Jan Walstrom: Where we're really spending good time and energy and getting actually really interesting and positive results, is around our solutions that are more bio-remediation oriented. They can be green, they can be lower cost and I think what we will see over the next one to three years is some really promising results in this space that actually Jacobs is really leading out on.

Steven Ludwig: Welcome to Inflection Points, a podcast series from Jacobs. I'm your host, Steven Ludwig. Today we're talking with Global Environmental Market Director, Jan Walstrom, and Global Water Market Director, Peter Nickel about an emerging contaminant known by the initials PFAS. We're discussing the nature of PFAS compounds, what it means to public health and how Jacobs is helping clients assess, treat, and remediate PFAS in the environment. Inflection Points is where we meet the people of Jacobs that help create solutions that deliver a more connected sustainable world. This was really a fascinating conversation. With that, it's on with the podcast. So Jan, let's start with the question, what are PFAS chemicals?

Jan Walstrom: Well, Steve, they're a class of organic compounds that are thousands of compounds, actually. Four or five of them are the most known, and they have some very unique properties. It's the combination of the carbon and fluorine bond in them, along with what's attendant to those bonds that actually make them surfactants. So they actually have really interesting properties where half of the molecule generally loves water, and half of the molecule doesn't like water. And so, you can find them at the leading edge of plumes. You can find them at the source areas of soils based on which of those compounds are in place and what are the hydrological properties in the soil. So they're really difficult compounds to deal with.

Steven Ludwig: But on that, Jan, it might be helpful just to explain where we even got them from. I mean, and part of that is they were developed originally by a number of manufacturing companies for non-stick environments, a variety of things like that. They were also-

Peter Nickel: So, non-stick.

Jan Walstrom: Like Teflon.

Peter Nickel: Like cooking Teflon, that kind of thing. So everybody's probably cooked on something that came and had what came out of the manufacturing of PFAS, also firefighting foam. So any large fires that firefighting equipment is brought in for when they need to control it with foam, it's one of the things, certainly all the airports around the world. That's one of the things that they not only use it to fight fires, but also use to practice when they're going through all their drills and emergency preparedness, and that kind of thing. Most of the world's military sites, certainly the US Military sites, but everybody's military sites. Because again, it's quite prevalent across that. So that's why it's so sort of widespread and why it's really something that we're probably most familiar with it from a

US perspective, because it's been in the news and been studied quite a bit recently. But it really is global reach with respect to the challenge.

Steven Ludwig: Why are they bad?

Jan Walstrom: They're actually carcinogenic.

Steven Ludwig: Oh, that's bad.

Jan Walstrom: Yeah. So at the end of the day, there are human health risks that are well known and well documented. The US actually is not the leader in the PFAS community. It actually really started in Australia a number of years ago, where they did find carcinogenic issues in populations around certain sites and they have been the leaders on evaluating those compounds. And then other nations around the globe have actually taken that on, most of Europe, even Northern Europe has standards in place or health advisories in place already, as does Australia. The US does not as yet, though we do have advisory levels in place. But we're at an interesting time in the regulatory environment, especially in the US, because we do not have maximum contaminant levels for water that we know what to treat it to. We don't have any soils levels that we need to remediate it to at this point in time. So it's a really interesting time for a set of compounds that are quite diverse in their nature.

Steven Ludwig: So when you say that, so we need some sort of yard stick to say, "This level of contamination is okay, and this level of contamination is unacceptable like this will not hurt you, this probably will."

Peter Nickel: Well, we looked for it and we've found it, and now we got to figure out what we do about it. And that's the challenge is, what level of treatment and remediation do we go through? Because all of it costs, all of it has a huge environmental and unexpected consequences impact as soon as you go through and do any of that. And so it's to the level that you're going to target with respect to that and so that's the challenge. So I think certainly in the US, there's a heightened awareness, particularly around drinking water and potential contamination, drinking water, following Flint, and all variety of other things that have gone on over the years.

And so there's concerns associated with that, but you don't just want to start fixing things if you're not really sure what you're fixing it to, because how do you know whether you've gotten to some level? So where's the science behind it and how do we know really what we're trying to accomplish as we move forward. And so that's where some of the challenges right now, just trying to figure it out because people want an answer and they want you to implement the solution, but we don't really know what we're targeting yet.

Steven Ludwig: So you mentioned that these things that have been helpful, firefighting foam is incredibly helpful, but it gets in the dirt. You mentioned plume for people that

might not know what a plume is, what does that mean? Because if it goes into dirt, it's fine, right? And the answer is no, but how do plumes work?

Jan Walstrom: Well? So water infiltrates into the soils. If these compounds are in the soils, because someone did firefighting training somewhere and they use that material, water infiltrates these compounds because their chemical nature actually will move through those soils and be carried by that water. And they'll be carried at differential rates based on which of the more than 1,000 versions of the compound that are there, some will stay very, very close to the source. Some will travel readily. They'll actually travel at the very leading edge of that plume. If that soil is close to, let's say a water course, it can then get into streams. It can move downstream and streams, et cetera, et cetera. So they really are very interesting in nature, what Peter represented here in terms of the science, this is what's so really interesting about this diverse set of compounds today. And what's kind of a complex situation for us and for our clients.

We actually studied and began to learn how to treat and remediate a set of compounds very familiar to ourselves, like TCE, PCE, vinyl chloride. It took the industry 20 to 30 years to really understand that science, how to remediate it sort of effectively and now how to remediate it really effectively in a sustainable bioremediation kind of way. We're asking now as a public with a real health concern out there, well, you guys know how to go do this for these other class of compounds, why can't you just snap your fingers and in less than three years, go figure out how to go deal with these? The science of these things, the chemistry of these things is so much more complex than it is for those kinds of chlorinated solvents.

And so then that's really, we're trying to compress what we learned and how we learned it around that set of compounds and figure out how to deal with this set of compounds very quickly and figure out how to set appropriate standards that are protective of human health and the environment. So we've got a couple of those dynamics going on at the same time.

Steven Ludwig: So what you're saying is the PFAS, we just figured it out recently that it's a carcinogen?

Jan Walstrom: Yeah, it has not been long.

Steven Ludwig: Okay. Five years, four years?

Jan Walstrom: Seven to 10.

Steven Ludwig: Okay. So you're saying for us to figure out these other contaminants took us 10, 20, 30 years.

Jan Walstrom: 20 to 30.

Steven Ludwig: So it's going to take us this long to get this figured out, maybe a little bit shorter?

Jan Walstrom: I don't think it'll take as long because we understand better how to approach the science, how to approach some of those kinds of things. We have learning from the methods we used in the past. And so we can speed it up, but there will be incredible pressure regulatorily and from the public for us to do it very quickly.

Steven Ludwig: So why is this... Is it a serious thing? I mean, why is it a growing public health concern about PFASs?

Peter Nickel: Just, it's a widespread, every water plant that looked at it found it, all the airports that looked for it, found it. And so that it's in the soils, it's continuing to leach into the groundwater, into surface waters. It can be an aerosol, so it can be in the air. And just because of the nature, the different compounds that are out there, just the complexity of it. And so people... One of the challenges with our ability to find all these things, is that we've got the equipment and the technology today that we can find two minute quantities and we're talking parts per trillion when we're talking about this. So normally we deal in parts per billion. Now we're talking parts per trillion for some of these compounds, but the question remains, what do we target?

I mean, what do we sort of look at? What's the maximum contaminant limit that is something that is a threshold that we can at least build around and then start to develop our solution sets to treat for. And so there's a number of technologies that have been developed out, there's a number of approaches. Our staff certainly have been studying this and working on it for a number of years. And so we've got a number of approaches to deal with it, it's just a matter of, be careful because if you don't know what you're shooting at, you're not sure what you're going to hit.

Steven Ludwig: Right. What are some of the challenges surrounding the treatment and remediation of PFASs in the environment? Because you mentioned there's a number of ways to get at it.

Peter Nickel: Mm-hmm (affirmative).

Jan Walstrom: Yeah. So in the soils itself, as I said, they move differentially, and so it will partly depend on what species of the PFAS that you actually have, that's the predominant nature in the soil. To quote Bill Dee Guiseppe, our global thought leader in the area. We have some technologies, we have some destructive technologies. They're kind of the best of a bad set of alternatives right now. When we find this kind of stuff, yep, we can delineate it, we can dig it up and we can thermally treat it and destroy it. That's really expensive, that's not very sustainable. Where we're really spending good time and energy and getting actually really interesting and positive results, is around our solutions that are

more bioremediation oriented, they can be green, they can be lower cost. They can be just as, or more effective than even some other thought processes that some other of our competitors have out there with proprietary technologies that they're now starting to publish on. And I think what we'll see over the next one to three years is some really promising results in this space that actually Jacobs is really leading out on.

Peter Nickel: And then to add to that, I mean, we're also seeing a number of the equipment vendors particularly in the drinking water space that are developing their own technologies that we will likely look at, depending on the, again, the compounds that we see when we look and find them, there might be some of those that are applicable. And so we'll be looking for best available technology to solve the challenges that we have. But I think that with the visibility of it today, there's just a lot of research going on, there's a lot of development work. And so I think we'll see sort of leaps and bounds, which is probably different than what we saw around some of these other previous chemicals, because we have been through this before and we have seen it and the companies that are out there all trying to figure out, okay, how can they be at the forefront of providing some solution sets to deal with this?

Steven Ludwig: You said bioremediation, what does that mean on a layman's terms? Or bioremediation probably is a layman's terms. Can you explain it?

Jan Walstrom: That's fine, Steve. So obviously there are microbes, there's bacteria, there's fungus in the soils. So knowing what those communities of quote unquote bugs are, which ones are the stabilizing, supporting foundational bugs in that community, making sure that they can thrive. So that the ones who are really doing the hard work of breaking that bond between the carbon and the fluorine, if we can break that bond, then we actually have solved the issue with the PFAS being a carcinogen. It is no longer, we have a different compound, we've basically solved the problem. And so our teams are working with university consortia around this and partnering with other investigators in the industry, being funded by some grants, being funded by internal sources that we're making available to continue to lead out in this area. And I think, as I said, I think we're going to see some very promising results that are actually going to surprise many in the industry as to how effectively we can actually treat this and then work our way through, how can we make it even more cost effective, where we need to.

Steven Ludwig: Great. You mentioned the military, you mentioned airports and a couple others and water, what clients are most impacted by the PFAS contamination?

Peter Nickel: Well, I mean, I think any airport authority, certainly most of the ones that have looked forward have found it and are aware of it and are trying to figure out their path forward with dealing with that. We know that it's on military bases, it's been investigated and it has been found, different concentrations, different types of products associated with that and can't speak globally. But I know that

within the US, between 2013 and 2015, the EPA basically asked any community over 10,000 service offering like services to test that. And they found PFAS in the majority of those and so that we know it's out there, we know it's out there in a broadly spread area. What we're hopeful of is that some of the research that we're doing, that Jan talked about earlier is going to provide us with solutions that we can scale and really provide treatment options that are alternatives out there that can really help this.

Jan Walstrom: Effectively, Steve, anyone who ever had to have in-place training facilities or the ability to firefight major fires. So oil, gas, chemical plants.

Steven Ludwig: Every city.

Jan Walstrom: Every city.

Peter Nickel: Every city.

Jan Walstrom: Okay. Anyone who had to have that has the potential to have had PFAS that they've been dealing with.

Steven Ludwig: So we're talking billions and billions of dollars to clean this up around the world, if not more?

Peter Nickel: Correct.

Steven Ludwig: Wow. So you mentioned Australia sort of took the lead in this. Why did it start there and how are other countries responding?

Jan Walstrom: So Australia actually found they had a public health issue that came to the fore. If you think about what happened with the water supply in Flint, think of an analogous situation happening in Australia around PFAS, and they basically treated it. And from a public health standpoint, in a very similar way to what happened in America around Flint. They took the lead on investigating it, they took the lead on understanding some of the chemistry around it, the sampling methodologies, those kinds of things. And that happened about, I believe 10 years ago. Others really didn't see much of it at that point in time, but you will see the Commonwealth countries actually did take a very interesting interest in it. Their regulatory environment is somewhat similar.

So you started to see some of that in the European countries, then you get into Scandinavia, et cetera, where they took a little bit different approach to it. And you'll see that as part of their regulatory regime, how have they set health standards, how some have actually set definitive levels for a specific PFAS compound, others have set levels for combinations of all the PFAS we can find, it cannot be greater than this concentration. And so everybody's taking a little bit different approach from a standard setting or guideline perspective. And the

US is set potentially to look at this and make a determination of how we're going to approach it by the end of the year,

Peter Nickel: The positive side of it, because it is so broadly spread. There's a whole pile of pretty incredible minds around the world that are sharing information, looking for solutions, challenging each other and sharing what they learn. And so I think as an industry, that's again, when I think that we'll see solution sets come to the forefront and narrow down to ones that are applicable and can be readily scaled to meet some of the volume requirements that are going to be necessary out there. And we'll move this to the forefront in much quicker times than what we've seen in the past.

Steven Ludwig: That is good news.

Peter Nickel: Yeah, I think it is. And I think it's something that we need to really look at because Australia did find this and sort of raise the alarm to begin with, but then others took that and thought, "We better have a look." And I think that that's just sort of more broadly spread as it's been shared and people have been writing papers and sharing results and the regulators have started to get involved on a variety of different jurisdictions.

Jan Walstrom: And certain client sets. So it was Australia Ministry of Defense that actually led out on that, that's who actually had the initial issue. Obviously our Department of Defense in the US government has millions, if not billions, more dollars. They know they have an issue, there is no question that they have an issue. And for the last several years, they've been dedicating research funding towards, "Okay, we know we have a problem, let us help the industry work with us to actually figure out how to go solve that problem."

Steven Ludwig: Now, Jan, you mentioned bioremediation as a natural approach using natural things to fight this. What are some other technological solutions that Jacobs is deploying or developing to help mitigate this challenge?

Jan Walstrom: In the soil space, it's really a pretty limited set of options that you have.

Steven Ludwig: Because you mentioned one, the cooking.

Jan Walstrom: You can cook it.

Steven Ludwig: Or the thermal.

Jan Walstrom: You can cap it, okay?

Steven Ludwig: Which means literally bury it.

Jan Walstrom: You literally put a cap on it, you make it less permeable.

Peter Nickel: Yeah, you capsulate it.

Jan Walstrom: You make it less permeable. So we don't create as much of a water problem or as a much of a water problem as far downstream et cetera as quickly or you bioremediate it. So really where the lots of different and varying technologies play comes in is actually on the water side.

Peter Nickel: And I think that's still in the early development stages that I don't think we've seen really the one that's going to potentially, or a few that are going to bring through with respect to that.

Steven Ludwig: Do you think this is going to get more and more public attention? It sounds like it will. I know that you're talking a lot about this, so you're seeing it more probably than others would because you're paying attention. Do you think this will become one of those issues that the public really latches onto?

Peter Nickel: Well, it's certainly something that's in front of the US government regulatory bodies today. We expect that we may have a maximum contaminant limit in place by the end of this year. I mean, it's certainly, the paperwork's all there, it's being discussed. There's a number of associations and special interest groups that are focused on this. Certainly one that's very focused is the National Association Clean Water Agencies because they're putting water out to all these communities and they're members of that. And so they're working with their members very closely and trying to make sure that they continue to keep the pressure on so that we get some of this regulatory framework sorted out, and then we can really get into the solution side of things and move things forward.

Steven Ludwig: Why is this area important for Jacobs and how is the company uniquely positioned to help our clients address this very serious public health concern?

Jan Walstrom: Well, it really is a health concern that is ubiquitous. It affects our communities around the globe. It's important that we, as a set of not just thought leaders, but solution leaders in this space really lean forward into this and partner with others in an appropriate way. So that we really tackle the problem with the best available minds around the globe, Peter mentioned that before. It really is around the globe. We are stakeholders and facilitators of bringing some of those communities together. We have some thought leadership positions in some of those bodies that are really leading out, bringing hundreds of research minds, client minds, regulatory minds together, to be able to do the best thinking around this. So it really is in the purpose of this company, what we value, how we value it, it's part of who we are and what we need to be doing for our clients and for the world. So to me, it's at the forefront of how we are uniquely built as a company to be able to partner across market, it partner across our client bases to actually go tackle it.

Steven Ludwig: What's it like to be on really you're on the front lines. This was only discovered a really short time ago. You're with this great company, Jacobs that has all these

resources to bring to bear, the Global Community, the Global Research Community is behind this. You're sharing a lot of information. What's that like for you as professionals to be a part of something that's really at the end of the day, going to make people's lives better by helping fix this problem?

Peter Nickel: Challenging and rewarding. Because I do think that really hard things to solve are something that we're built for from a solutions perspective. But this isn't the first time we've been through something like this, our teams are experienced, we've been through nuclear site remediations, we've been through other contaminant type remediations. We've been through water challenges associated with it. We do storm recovery, extreme storm event impact, just all the FEMA work the firm is involved in. And so when you look at it, just the set of people that we have, and how they work together and how they focus on putting their minds together to solve these kinds of challenges, I agree with Jan. I just think we're uniquely built for it. I think it's what we're here for. And I think we're out there to meet our clients' challenges and try to work with them on implementing those solutions.

Steven Ludwig: Great. Is there anything you'd like to add that I might have forgotten to ask about this very interesting and important topic?

Jan Walstrom: I think this notion of really both thought leadership and leaning into solution leadership, I think that's the piece Jacobs really is uniquely built to go do in the world. There's a lot of folks who are really incredible minds who are doing incredible work and they will have their work out there talking about different aspects of this challenge. It's when you come together to figure out how to build that solution and deliver that solution, that's where I think we're at the forefront.

Steven Ludwig: Well, thanks for all your work on this, because it's really making an impact for a lot of people. And I'm glad to hear that we have both of you on this important topic. Thanks for being here today.

Peter Nickel: Well, appreciate the opportunity.

Jan Walstrom: Thanks for having us.

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