April 12, a full day field trip through the heart of Puerto Rico's world famous mogote karst.
- Tuesday, April 13, four expert-taught short courses on geotechnical and hydrogeologic aspects of karst.
- Wednesday, April 14 through Friday, April 16, technical paper sessions, kicked-off by a thought-provoking keynote address.
- Thursday, April 15, the Conference Banquet with a special invited speaker.
- Friday, April 16, a half-day field trip to a karst Superfund site.
- Breakfast and lunch are included in the price of registration, plus a welcoming reception, social breaks between sessions, and a poster-viewing reception.
- The widely sought proceedings will be given in digital form to all conference registrants.





# PROGRAM AT-A-GLANCE

April 12, 2021 MONDAY	April 13, 2021 TUESDAY	April 14, 2021 WEDNESDAY	April 15, 2021 THURSDAY	April 16, 2021 FRIDAY
Registration	Registration	Registration	Registration	Registration
Optional Field Trip:	Short Courses 1 & 2 8:00 am –12:00 pm	Keynote Speaker and Session	Sessions	Sessions
Karst of Rio Camuy Cave Park and Arecibo Observatory	Lunch	Lunch	Lunch	Lunch
8:00 am – 6:00 pm	Short Courses 3 & 4 1:00 pm – 5:00 pm	Sessions	Sessions	Optional Field Trip: Karst of Superfund sites in Vega Alta and Vega Baja
	Welcome Reception	Beck Memorial Reception & Poster Session	Banquet and Guest	
		Planning meeting for 17th Sinkhole Conference	Speaker	

## SUBMIT YOUR ABSTRACT TODAY!

Authorship or co-authorship of a full technical paper (approximately 8-10 pages in length) is encouraged of all conference registrants. Abstracts of proposed paper submissions will be accepted through July 24, 2020. Draft paper submissions will be due October 19, 2020. Please check <u>www.sinkholeconference.com</u> for further details and updates.

This is a 2nd call for abstracts due to rescheduling the Conference from 2020 to 2021. Papers already submitted are available as the 1st Edition of this Conference.



## SHORT COURSE 1: Conducting Geotechnical Investigations in Karst

*Instructor:* Michael J. Byle, D. GE, F. ASCE (National Discipline Lead, Civil/Geotechnical Engineering, Tetra Tech, Inc.)

Course length – 4 hours 8:00 am –12:00 pm

Carbonate and evaporite geologic formations underlie a large portion of the world. These formations contain soluble compounds that result in portions of the formations dissolving over time to produce cavities, conduits, enlarged joints, caves, etc. The landforms resulting from these features are referred to as karst. Karst poses many geotechnical concerns such as subsidence, sinkholes, uneven structural support, high groundwater production, and groundwater sensitivity to contamination.

Locating and characterizing karst features at depth is a challenging task. Even large features can be easily missed by conventional borings and may not be detectable by some geophysical methods. This makes it necessary to employ a specially focused investigation that incorporates geological, geotechnical, statistical, and geophysical approaches to evaluate risks and determine the appropriate level of investigation.

This short course will include a brief introduction to karst and the associated geotechnical issues. A discussion of karst factors to various land use, construction, and development will be presented. Methods and strategies for investigating and characterizing various aspects of karst will be covered and examples provided. Methods of investigation including, geologic data review, borings, test excavations, and aerial and terrestrial geophysics will be considered with particular focus on developing an integrated approach to characterizing karst conditions.

### SHORT COURSE 2: Stormwater Management in Karst

Instructor: Robert K. Denton Jr., CPG, LPSS (GeoConcepts Engineering Inc., a Terracon Company)

Course length – 4 hours 8:00 am –12:00 pm

The short course will detail general principles of karst characterization used for the siting and design of stormwater best management practices (BMPs) in karst. Topics to be covered will include:

1) Using terrain, hydrogeological, and subsurface investigation analyses (borings, electrical resistivity, etc.) to properly characterize and design stormwater BMPs in karst.

2) Environmental issues including the mitigation of the transport and migration of soil-adsorbed contaminants into the karst aquifer.

3) Design of stormwater BMPs for internally drained sites (onsite absorption, dry ponds, Class V injection wells, etc.)

4) The impact of limestone saprolite on pond design and failure.

5) Understanding and utilization of the Karst Reduction Factor.

6) A review of regional guidelines and regulations governing karst stormwater BMPs.



## SHORT COURSE 3: Designing and Conducting Tracer Studies in Karst – With Emphasis on Sites with Actual or Potential Contaminant Releases

*Instructors:* Ralph O. Ewers, Ph.D. (President, EWC - Ewers Water Consultants, Inc.) Keith A. White, CPG

(Vice President/Principal Geologist, Arcadis, Inc.)

Course length – 4 hours 1:00 – 5:00 pm

Tracer investigations, particularly those conducted with fluorescent dyes, provide essential information regarding the fate and transport of contaminants in karst aquifers. They do this quickly, reliably, and inexpensively in most karst terranes. Modern spectrofluorometric analytical techniques provide partper-trillion sensitivity and identify each dye by its characteristic wavelength, allowing several dyes to be used simultaneously.

Test Design Essentials – The four essential steps in conducting a tracer test: 1-reconnaissance, 2-tracer background assessment, 3-tracer introduction, and 4-tracer monitoring, will be explored, and the rationale for each will be given.

Tracer Dyes – This short course will provide details on the usefulness of each of the common fluorescent tracer dyes and their individual characteristics. We will discuss the means by which the tracers can be introduced and how, where, and when to monitor for them. The pros and cons for each of the analytical methods will be examined.

Example Tests – Recent and historical tracing examples will be examined in detail, offering a wide range of karst settings in which tracing has been successfully used. In these examples the hydrogeology demonstrated by the tracing will be compared to the hydrogeology inferred by traditional well data.

Qualifications – The presenters have a combined experience of 70 years in karst studies and have been involved in nearly 1,000 tracer tests.

## SHORT COURSE 4: Geologic Site Characterization in a Karst Setting

*Instructors:* Michael J. Byle, D. GE, F. ASCE (National Discipline Lead, Civil/Geotechnical Engineering, Tetra Tech, Inc.)

Peter Hutchinson, P.G., Ph.D. (President and Principal Scientist, THG Geophysics, Ltd.)

Course length – 4 hours 1:00 – 5:00 pm

Geologic site characterization is the technical foundation for all geotechnical and environmental projects. The objective of a geologic site characterization is to gain an accurate and complete understanding of subsurface conditions that will impact the engineering or environmental decisions made at a site. If the site characterization is done right, these decisions will be made with a high degree of confidence and be supported by reliable technical data.

This 4-hour course is based upon an integrated approach to site characterization. Therefore, we will cover a wide range of topics ranging from a discussion of the problem, a strategy, appropriate levels of site characterization, the impact of scale, the methods available and case histories to illustrate the process.

This topic is covered in detail in the recent book titled Geologic Site Characterization in Karst and Pseudokarst Terrains authored by the presenter and Richard C. Benson, PG, CPG (founder and Senior Engineering Geologist of Technos, Inc.) The book is based upon their combined and diverse experience specializing in site characterization with an emphasis on karst.



# Karst of Rio Camuy Cave Park and Arecibo Observatory

Monday, April 12, 2021 All Day Trip: 8:00 am to 5:30 pm

Trip Co-leaders: Ingrid Padilla- University of Puerto Rico, Mayaguez

Brian Smith- Barton Springs/Edwards Aquifer Conservation District, Austin, Texas

The Rio Camuy Cave System is an underground river in the northern karst belt of Puerto Rico. The cave system consists of about 16 km of river and tributary passages and considerably more side passages. This field trip will follow the traditional tourist trip that includes a walk through the Cueva Clara passage to a wide ledge with views of the Rio Camuy below and the large opening of the Empalme Sinkhole above. Another stop on the trip will be a view of the large Tres Pueblos Sinkhole (see image below) with a view of the Rio Camuy flowing across the bottom of the sinkhole about 120 m below the surface. In addition to discussion of the system's hydrology, the impact of record flooding from Hurricane Maria in 2017 will also be examined.

The Arecibo Observatory is a radio telescope with a 300-m diameter dish set into a large sinkhole adjacent to the Tanama River (see image below). The visit will include views of the dish and antenna and the surrounding karst hills. The exhibit area has photographs of the modification of the sinkhole and construction of the dish along with how the radio telescope functions and some of the findings of the telescope.



# Karst of Superfund sites in Vega Alta and Vega Baja

Friday, April 16, 2021 Half Day Trip: 1:30 pm to 6:00 pm

Trip Co-leaders: Brian Smith- Barton Springs/Edwards Aquifer Conservation District, Austin, Texas

Ingrid Padilla- University of Puerto Rico, Mayaguez

The northern karst belt of Puerto Rico is heavily dependent on the karst aquifers for much of its water supply. It is also home to many industrial sites from which industrial contaminants have entered the karst aquifers. Studies have been made of these aquifers for close to 40 years and attempts have been made to clean up the industrial sites and the aquifers, some of which are Superfund sites. The image below shows a plume of TCE at the Vega Alta Superfund Site as it was interpreted in 1993. This trip will include visits to some of the sources of contamination and the surrounding karst landscape. Plumes of contaminants generally move north toward the Atlantic Ocean, although the plumes spread to the east and west where the gradients of the potentiometric surfaces of the aquifers become nearly flat. Pumping from water-supply wells also induces flow of contaminants toward these wells.



NOTE: Participants on either field trip should be prepared for warm to hot, humid, tropical weather. Rain is likely so participants should bring an umbrella or rain parka. Between rain events the tropical sun is intense, so participants should bring a strong sunscreen. Walking will be on paved trails with minor elevation changes. Comfortable shoes, such as tennis shoes or sandals, are encouraged. Caving equipment will not be necessary for the visit to the Camuy cave. Lunch and drinks will be provided for the all-day field trip. Drinks will be provided for the half-day field trip.

## THE BARRY F. BECK SINKHOLE CONFERENCE STUDENT SCHOLARSHIP

The Barry F. Beck Sinkhole Conference Student Scholarship (Beck Scholarship) is a competitive grant that is awarded to one or more students who are presenting the results of their research at the Sinkhole Conference. The award was established in 2013 in memory of the late Dr. Barry Beck, a pioneer in the scientific study of sinkholes who founded the Sinkhole Conferences, and who died in 2011.

At least one Beck Scholarship is awarded for each conference. Additional scholarships are awarded if funded from donors. For this conference, a record eight scholarships have been awarded! We thank them for advancing the careers of eight highly talented young people. Donations to support students at other upcoming Sinkhole conferences are tax deductible and your company is given recognition as outlined below.

**Sponsor**: A donation of \$1,500 or more allows the award to be labeled with the Sponsor's name, such as Acme Corporation – Beck Scholarship. The Sponsor will be distinguished in this manner in all recognitions and announcements of the student's scholarship, including the conference program and website. If the donation exceeds \$1,500, additional awards will be given in \$1,500 increments. Any excess funds will go into the...

General Beck Scholarship Fund: This fund is for donations less than \$1,500. Donors will be acknowledged in the conference program and website. Money in this fund will be carried until the total is sufficient to support a scholarship and will be spent for the next Sinkhole Conference with a qualifying student. Supporting students through this scholarship provides them the opportunity to grow substantially as scientists, learn more about the significant challenges of karst environments, and to establish personal connections with potential employers and partners in future cave and karst research. We hope you will support them. Donations may be made online or by contacting the National Cave and Karst Research Institute's Executive Director, Dr. George Veni at gveni@nckri.org. For more information see www.sinkholeconference.com/how-tosponsor-the-scholarship.

Below: Beck Scholars at the 15th Sinkhole conference joined other authors to present their research at the poster and oral sessions



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Barton Springs Edwards Aquifer CONSERVATION DISTRICT







Please complete this registration form, including signature and payment information. Use <u>one</u> registration form <u>per person</u>. Registrations will not be processed without full payment and the registrant's full name. *Please note: If someone else is registering for you, the name of the actual registrant must be filled out and not the name of the person paying*.

Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst

Full Registration and Full Student Registration includes evening reception, poster session, and evening banquet. If you are not registering for the full conference you must purchase a Day Pass in addition to other registration activities for that day.

Contact Information (\*Indicates required information)

*First Name	MI	*Family Name	Badge Nickname	-	
*Company/Organization/University					
*Street Address/PO Box					
*City	*State	*Zip/Postal Code	*Country		
*Work Tel	*Home Tel	*Cell	*Email		
Full Registration		<mark>Day Pass Registra</mark>	tion, Hats and T-Shirts on second	<u>d page</u>	
Full Registration			□ \$700		
Student Registration**			□ \$350		

\*\*Copy of student ID must accompany registration form

**Special Events-** The following three items are included in Full, Student and certain Day Pass registrations. These items apply only to guests of Full or Student registrants, and if the guests attend only these events and/or the field trips (such guests must complete their own registration form and identify their Full or Student registrant).

Tuesday, April 13:	Guest Evening Reception	<b>□</b> \$30
Wednesday, April 14:	Guest Poster Session Reception	□ \$30
Thursday, April 15:	Guest Banquet	□ \$60

Field Trips (Not included in Conference Registration)

<b>Monday, April 12</b> (Price with full or student registration only) Full Day Field Trip – Arecibo Observatory & Rio Camuy Cave Park	□ \$140
<b>Friday, April 16</b> (Price with full or student registration only) Half Day Field Trip – Superfund sites in Vega Alta and Vega Baja	□ \$70

Short Courses, Tuesday, April 13 (Not included in Conference Registration)

Morning Short Courses—select no more than one morning course Short Course 1 – Conducting Geotechnical Investigations Course Length: 4 Hours	□ \$140
Short Course 2 – Stormwater Management in Karst Course Length: 4 Hours	□ \$140
Afternoon Short Courses—select no more than one afternoon course Short Course 3 – Designing & Conducting Tracer Studies Course Length: 4 Hours	□ \$140
Short Course 4 – Geologic Site Characterization in Karst Course Length: 4 Hours	□ \$140

## Day Pass Options (if you did not register for the full conference)

<b>Monday, April 12</b> Full Day Field Trip – Arecibo Observatory & Rio Camuy Cave Park	□ \$140
<b>Tuesday, April 13</b> (All courses 4 hours in length and evening reception included) <i>Morning Short Courses—select no more than one morning course</i> Short Course 1 – <u>Morning Half Day Pass</u> Conducting Geotechnical Investigations Short Course 2 – <u>Morning Half Day Pass</u> Stormwater Management in Karst	□ \$280 □ \$280
<i>Afternoon Short Courses—select no more than one afternoon course</i> Short Course 3 – <u>Afternoon Half Day Pass</u> Designing & Conducting Tracer Studies Short Course 4 – <u>Afternoon Half Day Pass</u> Geologic Site Characterization in Karst	□ \$280 □ \$280
<i>Wednesday, April 14</i> Day Pass to sessions with evening poster session reception	□ \$305
<i>Thursday, April 15</i> Day Pass to sessions with evening banquet	□ \$335
<b>Friday, April 16</b> Day Pass to sessions & field trip (trip ticket sold separately below) Half Day Field Trip only – Superfund sites in Vega Alta and Vega Baja	□\$210 □\$70
Day Pass total amount	\$

#### T-Shirts and Hats (not included in Full, Student, or Day Pass registration)

		SIZE	QUANTITY	AMOUNT	Please tally all of your	Please tally all of your registration choices:	
		□ S			Full Registration	\$	
		ШM					
T-Shirt	□ \$20	🗖 L			Day Pass total	\$	
		🗖 XL			Field Trips	\$	
		□ XXL			Special Events	\$	
Hat: Sinkhole Conf. Logo	<b>□</b> \$20	One size fits all			Short Courses	\$	
					T-shirts	\$	
					Hats	\$	
	Procee	ds from the T	Shirts and Hats go to	o the			
	Beck St	udent Schola	rship Fund		GRAND TOTAL (pay this amount)	\$	

#### **Credit Card:**

□ AMEX □VISA □ MC □ DISC

PAYMENT: Full payment must accompany this registration form.

**REFUND POLICY: 80% by September 1, 2020; 50% by December 1, 2020 (no refunds after this date). For online credit card payment, register at:** <u>http://sinkholeconference.com</u>

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