

# PFAS MANAGEMENT

---

**PHIL FARINA** BS,BA,MS,MBA  
MIDWEST BUSINESS DEVELOPMENT  
MANAGER

(419) 346-8848

[PFARINA@CLEARCREEKSYSTEMS.COM](mailto:PFARINA@CLEARCREEKSYSTEMS.COM)



# AGENDA

- Introduction
- What do I need to know BEFORE deciding on a solution?
- Current technologies
- Holistic approach and systems integration
- Conclusion

# CLEAR CREEK SYSTEMS / YUKON TECHNOLOGY

---

- Clear Creek Systems / Yukon Technology: A strategic technology partnership
- Water treatment; leader in applying new technology to market since 1994
- Fill supplier diversity requirements as a certified SDVOSB



**“Providing engineered solutions to the most difficult water treatment problems”**

# WHAT DO I NEED TO KNOW BEFORE I START?

## **Consider the water and its ultimate use**

- Ground water, well water, pond water, PFAS bloom, Municipal, Industrial, Landfill Leachate, Storm Water
- Drinking water, NPDES permit, outflow to river, WWT system, irrigation
- Waste stream created by treatment

## **Analyze the water**

- Include TSS, pH, PFAS speciation, Metals, Organics, VOC etc.
- How are you delivering the water to the system

## **Understand the treatment requirements based on permit limits**

- PFAS limit (70 PPT down to 7 PPT)
- Other concerns such as TSS, pH, metals, VOC, organics, nitrates, sulfates etc.

## **Equipment selection**

- Permanent or Temporary
- Flow rate
- Regeneration or replacement

# MOST COMMONLY EMPLOYED TREATMENT TECHNOLOGIES

- **Carbon**
  - Well known, significant history
  - More general in application
  - Virgin or reactivated carbon
  - Mid range and longer chain preference
  - Renewable carbon sources, Mined carbon (bituminous)
- **Organoclay**
  - Used in conjunction with other media
  - Can be blended to improve performance
  - Can remove other contaminants such as oils, heavy metals
- **Ion exchange resins (IX)**
  - Newer technology
  - Can be used with or replace carbon
  - Man made polymers - PFAS specific, designer system
  - Long and short chain PFAS preference
  - Can get to lower target levels

CARBON:

VIRGIN  
SOURCES

REGENERATED  
SOURCES

## Positives

- Low cost
- Easily obtained
- Variety of packages: bags, super-sacks, bulk
- Easy disposal via incineration or regeneration
- Excellent for short term projects
- High Flow capability

## Negatives

- Exhausts quickly, frequent change out
- Difficult to get to 7 PPT in some applications
- Easily clogged
- Allows some PFAS pass through
- Regenerated carbon may be only 80% effective
- Potential high total use cost

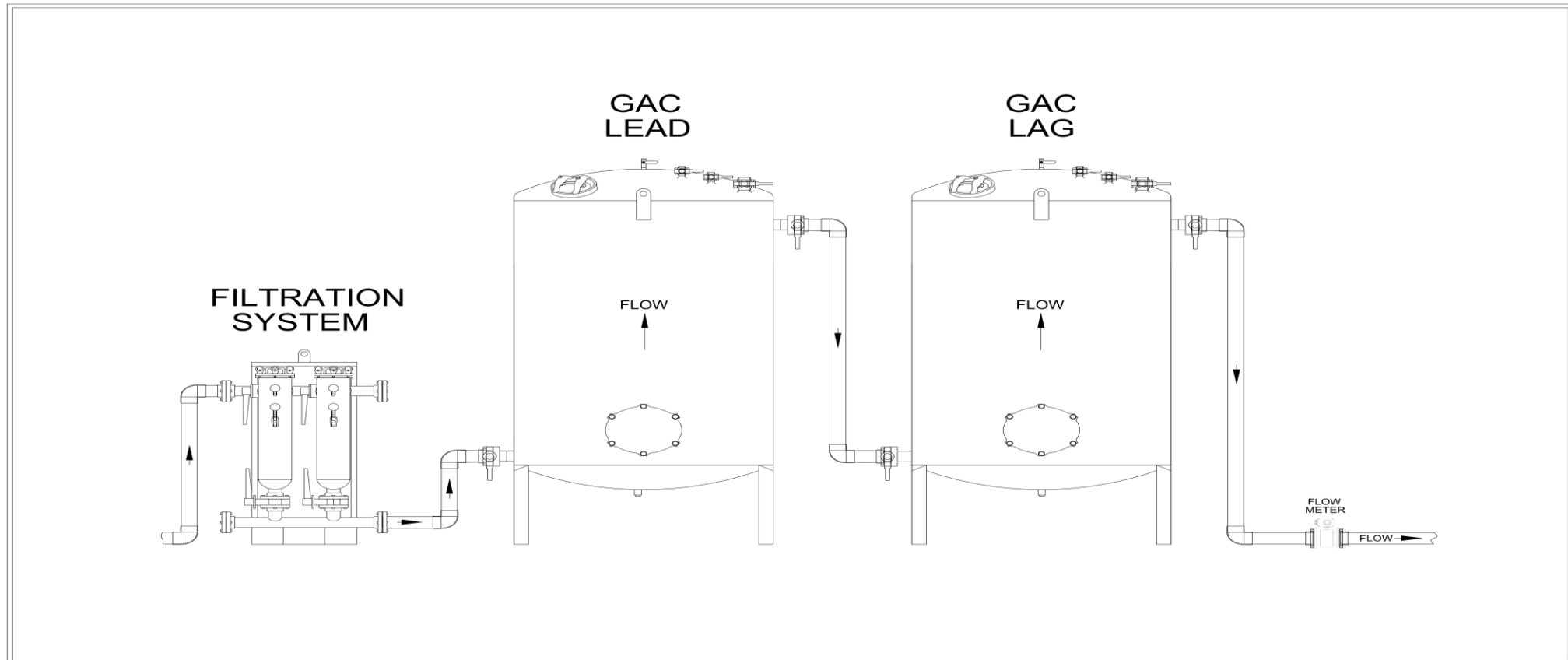
CARBON:

DIGGING  
DEEPER

## Granular Activated Carbon

- Many forms from Coconut Shell to Bituminous sources each has different capacity for PFAS
- May require large vessels for larger flow rates
- Lead/Lag configuration
- 10 Min EBCT
- Removes all Organics; may interfere with PFAS uptake
- Adsorption into pore structure allows for desorption back into the stream
- Dissolved Organic Carbon (DOC) negatively impacts PFAS uptake
- Preference given to Long Chain molecules
- Removes branched PFAS better than linear chain molecules
- Preference given to hydrophobic PFAS molecules
- Multi faceted streams are therefore problematic for carbon systems
- Removes PFAS quickly however exhaustion curve shows carbon continues to remove PFAS but not to required treatment levels
- Capacity limited to reactive site availability
- Effective use 30,000 BV

# CARBON ONLY TREATMENT SYSTEM DESIGN



The designs, information and data contained herein is proprietary and is submitted in confidence and shall not be disclosed, used or duplicated in whole or in any part for any purpose whatsoever without prior written permission from Clear Creek Systems, INC. This document shall be returned to Clear Creek Systems, INC on its demand. Receipt of this document shall be deemed to be an acceptance of the conditions specified herein.



TITLE: CARBON

DRAWING #: 1

DATE:

DRAWN BY: SPC

REV: 1.0

NOTES:

- 1.
- 2.
- 3.



# ORGANOCLAY

## **Positives**

- Bentonite or Zeolite clay sources
- Blended to specific need
- Removes PFOA, PFOS, FTCA, FTSA, FTOH, PFCA
- Long and short chain species
- Removes branched species effectively
- High working capacity use less volume than carbon
- Ion exchange and adsorption mechanism

## **Negatives**

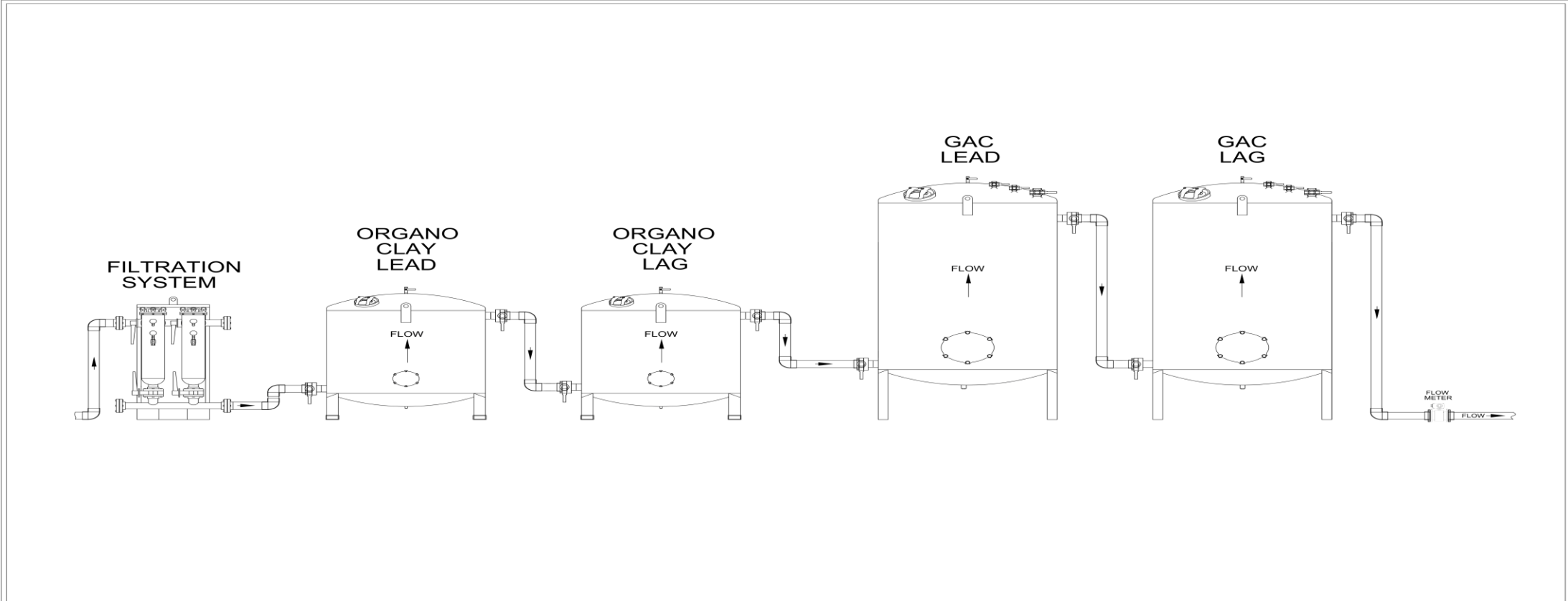
- Hydrophilic surface, requires modification
- Prefiltration suggested to prevent “clogging”

# ORGANOCLAY

## DIGGING DEEPER

- **Organoclay**
  - Frequently used in conjunction with carbon
  - Can be blended with carbon to reduce footprint
  - Can remove oils
  - Can be modified to remove some organics
  - Specialty clays can remove some heavy metals
  - Can hold a higher capacity of PFAS before exhaustion
  - 5 Min EBCT
  - >50,000 BV typical performance

# ORGANOCLAY / CARBON TREATMENT SYSTEM



The designs, information and data contained herein is proprietary and is submitted in confidence and shall not be disclosed, used or duplicated in whole or in any part for any purpose whatsoever without prior written permission from Clear Creek Systems, INC. This document shall be returned to Clear Creek Systems, INC on its demand. Receipt of this document shall be deemed to be an acceptance of the conditions specified herein.



TITLE: **ORGANOCLAY AND CARBON**

DRAWING #: 2

DATE:

DRAWN BY: SPC

REV: 1.0

NOTES:

- 1.
- 2.
- 3.

# ION EXCHANGE (IX) RESINS

## **Positives**

- Manmade specifically for PFAS removal
- Ion exchange positively charged sites
- Adsorption mechanism
- Wide variety of resins available
- Very high holding capacity
- Can reach non detect levels
- Less frequent media change out
- Regeneration capabilities for some resins

## **Negatives**

- Inorganics affects performance
- Somewhat limited availability
- SO<sub>4</sub>, NO<sub>3</sub>, HCO<sub>3</sub>, Cl, TO impact resin performance
- TSS and organic matter may foul resin

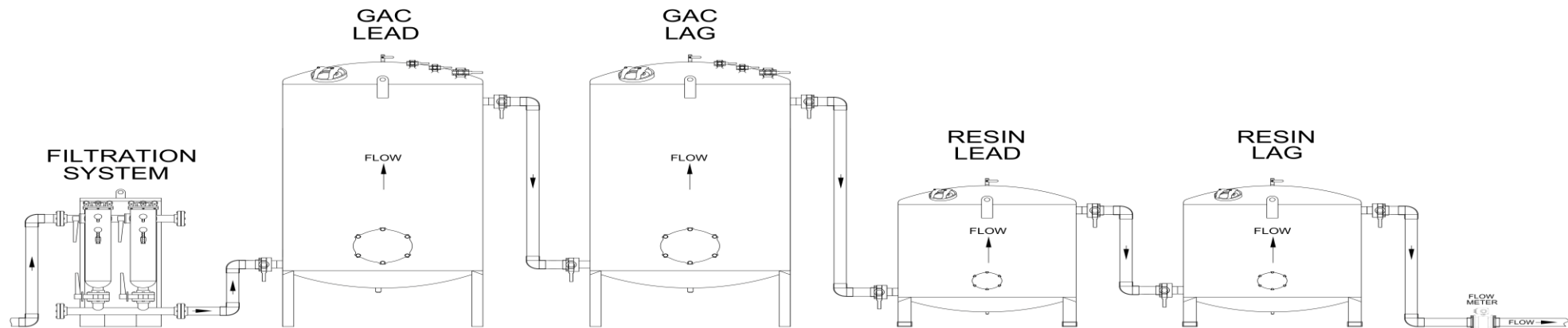
# ION EXCHANGE (IX) RESINS

## DIGGING DEEPER

### Ion Exchange Resin

- Filtration prior to resin vessel is recommended
- Must know the speciation to select proper resin
- Prefers Sulfonic Acids (PFOS) and Longer chain species
- Also effective with some short chain species
- Ion exchange and adsorption mechanism
- Lead / Lag configuration
- High holding capacity with quick reaction time
- 2.5 min EBCT; very fast kinetics;
- May last 1 – 3 years
- >100,000 BV typical performance

# CARBON/RESIN TREATMENT SYSTEM



The designs, information and data contained herein is proprietary and is submitted in confidence and shall not be disclosed, used or duplicated in whole or in any part for any purpose whatsoever without prior written permission from Clear Creek Systems, INC. This document shall be returned to Clear Creek Systems, INC on its demand. Receipt of this document shall be deemed to be an acceptance of the conditions specified herein.



TITLE: CARBON AND RESIN

DRAWING #: 3

DATE:

DRAWN BY: SPC

REV: 1.0

NOTES:

- 1.
- 2.
- 3.

# OTHER TECHNOLOGIES

- **Nano-Filtration**
  - Used in combination with media absorption
  - Point of use systems
- **Electro-Coagulation**
  - Electrical cleavage of the Fluorine bond
- **PFAS destruction technology**
  - Chemical cleavage of the Fluorine bonds
- **R/O membrane**
  - May be used in combination with adsorption for drinking water applications
  - High and low pressure systems
- **Biological treatment**
  - PFAS is a man made non-naturally occurring substance
  - Not subject to biological treatment
  - Looking for the magic BUG



---

SO WHAT DO I DO?



# CONSIDER THE HOLISTIC APPROACH

---

- Understand the water chemistry
- Define the specific outcomes of the project
- Design a treatment system for your specific needs

**“Clear Creek Systems / Yukon Technology  
Are Your Partners in PFAS Remediation Management”**

# CLEAR CREEK SYSTEMS / YUKON TECHNOLOGY

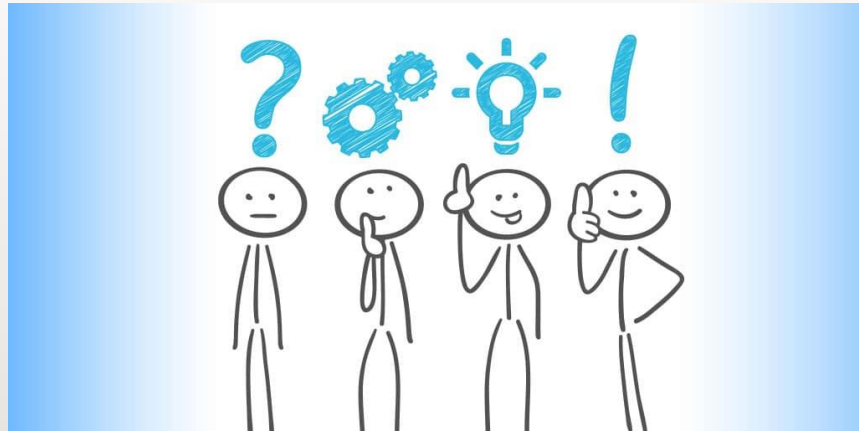
---

- Individually engineered solutions for PFAS applications:
  - Customized, fabricated, self-contained systems
  - Permanent or temporary system designs
- Field services:
  - Installation
  - Operation
  - Maintenance
  - Upgradeability / optimization evaluation
- Systems available for purchase or rental



# QUESTIONS

---



Phil Farina  
Clear Creek Systems  
[pfarina@clearcreeksystems.com](mailto:pfarina@clearcreeksystems.com)  
419-346-8848