PFAS AND DUE DILIGENCE: PRACTICAL INFORMATION FOR MANAGING THE EMERGING RISK.

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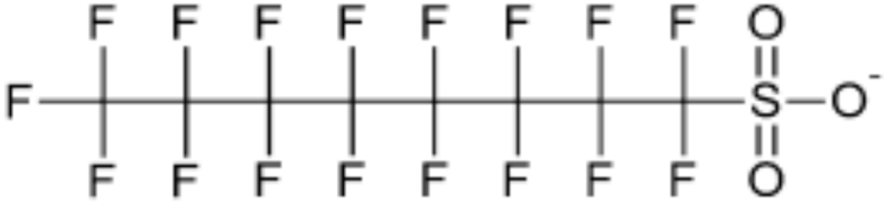
WHEN YOU NEED TO BE SURE

SGS

WHAT ARE PFAS COMPOUNDS?

- PFAS are a class of synthetic compounds containing thousands of chemicals formed from carbon chains with fluorine attached to these chains.
- The C-F bond is the shortest and the strongest bond in nature and is responsible for most of the unique and useful characteristics of these compounds.
- PFAS are surfactants that repel oil and water, reduce wear or surface adhesion.
- Introduced as early as 1948 (Teflon, or PTFE polymer) with a great increase in use in the late 1960s and 1970s.
- At low concentrations, many have significant water solubility.

13	14	15	16	17	18
					1 He
5 B	6 C	7 N	8 O	9 F	10 Ne
13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn



WHY DOES PFAS MATTER FOR DUE DILIGENCE?

- Widespread
- Many sources
- Omitted from prior due diligence and site investigations
- Insurance exclusions
- Limitations of remedial technologies
- Significant regulatory uncertainty, regulatory re-opener
- Rapidly increasing litigation
- Uncertainty in how to assess and manage risk
- Complexity and cost
- We are just the beginning - GenX

PROCESSES AND PRODUCT USES/SOURCES OF PFAS INCLUDE THE FOLLOWING:

Processes	Product Uses/Sources
Fluoropolymer coatings	Some grease-resistant paper
Plastics/polymers	Fast food containers/wrappers
Oil and water repellent treatments	Microwave popcorn bags, pizza boxes, candy wrappers, furniture, clothing, carpets,
Surfactants used in fire fighting foams	Non-stick cookware such as Teflon™ coated pots/pans
Mist suppressants for metal plating operations	Stain-resistant coatings such as Scotchgard™ used on carpets, upholstery and other fabrics
Photo-microlithography process to produce semiconductors	Water-resistant clothing such as Gore-Tex®
Photography and film products	Adhesives, Aviation hydraulic fluids, cleaning products
	Personal care products such as shampoo, dental floss, and cosmetics (nail polish, eye makeup)
	Paints, varnishes and sealants

SOURCES OF PFAS

- PFAS have been used since the late 1940s.
  - 70 years of use
  - Developed by major chemical corporations
  - Non-stick surfaces
  - Water and stain resistance coatings
  - Food packaging
- PFAS have been used in various industries:
  - Textile and Leather – Oil and water repellent
  - Paper Products
    - Non-food contact: cardboard, masking papers
    - Food contact: fast food wrappers, microwave popcorn bags, pizza boxes
  - Metal Plating – Mist suppression, electroplating, cleaner
  - Semiconductor and Photo imaging – etching, anti-reflective coatings
  - Wire Manufacturing – Insulation, wear reduction
  - Plastics Manufacturing – Composite resins, increase strength and flexibility

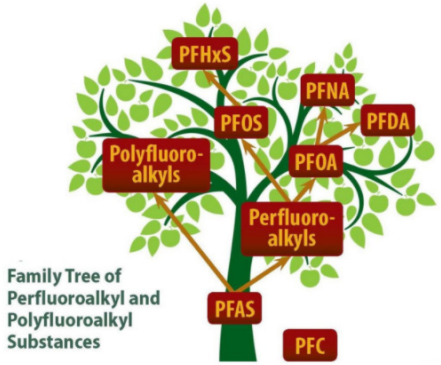


*Image courtesy of https://**www.atsdr.cdc.gov**

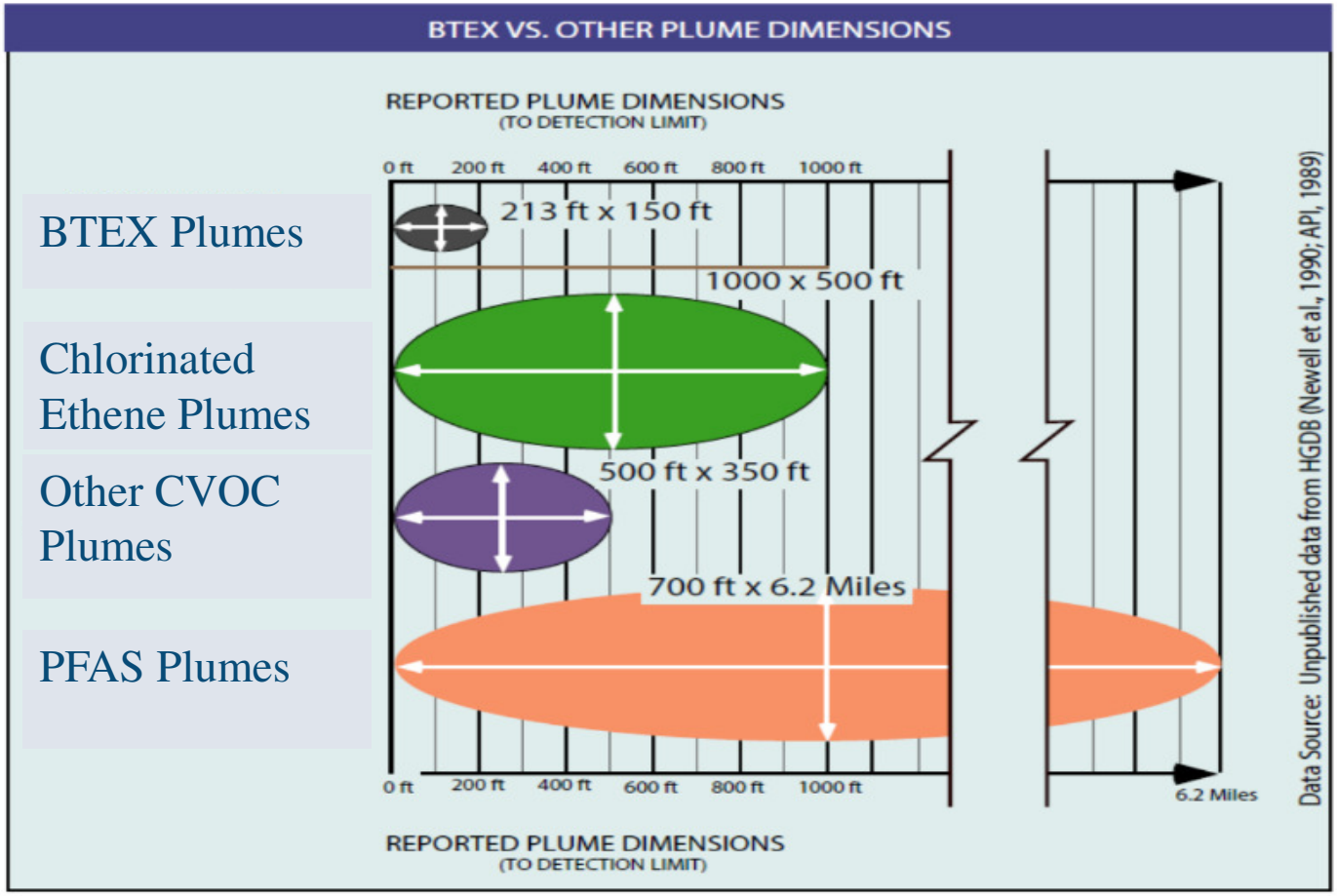
SOURCES OF PFAS

- AFFF – Aqueous Film Forming Foams
  - Developed by US Navy in the 1960s
  - Complex mixtures of known and unidentified PFAS
  - Designed for hydrocarbon fuel fires
  - AFFFs were produced to meet a fire fighting specification not a chemical composition, so various formulations exist
- Sites that used or stored AFFF
  - Military installations
  - Commercial airports
  - Fire training areas and local fire departments
  - Petroleum refineries and storage areas
  - Chemical manufacturing plants
- Other Sources
  - Landfills
  - Biosolids

SITES WITH RISK OF PFAS RELEASES

PFAS Source	Risk Score	
DoD Facilities	100	
Chemical manufacturing	100	
Fire training areas	100	
Landfills	75	
Airports	75	
Petroleum refineries	75	
Textiles	50	
Furniture	50	
Paper	50	
Rubber/plastics	50	
Fire Stations	25	
Metal Fabrication	25	

PFAS MOBILITY AND DUE DILIGENCE



LIABILITY POTENTIAL EVOLUTION FOR PFAS

- To qualify for the statutory defenses to CERCLA liability, a Phase I must comply with EPA's Final Rule for All Appropriate Inquiries.
- ASTM E1527-13 standard satisfies the requirements.
- PFAS currently not CERCLA hazardous, but USEPA evaluating inclusion of PFOS & PFOA.
- PFAS considered a hazardous substance in some states.
- Third party claims.
- What about all other PFAS precursors that we are not analyzing at this time?
- Could TOP be an answer for Due Diligence?

PFAS: RCRA LEGAL CONSIDERATIONS

- In February 2017, a U.S. District Court denied motions to dismiss RCRA "imminent and substantial endangerment" claims relating to PFAS. See Tennessee Riverkeeper, Inc. v. 3M Co., No. 5:16-cv-01029-AKK, 2017 WL 784991 (N.D. Ala. Feb. 10, 2017). This case involved the alleged continuing contamination of the Tennessee River and associated public drinking water supplies with PFAS that the plaintiff claims originated from a local manufacturing facility and two local landfills
- RCRA 7002 orders have been filed to address PFAS contamination as "solid waste" that "may present an imminent and substantial endangerment"
  - Solid waste can be "any discarded material"
  - "may present endangerment"
  - RCRA 7002 lawsuits have been filed in AL, NC, and MI

CHANGES IN REGULATORY LANDSCAPE

- PFAS: States Not Waiting For EPA

  - The State of New Jersey implemented the nation's strictest groundwater limits for a pair of emerging toxic chemicals last week, when its Department of Environmental Protection published interim standards for (PFOS) and (PFOA).

  - March 22, 2019: The Maine Department of Environmental Protection (DEP) announced in a memorandum to licensed facilities that land apply, compost, or process biosolids (i.e., wastewater treatment sludge) that it will require the testing of that material for per- and polyfluoroalkyl substances (PFAS), a group of chemicals that includes PFOA, PFOS, PFBS, and many other compounds.

  - The State of New Hampshire NHDES Drinking Water Groundwater Bureau (DWGB) will be regulating 4 PFAS contaminants (acid form). The rules are in the comment phase at this time and should be approved and implemented shortly. See the whole rule for more information.

CHANGES IN REGULATORY LANDSCAPE

- PFAS: States Not Waiting For EPA
  - State of Vermont's senate has passed a bill that sets a stricter standard for per- and polyfluoroalkyl substance (PFAS) contamination in drinking water. As one of many states mulling a legislative solution to removing the contaminant, it is setting a precedent for local drinking water treatment operations.
  - State of New York, an advisory council recommended a MCL for PFOS and PFOA at 10 ppt.
  - State of California: Water code section 13267 order for the determination of the presence of Per- and polyfluoroalkyl substances **in Airports** ORDER WQ 2019-0005-DWQ
  - State of California: Water code section 13267 order for the determination of the presence of Per- and polyfluoroalkyl substances **in Landfills** ORDER WQ 2019-0006-DWQ
- ASTM E1527 revisions look to alert Phase I producers of risks associated with emerging contaminants

NEW AND UPCOMING

- **SPLP (1312) and LEAF (1315)**
  - Bottle Extractor HDPE
  - Filtration Apparatus Stainless Steel
  - Waste Characterization Impact Analysis
- **Air**
  - Various Media: Impinger Fluids, Particulate Filter, XAD-2 Resin
  - Media prepared by lab and batch tested
  - Prep Procedures Modified for Various Media
- **PFAS Forensics**
  - Custom projects – project needs clear definition, information on products and site, and an investigative plan.
  - Matching the fingerprints of a source or product (composition or degradation products) with the fingerprints at an area with PFAS concerns.
  - Analysis of products and consumer goods (PFAS and TOP) vs field results to determine sources found in field.

PFAS IMPACTED SITES FOR REDEVELOPMENT

- Industrial facilities that manufactured PFAS or used PFAS in their production chain
- Industrial facilities that have older wastewater impoundments or landfills
- Airports, Ports and other locations that use/used foam for fire fighting
- Former Department of Defense sites
- Municipal or industrial landfills
- Sites in areas with PFAS “regional issues”

PFAS AND INSURANCE INDUSTRY

- No standard policy for PFAS exclusion; insurers will underwrite to the risk.
- PFAS restrictions or exclusions at environmental insurance renewal for some operations – airports, landfills, public entities, certain manufacturing operations.
- Potential for general liability policies to exclude PFAS similar to asbestos and silica exclusion. Is PFAS the new asbestos?

PFAS INTO DUE DILIGENCE PROCESS

- PFAS and Phase I
  - Assess site history
  - Potential to be a source site
  - Potential to be impacted by PFAS released elsewhere
  - Prior Phase Is typically don't cover PFAS
  - PFAS contamination not included in government databases
- PFAS and Phase II
  - Will seller allow testing?
  - What Method and list of compounds do you use?
  - What are the state and local requirements?
  - Sampling Challenges

CA PFAS PHASED INVESTIGATION APPROACH PHASE I

Source investigation & nearby drinking water well sampling at:

- Airports: Public water system source wells within a 2 mile radius
- Municipal solid waste (MSW) landfills:…within a 1 mile radius
- Impacted drinking water sources identified by the 2013-15 Third Unregulated Contaminant Monitoring Rule (UCMR3) monitoring efforts and adjacent small systems….within a 1 mile radius…. (cont'd)

CA PFAS PHASED INVESTIGATION APPROACH PHASE II & III (DRAFT)

Source investigation & nearby drinking water well sampling at:

- Primary manufacturing facilities
- Refineries, bulk terminals, & non-airport fire training areas
- 2017-2018 urban wildfire areas
- Secondary manufacturing sites where PFAS-containing materials were discharged into wastewater
- Wastewater treatment & pre-treatment plants

HOW TO SAMPLE FOR PFAS

- Because of the potential presence of PFAS in common consumer products and in equipment typically used to collect soil, groundwater, surface water, sediment, and drinking water samples as well as the need for very low reporting limits, special handling and care must be taken when collecting samples for PFAS analysis to avoid sample contamination.

SAMPLING EQUIPMENT:

- Don't use: Pumps and Tubing: Teflon™ and other fluoropolymer-containing materials *(**Do use**: high density polyethylene [HDPE] or silicone tubing materials)*
- Don't use: Passive diffusion bags
- Don't use: Low density polyethylene (LDPE) Hydrasleeves (**Do use** *HDPE Hydrasleeves)*

- Don't use: Decontamination: Decon 90 *(**Do use** Alconox® or Liquinox®, potable water. followed by deionized PFAS-free water rinse)*
- Don't use: Sample storage and preservation: LDPE or glass bottles, Teflon™-lined caps, chemical ice packs (i.e., Blue ice®) *(**Do use** HDPE or polypropylene containers with HDPE or polypropylene caps, regular ice in Zip-loc bags)*

SAMPLING EQUIPMENT:

- Clothing: Don't use, clothing or boots with Gore-Tex® or other synthetic water-resistant and/or stain-resistant materials, Tyvek material, fabric softener *(**Do use** clothing made of cotton preferred)*
- Field documentation: Don't use waterproof/treated paper or field books, plastic clipboards, water proof markers, Post-its and other adhesive paper products *(**Do use** loose plain paper, metal clipboard, ballpoint pens)*
- Don't use Personal care products on day of sample collection: cosmetics, moisturizers, hand cream, sunscreen, and other related products, insect repellent
- Don't use Aluminum foil, Food and beverage: pre-packaged food, fast food wrappers or containers

FIELD/EQUIPMENT BLANKS

- When sampling for PFAS, it is recommended that additional and/or more frequent field/equipment blanks be collected prior to and during sampling to check for residual PFAS on sampling equipment due to the potential for cross-contamination issues and the need for very low reporting limits.
- SGS- PFAS free Blank water with certificate of analysis.
- Use Trip Blank for PFAS as required by some states.

CONTAINER & PRESERVATIVE REQUIREMENTS

Sample Type	Container/Preservative	Matrix code on COC	Method	Comments
Soil, sediment	1x4oz HDPE/none	SO/SED	537MOD	
Groundwater, surface water, water	2x125 ml HDPE/none	GW/SW/WW	537MOD	
GW/SW/WW needing lower RLs	2x250 ml HDPE/none	GW/SW/WW	537MOD	
Effluent	2x125 ml HDPE/TRIZMA	WW or EF	537MOD	Finished samples may need TRIZMA. TRIZMA is a buffer and removes free chlorine.
DW	2x250 ml HDPE or PP/TRIZMA	DW	537	
DW - not for compliance	2x250 ml HDPE/TRIZMA	WW	537MOD	Matrix code DW triggers the lab to use method 537 so samples need to be logged as WW.

MONITORING WELLS SAMPLING

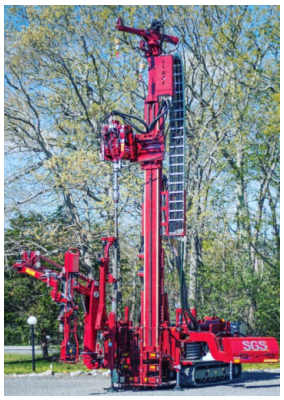
- When feasible, use single-use, disposable polyethylene or silicone materials (tubing, bailers, etc.) for monitoring well purging and sampling equipment.
- When reuse of materials or sampling equipment across multiple sampling locations is necessary, follow project decontamination protocols with allowed materials identified above, and incorporate collection of equipment rinsate blanks into sampling program, as appropriate.
- When using positive displacement/submersible pump sampling equipment, familiarize yourself with the sampling pump/accessory equipment specifications to confirm that device components do not contain Teflon® or PTFE.

SAMPLE COLLECTION METHOD/SEQUENCE

- Using new nitrile gloves collect the sample for PFAS **first, prior to collecting samples for** any other parameters into any other containers; this avoids contact with any other type of sample container, bottles or package materials.
- As with all other samples, do not place the sample bottle cap on any surface when collecting the sample, and avoid all contact with the inside of the sample bottle or its cap.
- When sample is collected and capped, place the sample bottle(s) in an individual sealed plastic bag (e.g. Ziploc®) separate from all other sample parameter bottles, and place in shipping container packed only with ice.

PFC-free

NOT ALL DRILLERS ARE CREATED EQUAL



- If it supports your PFAS project, we've tested it.
  - SGS West Creek Supply Well
  - Support Truck Water Tanks
  - Rig Tender Water Tanks
  - Consumables (Macroliners, PVC)
  - Thread Lubricant
  - Auger Flights
  - Drill Rod
  - Drill Bits & Hammers
  - Dual Rotary Casing

PFC-free

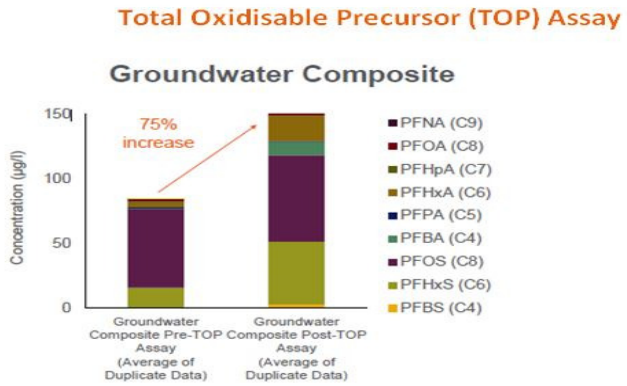
METHODS

- Method Development and Validation
  - EPA 537 Drinking Water Method Released 2008 (EPA 500 series method – prescriptive) Revision 1.1 Release 2009
  - EPA 537.1 Drinking Water Method Updated November 2018.
  - Other matrices use EPA 537 method modified (modification vary from lab to lab)
  - ASTM D7968-17 Standard Test Method for Determination of Perfluorinated Compounds in Soil by Liquid Chromatography Tandem Mass Spectrometry
  - ASTM D7979-17 Standard Test Method for Determination of Perfluorinated Compounds in Water, Sludge, Influent, Effluent and Waste Water by Liquid Chromatography Tandem Mass Spectrometry
  - Various documents, research papers, vendor application notes
  - DoD QSM 5.1 or newer Table B-15.
- New methods under development for non-drinking water matrices. EPA and DoD are working on these:
  - SW846 8327 Summer 2019?
  - SW846 8328 Winter 2019?

TOP (Total Oxidisable Precursors) Assay

- Process of transforming PFAS Precursors in a sample to measurable perfluorinated Carboxylic acid which can be measured.
- Sample + persulfate + heat converts precursors to terminal PFCAs and PFSAs
- LC MS/MS analysis without conversion (Before) + conversion (After) + LC MS/MS analysis
- Delta is converted precursors
- Can TOP be the Answer to PFAS

  and Due Diligence?



- Significant increases in perfluorinated carboxylic acids and sulphonic acids (PFAAs) following TOP assay reveal the hidden mass of PFAA precursors present
  - An additional 240% of PFAS in soils and 75% in groundwater
- Demonstrates matrices impacted with AFFF contain a greater mass of PFAS than identified by conventional analysis with LC-MS/MS (EPA Method 537).

WHAT IS NEXT?

- Future NPDES permits for WWTP wastewater discharge, stormwater and other industries for PFAS-related compounds.
- Reduction and restriction on waste impacted with PFAS to landfills and other waste storage facilities.
- Groundwater standard consideration for PFAS by different states.
- PFAS air emission regulation and monitoring
- Remember, litigation continued many years after production and use of MTBE, PCBs and Asbestos.

QUESTIONS?

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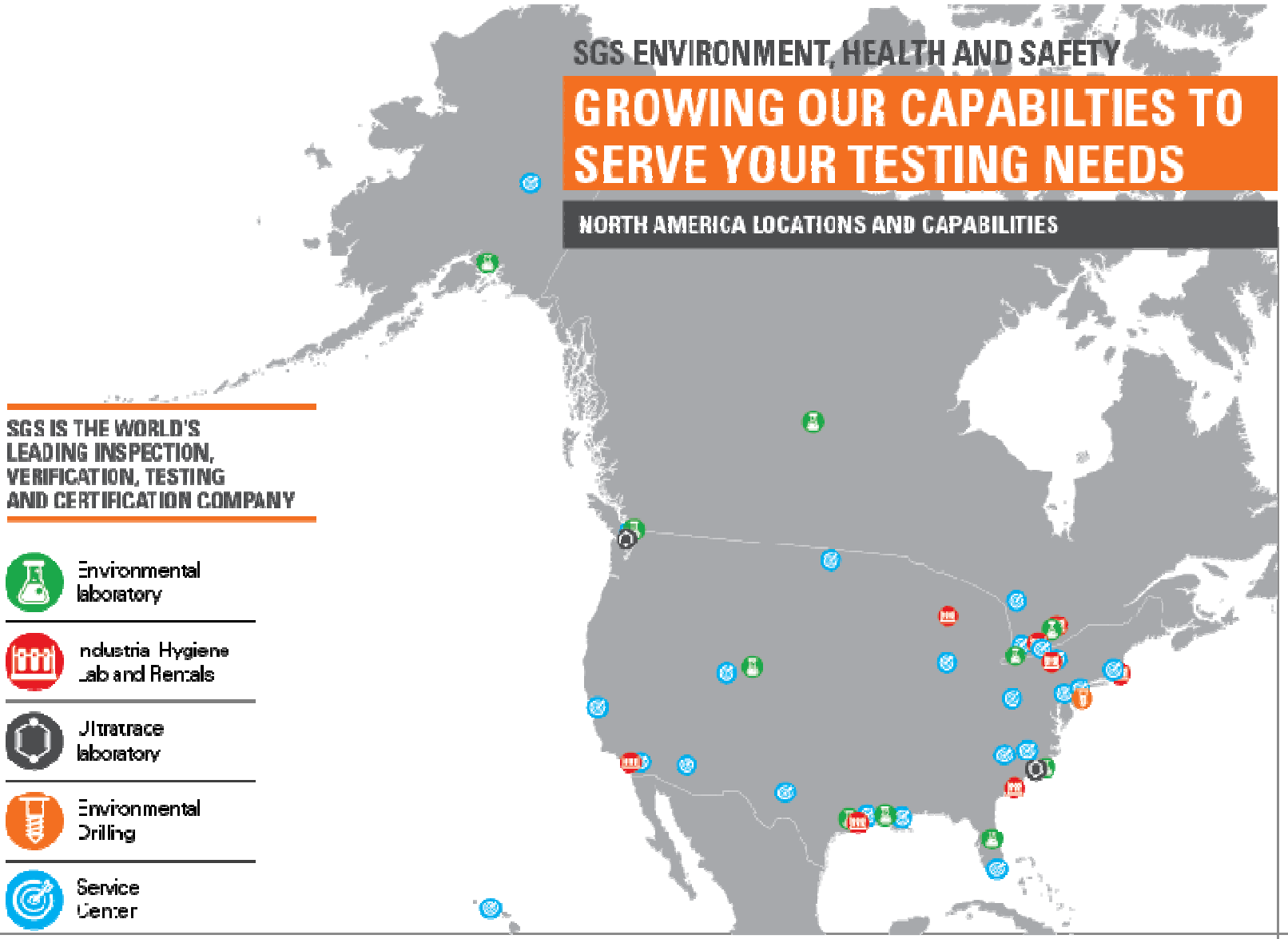

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