Supplementary Information for, “Sustainable pathways for PFAS management in an urban ‘One Water’ system”

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Supplementary Table 1: **Narrative evaluation criteria used by stakeholder sub-committees to assess candidate PFAS interventions.** Criteria were designed to support rapid feasibility screening while preserving flexibility to capture governance, financial, and system-level considerations relevant to One Water decision-making.

Evaluation dimension	**Guiding question(s)**	**Purpose in decision process**
Initial viability screen	Is the intervention clearly viable, potentially viable, or not viable? If not viable, why?	Rapidly removes options that fail basic feasibility or relevance (“first-cut” screening). Interventions classified as not viable were not evaluated further using the remaining criteria.
Timescale of impact	When would meaningful benefits be realized (0–5, 5–10, or >10 years)? What factors drive this timeline (e.g., funding, permitting, design, behavior change)?	Distinguishes near-term compliance actions from longer-term sustainability investments.
Intervention readiness level (IRL)	How mature is the intervention (from theoretical concept to fully operational practice)?	Provides context for implementation risk and uncertainty without eliminating early-stage options.
Implementation requirements and institutional control	What actions are required to implement the intervention, and to what extent are these actions under the direct control of the utility or jurisdiction (e.g., land acquisition, permitting, power supply, coordination with external entities)?	Clarifies practical implementation pathways and degree of institutional control, helping distinguish interventions that can be advanced directly by utilities or agencies from those requiring substantial external coordination.
Cost estimation approach	How could capital and O&M costs be estimated (e.g., direct estimates, analogs, or unit-cost methods)?	Identifies feasibility of near-term costing and data needs for subsequent cost modeling.
Cost responsibility and funding pathways	Who might bear the cost and through what mechanism (e.g., utility rates, fees, general funds, or shared investment)?	Highlights governance and equity considerations often overlooked in purely technical screening exercises.
Regulatory considerations	What regulatory approvals, constraints, or uncertainties affect implementation?	Connects technical feasibility to real-world regulatory environments.
Flexibility and adaptability	How readily can the intervention adapt to changing watershed conditions (e.g., increasing urbanization), climate variability, or evolving regulations?	Evaluates robustness under uncertainty as an explicit decision criterion.
Co-benefits and tradeoffs	Are there win–win, win–lose, or lose–lose outcomes across water quality, water quantity, community co-benefits, or climate adaptation objectives?	Captures non-PFAS outcomes important to system-level One Water decision-making.
Operational and maintenance constraints	Are there significant long-term O&M burdens or reliability concerns?	Prevents underestimation of lifecycle implications.
Other considerations	Are there additional concerns or opportunities unique to this intervention?	Preserves flexibility for context-specific insights contributed by stakeholders.

Supplementary Table 2: **Scoring rubric used to translate narrative stakeholder evaluations into ordinal scores for candidate PFAS interventions.** Scores were assigned to support semi-quantitative comparison of interventions across the evaluation dimensions in Table 1. Higher scores generally indicate greater feasibility, maturity, institutional control, or broader system relevance, depending on the criterion.

Criterion	**Scoring rubric**
Viability	High priority / clearly viable (4); medium priority / potentially viable (2.5); not relevant / infeasible / not viable (1).
Time to benefits	>10 years (4); 5–10 years (2.5); 0–5 years (1).
Maturity	Mature and fully operational / similar projects exist (4); limited- to moderate-scale implementation / mixed maturity—more mature than not (3); pilot testing stage only / mixed maturity—less mature than not (2); theoretical / emerging in this space (1).
Utility control	Under utility or county control (4); partial utility/county control (2.5); not under utility/county control (1).
Ease of cost estimation	Straightforward / fairly simple using existing studies or standard methods (4); moderate—some information or approaches exist for cost estimation, but other information will be hard to come by (2.5); challenging / difficult / no or uncertain analogues (1).
Breadth of burden	Cost borne by ratepayers, landowners, homeowners, and other entities (4); cost borne by ratepayers, landowners, or homeowners (3); cost borne by several entities or classes of entities, but not ratepayers, landowners, or homeowners (2); cost borne by a single entity or class of entity (e.g., a utility or significant industrial user) (1).
Regulatory considerations	Entirely regulatory / significant regulatory considerations / requires regulation to proceed (4); at least one regulatory consideration is certain (others may be possible) (3); regulatory considerations possible / uncertain (2); no or limited regulatory considerations (1).
Adaptability	Highly adaptable or likely adaptable / improves resiliency / flexible / can adjust to changing conditions (4); uncertain / possibly adaptable / adaptable in principle, but difficult / mixed adaptability (flexible in some ways, limited in others) (2.5); not adaptable or probably not adaptable (1).
Co-benefits	Win–win or win–win–win only (4); mixed win–win and win–lose (3); limited or no obvious co-benefits (2); win–lose, win–lose–lose, or lose only / worse than no co-benefits (1).
O&M cost	Significant maintenance or costs / expected to be high / multiple O&M activities listed (4); uncertain with many outstanding questions (3); some expenses or maintenance listed, but not many / not especially burdensome (2); minimal to no direct impact on utilities or counties / no or limited O&M burden (1).

Supplementary Table 3: **Drinking water subcommittee narrative evaluations of candidate PFAS interventions.** Table entries represent an initial screening by practitioners working in the drinking water domain.

Intervention	Subcommittee description / understanding	Time to Benefit	Maturity (intervention readiness level)	Utility Control (implementation requirements)	Ease of Cost Estimation	Breadth of Burden	Regulatory Considerations	Adaptability	Co-Benefits	O&M Costs
High Priority/Clearly Viable										
1. Blend raw water sources — Occoquan Reservoir and Potomac River	Construct transmission to convey Potomac water during periods of low PFAS and abundant Potomac flow to Griffith Drinking Water Treatment Plant (GWTP), Occoquan Reservoir, or Edgemon Reservoir.	5–10 years	Transmission mains = mature; blending source waters in reservoir = medium; feeding Potomac raw water directly to GWTP = theoretical	Utility control: Secure funding, plan, design, permit, and construct transmission; and plan, design, permit, and construct Edgemon-related infrastructure if included.	Proven linear asset cost estimating approaches exist. Reservoir construction costs could be estimated at a high level.	Fairfax Water Ratepayers	None	Improves resiliency of reservoir water quantity/quality in response to climate change or urbanization.	Win/win: Increased supply resiliency for Fairfax Water and Region	Uncertain
2. Dilute with stored (low PFAS) water from Edgemon Reservoir	Construct Edgemon Reservoir; fill it with low-PFAS Occoquan water; and supply GWTP with low-PFAS Edgemon water when PFAS levels in the Occoquan increase.	5–10 years	Similar projects exist for avoiding seasonal nitrate impacts on drinking water treatment plants.	Utility control: secure funding and plan, design, permit, and construct Edgemon-related infrastructure.	Construction costs could be estimated at high level. O&M costs will be difficult to estimate, because variable pumping/flow constraints unknown.	Fairfax Water ratepayers.	DEQ and COE requirements unknown.	Already planned project should increase resiliency of the Occoquan system by increasing storage volume available, however constraints on filling reservoir (with low PFAS water) and needs to pull from the reservoir when Occoquan PFAS is high limits the intent of a project originally devoted fully to increasing supply resiliency.	Win/Win: Planned new reservoir increases water quality & resiliency of Occoquan supply. Win/Lose: PFAS-driven operating rules put constraints on the use of the new reservoir.	Uncertain
3. Membrane Technology	Add membrane process to GWTP; identify new water supply to offset roughly 25% loss to membrane reject stream; add new power source; add brine PFAS treatment step; and identify a brine disposal pathway.	>10 years	Membrane = mature; brine treatment = theoretical; filling Edgemon with low/no PFAS water = uncertain	New power supply is not under utility control. Brine treatment requires research, brine disposal is unexplored, and multiple permitting challenges would be expected.	Current cost estimates may focus only on adding membranes, but do not address all needed components.	Fairfax Water ratepayers and potentially others.	Could be significant. Discharge permit requirements for brine disposal.	Membrane treatment is modular and scalable, but is not well suited to day-to-day adjustments (e.g., in response to predicted or measured PFAS concentrations).	Win/Win: Membrane technology will remove PFAS and other pollutants of emerging concern (e.g., salts). Win/lose/lose/lose: excellent water quality but technology is capital and O&M intensive, reduced finished water production efficiency, brine disposal and/or treatment, and corrosion control concerns.	Brine treatment and disposal; membranes will alter finished water quality requiring corrosion control strategy and introducing risk.

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Supplementary Table 3. Continued.

Intervention	Subcommittee description / understanding	Time to Benefit	Maturity (intervention readiness level)	Utility Control (implementation requirements)	Ease of Cost Estimation	Breadth of Burden	Regulatory Considerations	Adaptability	Co-Benefits	O&M Costs
4. Powdered Activated Carbon (PAC)	Add PAC to raw water.	0–5 years	Mature (Fairfax Water has studied treatment requirements and initiated PAC feed system design and construction). Limited understanding of long-chain versus short-chain PFAS removal.	Utility control: increase PAC storage capacity and system reliability.	Cost estimation based on consultant report and current design/build project.	Fairfax Water ratepayers.	Limited regulatory considerations; already permitted to feed. Effective only at low-levels of PFAS.	PAC is well suited to day-to-day adjustments (e.g., in response to predicted or measured PFAS concentrations).	Win/Win: additional PAC could improve TOC treatment and reduce DBP formation. PAC can remove other contaminants (e.g., fuel spills).	PAC is expensive; contact time needs to be considered, especially at higher plant flows. Also limitation on viable vendors.
5. Anion Exchange (IX)	Post-filter ion exchange treatment for PFAS adsorption.	5–10 years	Mature understanding of the technology but no installations as large as GWTP yet.	Utility control: develop design criteria through piloting. Compare against other treatment technologies, perform cost/benefit analysis (CBA), and proceed to full-scale design and construction.	Costs can be estimated based on consultant bench-scale work, refined by ongoing pilot studies.	Fairfax Water rate payers.	VDH permitting; special exemption impacts must be considered; EPA recognized Best Available Technology.	Effective for long- and some short-chain PFAS, but limited effectiveness for compounds beyond PFAS.	Limited co-benefits.	IX media is expensive; IX implemented post-filter, so pumping would be required; IX implemented in pressure vessels with regular media replacement required; limitation on viable vendors.
6. Post-filter Granular Activated Carbon (GAC)	Post-filter GAC treatment for PFAS adsorption.	5–10 years	GAC is a mature technology (pilot study at Fairfax Water is examining effectiveness of several GAC products).	Utility control: develop design criteria through piloting, compare against other treatment technologies, perform CBA, and proceed to full-scale design and construction.	Costs can be estimated based on consultant bench-scale work, refined by ongoing pilot studies.	Fairfax Water rate payers.	VDH permitting; special exemption impacts must be considered; EPA recognized Best Available Technology.	Media can be replaced more frequently as source water concentrations change; effective for contaminants other than PFAS.	Win/Win: remove PFAS and improve finished drinking water quality.	GAC media is expensive. GAC implemented post-filter so pumping would be required.
7. Convert existing biofilters to GAC adsorbers	Repurpose existing biofilters so they function primarily as adsorption contactors using GAC.	0–5 years	GAC is a mature technology. Current filter media works but is not the most efficient GAC available for PFAS removal. Evaluation of different media and media depths would be needed to understand costs and implementation requirements.	Utility control: develop design criteria through full-scale filter testing, compare against other treatment technologies, perform CBA, and proceed to full-scale implementation.	Use actual GAC media replacement cost based on Fairfax Water filter rehab project.	Fairfax Water ratepayers.	Permits for disposal of PFAS-laden GAC.	Media could be replaced frequently as source water concentrations change.	Win/Win: PFAS removal and improved finished drinking water quality; Win/Lose: PFAS removal but increase filter outage cycle and backwash water. Win/Lose PFAS removal but reduced biological treatment/stabilization benefits that exist currently.	Increased GAC O&M expenditures.
Medium-priority / potentially viable										

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Supplementary Table 3. Continued.

Intervention	Subcommittee description / understanding	Time to Benefit	Maturity (intervention readiness level)	Utility Control (implementation requirements)	Ease of Cost Estimation	Breadth of Burden	Regulatory Considerations	Adaptability	Co-Benefits	O&M Costs
8. Alternate Adsorbents (Fluorosorb, FS)	Fluorosorb to be added post-filter or as a replacement filter media for PFAS adsorption.	5–10 years	Technology has been piloted for performance, but many implementation questions remain (hydraulic concerns, backwashing PFAS release, etc.).	Utility control: develop design criteria through piloting, investigate hydraulics to determine feasibility, CBA to compare against other treatment technologies, and proceed to full-scale design and construction.	Estimate cost based on consultant feasibility study.	Fairfax Water ratepayers.	VDH permitting; special exemption impacts must be considered; Not an EPA recognized Best Available Technology.	Effective for long- and some short-chain PFAS, but limited effectiveness for contaminants outside PFAS.	Limited co-benefits.	FS media is expensive; media is implemented post-filter so pumping required; unknown impacts of media hydraulics may require significant pretreatment or impact plant hydraulics and capacity. Major supply-chain risks because it is a proprietary product.
9. Aeration and Surfactant (Foam Fractionation)	Use micro-/nano-bubble aeration to create hydrophobic surfaces that PFAS will partition to, forming a foam layer that can be removed.	>10 years (if at all)	Emerging in this space.	Utility control; requires extensive pilot and full-scale testing and development to demonstrate viability at large scale and low concentrations.	No relevant costs available.	Fairfax Water ratepayers.	Possible permitting challenges associated with the disposal of concentrates.	Adaptability constrained by residuals management requirements and variable performance.	Win/lose: PFAS removal is potentially reduced by the presence of natural organic matter.	High energy and chemical requirements, foam management, and residuals disposal.
10. Super Critical Water Oxidation (SCWO)	Use heat and pressure to enhance oxidation of organic compounds like PFAS down to minerals.	>10 years (if at all)	Emerging in this space.	Utility control. Requires extensive pilot and full-scale testing and development to demonstrate viability at large-scale and low concentrations. Might be useful for treating concentrated waste streams, such as reverse osmosis brine or PFAS-laden residuals.	No relevant costs available.	Fairfax Water ratepayers.	SCWO systems may trigger air-permitting, hazardous-waste handling, and residuals-management requirements.	Not adaptable; only suitable for concentrated streams.	Limited to destruction of co-occurring refractory organics	Expected to be high due to substantial energy demand, specialized high-pressure equipment maintenance, corrosion management, and skilled operational oversight.
Not relevant/infeasible/not viable										
11. Dissolved Air Flotation	Use aeration to create a top layer with high organics concentration that can be skimmed for further processing.	–	Established, but not for PFAS removal (low efficacy for PFAS compounds, particularly PFOA)	–	–	–	–	–	–	–
12. Advanced Oxidation/Reduction	Use oxidation in the presence of catalysts to break PFAS down.	–	Established, but not for PFAS (data suggests low-level efficacy for PFAS compounds)	–	–	–	–	–	–	–

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Supplementary Table 3. Continued.

Intervention	Subcommittee description / understanding	Time to Benefit	Maturity (intervention readiness level)	Utility Control (implementation requirements)	Ease of Cost Estimation	Breadth of Burden	Regulatory Considerations	Adaptability	Co-Benefits	O&M Costs
13. Point-of-Use Treatment Technology	Utility would distribute point of use filters to all customers indefinitely.	–	Not viable for a system the size of Fairfax Water, considering both retail and wholesale customers; unlikely to be accepted by VDH.	–	–	–	–	–	–	–
14. Do nothing – rely on margin of error for compliance	Count on running annual averaging calculation for compliance.	–	Not viable. Regional droughts in 2024 and 2025 suggest noncompliance would be likely.	–	–	–	–	–	–	–
15. Do nothing–focus on public awareness.	Disregard non-compliance with the PFAS National Primary Drinking Water Regulation (NPDWR).	–	Utility will not consider noncompliance with the NPDWR as an option.	–	–	–	–	–	–	–

Supplementary Table 4: Wastewater subcommittee narrative evaluations of candidate PFAS interventions. Table entries represent an initial screening by practitioners working in wastewater management.

Intervention	Subcommittee description / understanding	Time to Benefit	Maturity (intervention readiness level)	Utility Control (implementation requirements)	Ease of Cost Estimation	Breadth of Burden	Regulatory Considerations	Adaptability	Co-Benefits	O&M Costs
High Priority/Clearly Viable										
1. Granular activated carbon (GAC) in adsorptive mode	Utilize existing GAC facilities in adsorption mode to reduce PFAS.	0–5 years	Fully operational on site, but needs improvements to run continuously in adsorption mode	Under UOSA control. Equipment exists on-site. However, improvements to process reliability and reactivation would be necessary to run full-time adsorption mode.	Relevant costing information exists from previous efforts. However, costs would need to be updated.	UOSA rate payers (member jurisdictions and their customers)	Likely limited regulatory constraints. Perhaps air permitting if new reactivation technology is implemented.	Easily adapted to changing conditions; however, GAC is susceptible to rapid breakthrough of currently unregulated PFAS and CECs.	Win/win: improved water quality entering the Occoquan with additional continuous treatment.	Requires frequent replacement or reactivation of GAC, requiring material, staff time, and equipment to handle. Since UOSA has GAC reactivation facilities, it might make sense to upgrade the reactivation technology to minimize costs.
2. Study precursors in sources	Continue ongoing collection-system source identification efforts, and expand to identify precursors.	5–10 years	Operational; similar study completed last year	Monitoring of the sewershed requires assistance from partner jurisdictions.	Cost of monitoring campaigns and analytical costs.	UOSA general fund; shared investment with member jurisdictions.	No regulatory approvals required.	Study might need to be repeated periodically to account for changing conditions.	Win/win: Better understanding of precursors and sources of PFAS more generally in UOSA's sewershed; Win/lose: money spent on precursor characterization cannot be spent on infrastructure needs.	One and done: No O&M costs for a study of this kind.
3. Study baseline domestic PFAS load	Identify background domestic PFAS loads and determine impacts from SIUs or unidentified dischargers. Outcome is defining point versus non-point sources in the sewershed.	0–5 years	Methods exist to perform the analysis	UOSA would need cooperation from member jurisdictions to access collection-system locations.	Costs would be estimated based on similar studies currently underway.	UOSA general fund; shared investment with member jurisdictions.	No regulatory approvals required.	Study might need to be repeated periodically to account for changing conditions.	Win/win: Identify point and non-point sources of PFAS in UOSA's sewershed and improve overall understanding of PFAS fate and transport in the sewage collection system; Win/lose: money spent on PFAS load characterization cannot be spent on infrastructure needs.	One and done: No O&M costs for a study of this kind.

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Supplementary Table 4. Continued.

Intervention	Subcommittee description / understanding	Time to Benefit	Maturity (intervention readiness level)	Utility Control (implementation requirements)	Ease of Cost Estimation	Breadth of Burden	Regulatory Considerations	Adaptability	Co-Benefits	O&M Costs
4. Study in-plant precursor transformation	Determine whether precursors to PFOA (or other PFAS of concern) are found in UOSA influent, and then evaluate whether transformation can be eliminated.	0–5 years	Theoretical	Studies and process modifications would be controlled by UOSA. Potential for source control down the road if precursors can be eliminated.	Would need to understand the extent of potential process modification; this would be challenging. Monitoring costs can be estimated.	UOSA general fund; shared investment with member jurisdictions; SIUs if precursors are found.	Without a permit limit for PFAS precursors, it would be difficult for UOSA to make any significant process changes or impose any pretreatment restrictions.	Process might need to be repeated periodically to account for changing precursor conditions.	Win/win: Identify potential precursor sources of regulated PFAS and open the door to novel precursor treatment options; Win/lose: money spent on precursor transformation cannot be spent on infrastructure needs.	Potential process changes and monitoring costs.
5. Intermittent / Seasonal PFAS Treatment	Utilize existing GAC facilities, or another technology, on-site at UOSA to seasonally remove PFAS from the main stream. The intervention would require upgrades to existing facilities, or new treatment, and development of seasonal triggers for PFAS removal treatment.	0–5 years	Fully operational; would need to develop appropriate triggers for treatment	Must develop appropriate triggers for treatment; likely need additional GAC reactivation capacity. UOSA has facilities available (GAC) and control over implementation.	Calculate onstructions costs of new GAC furnace; calculate operational costs of carbon reactivation; calculate labor costs.	UOSA rate payers (member agencies and their customers).	May need regulatory approval air permitting associated with carbon reactivation.	Easily adapted to changing conditions; however, GAC is susceptible to rapid breakthrough of currently unregulated PFAS and CECs.	Win/win: improved water quality entering the Occoquan with additional continuous treatment.	Requires frequent replacement or reactivation of GAC, requiring material, staff time, and equipment to handle. Since UOSA has GAC reactivation facilities, it might make sense to upgrade the reactivation technology to minimize costs.
6. Treat high-PFAS side streams	Evaluate PFAS treatment options for all sidestream and recycle streams to implement effective treatment on high-PFAS, lower-flow streams (for example, leachate, centrate, and septage).	5–10 years	Proven technologies on bench/pilot scale; questions remain about scalability (destructive technologies implementation on UOSA sidestreams being studied in WRF 5337)	Under UOSA direct control.	Cost estimation will rely on the findings from the WRF 5337 study.	UOSA rate payers (member jurisdictions).	Typical DEQ regulatory process; VPDES permit? Other permits may be required depending on the technology adopted.	Uncertain.	Limited additional benefit beyond PFAS removal.	Destruction technologies are highly energy intensive.
7. Tighten pre-treatment regulations	Create limits on PFAS concentrations in known PFAS discharges to the UOSA sewershed.	0–5 years	There are mature approaches to source control and industrial treatment of PFAS	Virginia allows UOSA to require industrial discharges known to have PFAS to limit discharge to the MCL, but implementation responsibility is placed at the discharger.	Use UOSA SIU that discharges PFAS as a test case.	SIU that discharges PFAS pays for the technology (capital and O&M), UOSA pays for pretreatment implementation and enforcement.	Would need more stringent language in state regulations or local ordinances.	Enforcement would adapt to changing SIU sources, but changes to state regulations or local ordinances could be slow.	Win/lose/lose: PFAS reduced but economic loss if burden of compliance is so onerous that SIU leaves and UOSA might be sued if clear justification is not apparent.	Cost of intervention requires significant O&M; because not part of core business SIU might not prioritize maintance or reliability long term.

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Supplementary Table 4. Continued.

Intervention	Subcommittee description / understanding	Time to Benefit	Maturity (intervention readiness level)	Utility Control (implementation requirements)	Ease of Cost Estimation	Breadth of Burden	Regulatory Considerations	Adaptability	Co-Benefits	O&M Costs
8. Impose higher sewer rates on PFAS dischargers	Charge high rates to identified PFAS dischargers to offset treatment costs and provide incentive to reduce PFAS in effluent.	5–10 years	Theoretical	Would require regulatory impetus to force PFAS dischargers to consider treatment at their discharge or connection to UOSA. Recognition that supporting O&M costs of existing treatment at UOSA (GAC) may be more cost effective than implementing treatment at the discharge.	Use a case study to determine a revised rate structure to support regular GAC reactivation at UOSA (reactiva-tion furnace upgrades, ongoing O&M).	SIUs	Need a regulatory driver to catalyze this approach.	Rate structures are not readily adaptable.	Win/win: SIUs find a more cost-effective way to address PFAS from their discharge. Win/lose: costs are too high and SIUs leave the region.	Significant O&M costs for PFAS treatment onsite at UOSA.
9. Incentivize product substitution (Industrial Users)	Incentivize SIUs and industrial dischargers to eliminate regulated PFAS streams from their processes.	5–10 years, impacted by availability of alternative products	Theoretical	Voluntary cooperation to identify sources of PFAS, determine opportunities for product substitution, and implement. This approach has been successfully applied for sodium discharges to the sewershed.	Utilize sodium as a example test case, and explore costs of alternatives to PFOA.	SIUs.	Regulatory action may be required to force innovation of new alternatives.	Not readily adaptable.	Limited.	Replacement products are likely more expensive.
Medium-Priority/potentially viable										
10. Ban PFAS use in domestic products	Passing legislation to ban PFAS containing products in the sewershed, and then figuring out how to enforce it.	$> 10+$ years	Theoretical. Without national or worldwide bans on PFAS in consumer products, clothing, and food packaging, this intervention may not have meaningful benefits.	Not under utility control. Need public education, legislation, and means of enforcement.	Perhaps examples exist with phospho-rous ban in detergents, used motor oil disposal centers, or battery recycling centers, or expired pharmaceu-tical collection programs.	Tax payers or individual customers impacted by increased costs.	Requires regulatory action and new laws/ordinances (politics, consumer choices, and unwillingness to make changes must be overcome).	In principle the ban could be updated as new chemical forms of PFAS are developed, but in practice this could prove difficult.	Win/win: would reduce PFAS concentrations in wastewater and ambient waters; Win/lose while PFAS concentration might decrease, customers could face higher costs and reduced product choices.	Ongoing costs would not be borne by utilities, unless there is a mandate to provide specialty disposal options.

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Supplementary Table 4. Continued.

Intervention	Subcommittee description / understanding	Time to Benefit	Maturity (intervention readiness level)	Utility Control (implementation requirements)	Ease of Cost Estimation	Breadth of Burden	Regulatory Considerations	Adaptability	Co-Benefits	O&M Costs
11. Behavior change through social marketing and public education	Use public education campaigns and social marketing strategies to reduce PFAS inputs from households and consumers by influencing product choices, disposal practices, and awareness of PFAS sources.	> 10 years	Limited recent examples of impactful interventions.	Would require sustained coordination among utilities, public health agencies, retailers, and regulators, along with consistent messaging and outreach.	Use existing public education campaigns, like those in the Northern Virginia region for promoting conservative deicer use, as examples.	All stakeholders in the watershed.	No direct regulatory requirement.	Highly adaptable in principle, as messaging and focus areas can evolve with emerging science and changing product formulations; effectiveness may be limited by public engagement and behavioral inertia.	Win/win: public recognizes value in their water and becomes more participatory in the preservation of the resource.	Ongoing programmatic costs associated with outreach, education, and campaign maintenance; minimal direct operational burden on wastewater utilities.
12. Water quality standards for PFAS	Virginia DEQ to develop a UOSA discharge limit for PFAS.	5–10 years	The legal structure for the intervention is available, including PFAS in the regulatory construct in the discussion phase.	DEQ action; outside the purview of UOSA.	Cost of removing PFAS and financial penalties associated with violations if UOSA cannot comply with the new regulations.	UOSA and member jurisdictions.	100% regulatory driven.	Would likely be included in UOSA's permit with renewal process occurring at long intervals.	Win/win: If PFAS has impacts on aquatic life or recreation, the new regulations could have added benefits.	Could shift compliance burden upstream to UOSA, its member jurisdictions and SIUs.
Not relevant/infeasible/not viable										
13. Remove PFAS in biosolids	Use a PFAS destruction method to eliminate PFAS in biosolids retained water, which is ultimately returned to the process.	—	Destruction technologies are piloted, but not implemented at full scale; may be viable in the future. Key need for the process to work is a significant impact of biosolids return water on plant PFAS levels.	—	—	—	—	—	—	—
14. Supercritical Oxidation Treatment (SCWO)	SCWO is a technology for destruction of PFAS in solid/liquid matrices.	—	Emerging technology. Viable for solids, not viable for main-stream process water treatment	—	—	—	—	—	—	—
15. Destruction of PFAS in WW stream	PFAS destruction in main-stream UOSA treatment.	—	Technologies exist but not viable for main-stream water process; fundamentally too energy intensive without pretreatment to concentrate PFAS by 100 to 1,000×	—	—	—	—	—	—	—

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Supplementary Table 4. Continued.

Intervention	Subcommittee description / understanding	Time to Benefit	Maturity (intervention readiness level)	Utility Control (implementation requirements)	Ease of Cost Estimation	Breadth of Burden	Regulatory Considerations	Adaptability	Co-Benefits	O&M Costs
16. Divert UOSA effluent from watershed	Implement either through diversion of wastewater around the Occoquan watershed.	—	Theoretical. Not viable due to current political climate; additional work would presumably be needed to understand safe yield of the Occoquan system.	—	—	—	—	—	—	—
17. Divert UOSA effluent for reuse	Divert UOSA effluent from the Occoquan through finding more effluent reuse opportunities.	—	Theoretical. Challenging due to current political climate; additional work would presumably be needed to understand safe yield of the Occoquan system.	—	—	—	—	—	—	—
18. Reduce I&I + SSO	Reduce infiltration and inflow (I&I) to the sewer system and minimize sanitary sewer overflows (SSOs) through infrastructure rehabilitation, maintenance, and system upgrades.	—	Mature but not viable because the intervention would not impact PFAS levels in UOSA's effluent.	—	—	—	—	—	—	—

Supplementary Table 5: **Watershed subcommittee narrative evaluations of candidate PFAS interventions.** Table entries represent an initial screening by practitioners working in watershed management.

Intervention	Subcommittee description / understanding	Time to Benefit	Maturity (intervention readiness level)	Utility Control (implementation requirements)	Ease of Cost Estimation	Breadth of Burden	Regulatory Considerations	Adaptability	Co-Benefits	O&M Costs
High Priority/Clearly Viable										
1. In-situ isolation & remediation	Isolate known legacy PFAS source areas in place to limit ongoing release to groundwater or surface water.	0–5 years	Fully operational (in use)	Land acquisition or permissions may be needed. A variety of techniques might be applied depending on site specific circumstances for each PFAS source location.	Direct estimates and unit costs. Depending on technology used, there should be existing examples or surrogates for estimating costs (e.g., remediation techniques).	Pooled funding could be applied; landowner burden may also occur depending on site ownership, regulatory context, and permittee responsibility.	Some locations could be under regulatory requirement or legal decree to isolate site contaminants (regulations could compel this category of intervention). There may be requirements to prove that in situ isolated PFAS are completely contained/inert and ongoing monitoring.	Likely adaptable/flexible, since isolation techniques will vary based on site-specific conditions.	Win/win: PFAS isolation and wildlife habitat creation where revegetation is included in the suite of isolation techniques applied. Win/lose: PFAS isolation may come at the cost of loss of prior usable land/space and ongoing monitoring requirements to ensure the longterm viability of PFAS capture.	Ongoing performance monitoring and maintenance may be required. Land ownership changes could present longterm issues.
2. AFFF substitution & disposal	Replace PFAS-containing firefighting foams with non-PFAS alternatives and safely dispose of legacy AFFF stocks.	0–5 years	Fully operational (in use)	This intervention has already been applied by Fairfax County Fire and Rescue Department, in the County's portion of the watershed in 2021. Other fire fighting agencies in the watershed need to be identified and approached. Prince William County would likely be the largest of these.	Quantify cost differential between existing in-use AFFF and replacement PFAS-free foams.	Current agencies purchasing and using AFFF products would fund the changeover.	No major regulatory barriers identified. Destruction/disposal of remaining AFFF may require regulatory approval.	Likely not adaptable. One and done.	Win/lose: Non-PFAS foams are effective, but do they require greater volumes (higher costs) for identical efficacies. If so, is this a trade-off? Do substitutes have other water quality detriments?	Primary O&M burden is associated with collection, storage, and disposal of deprecated AFFF.
3. PFAS discharge requirements	More PFAS regulatory requirements for point or non-point sources.	5–10 years	Limited-scale implementation (one step up from pilot testing)	Regulatory action under DEQ's purview.	Look at analogs, including the Occoquan PFAS law that was passed by the Virginia State legislature in 2025.	Likely borne by regulated entities (permittees) and the regulator (DEQ).	Significant. Implications to industry and regulating/enforcement agencies.	Flexible and adaptable, although regulatory change can be slow.	Win/win: Likely co-benefits to human health and environmental protection if implemented effectively.	Specialized monitoring and compliance protocols would likely be required, depending on proposed regulations.

Continued on next page

Supplementary Table 5. Continued.

Intervention	Subcommittee description / understanding	Time to Benefit	Maturity (intervention readiness level)	Utility Control (implementation requirements)	Ease of Cost Estimation	Breadth of Burden	Regulatory Considerations	Adaptability	Co-Benefits	O&M Costs
4. PFAS criteria/narrative standards	Adopt PFAS-related criteria or narrative standards for discharges to the Occoquan or its tributaries.	5–10 years	Moderate-scale implementation (one step from limited-scale implementation)	Can we use the Occoquan Policy to enforce these criteria or special standards for PFAS in stormwater? VA DEQ might be opening Pandora's box by doing this in the Occoquan. Precedents for establishing special standards for pollutants in drinking source watersheds. Seems these could only be applied in VPDES discharge (stormwater/wastewater) permits (which has begun with the new Occoquan PFAS law HB2050).	Estimate costs for the establishment and implementation of new state water quality standards and assessment criteria.	VA DEQ primarily; MS4s and VPDES permittees likely affected later by compliance obligations.	Special criteria or water quality standards would need to be adopted by the state legislature; MS4 permittees and VAMSA may oppose new stormwater PFAS regulations due to cost effectiveness.	Not very flexible due to long timelines for regulatory adoption and revision.	None identified.	Specialized monitoring protocols would need to be instituted by permittees. Enforcement may not be an effective way to prevent exceedences (more effective at ceasing them, once they occur).
Medium priority/potentially viable										
5. Phytoremediation	Use selected vegetation to remove, stabilize, or transform PFAS at legacy source areas.	5–10 years	Unknown (theoretical)	Sites would need to be county owned or eased, otherwise MOUs would need to be established with the land owners on a case-by-case basis.	Unit costs (per area). Capital cost estimates should be fairly simple by using similar past planting projects (e.g., stream corridor restorations, forest and buffer replanting, etc.) as cost templates.	Variable; could be voluntary or be a cost-sharing agreement between land owner and regulated entity; investment costs may be lower for these kinds of non-structural projects.	Probably very few, although some planting restrictions on non-native or invasive species. May not be feasible at certain sites due to other operational considerations.	Unknown, but selected plant palettes should consider these factors in the context of the site (i.e., factor adaptability into the plant selection and site design).	Win/win/win: in addition to PFAS removal, numerous potential co-benefits for water quality, community ascetics, and wildlife habitat enhancement.	Harvesting schedules and safe disposal of contaminated biomass could create long-term O&M burdens.

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Supplementary Table 5. Continued.

Intervention	Subcommittee description / understanding	Time to Benefit	Maturity (intervention readiness level)	Utility Control (implementation requirements)	Ease of Cost Estimation	Breadth of Burden	Regulatory Considerations	Adaptability	Co-Benefits	O&M Costs
6. PFAS Phase-outs & bans	Phase out or ban targeted PFAS uses or products at the watershed scale.	5–10 years	Limited-scale implementation (one step above pilot testing)	Responsibility would be borne broadly. Which variants of PFAS would be targeted, and through what legal authority?	Difficult. Complex analogs; target compounds and their applications would need to be identified before cost estimating methods could be developed and implemented.	Probably the industries making/using identified PFAS compounds.	Uncertain without clearly identified targets and legal authority.	Unknown; likely industry pushback for certain bans and forced substitutions.	Win/win: potential co-benefits to human health and the environment through broad source reduction.	Dependent upon the proposed regulatory structure and enforcement framework.
7. PFAS sediment/biota monitoring	Monitor PFAS in sediments and biota (benthic organisms, fish) to identify stormwater driven accumulation zones.	5–10 years	Limited-scale implementation (one step above pilot testing)	This has already begun in the Occoquan by the OWML under the direction of Fairfax County. Analytical methods are now developed for sediment and fish tissue PFAS sampling and could be further developed for benthic organisms. This is currently being done on the larger watershed scale, but finer resolution sampling may be necessary to truly identify these zones.	OWML can provide sample costs from recently initiated Fairfax County program for PFAS sampling in fish tissue and sediment.	DEQ and VDH ideally; academic research. Maybe challenging to get funding for this from individual municipalities.	Could support state efforts to establish thresholds for human health risk, for fish consumption, or even recreational contact in certain state waters.	Probably not especially adaptable as a direct intervention, but monitoring designs can evolve.	Win/win/win: could identify sources, help inform understanding of true impacts to ecosystems and food webs, and provide a platform for public education.	No major O&M burdens identified beyond recurring sampling and analysis.
8. Zoning restrictions	Use land use zoning to restrict future PFAS-generating activities in sensitive areas.	>10 years	Limited-scale implementation (one step above pilot testing)	Under local government control. Assume this suggestion means Comprehensive Plan-based land use limitations (based on perceived/associated PFAS levels for particular land uses?). At the finer level, the Fairfax County Comprehensive plan is being used to condition proffers for entitlements (rezonings) that specifically identify and require practices that reduce PFAS in stormwater and wastewater from the site.	Unit costs primarily reflect staff time and planning effort.	Dictated by local governments.	Potential for lawsuits or other legal challenges.	If part of the entitlement process, could be very flexible.	No explicit co-benefits identified, though broader land use protection could result.	Would require legal, administrative, and planning effort to equitably implement and maintain.

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Supplementary Table 5. Continued.

Intervention	Subcommittee description / understanding	Time to Benefit	Maturity (intervention readiness level)	Utility Control (implementation requirements)	Ease of Cost Estimation	Breadth of Burden	Regulatory Considerations	Adaptability	Co-Benefits	O&M Costs
9. Biosolids PFAS destruction	Use destructive treatment to eliminate PFAS in land-applied biosolids within the watershed.	5–10 years	Theoretical, currently	Proposed 2026 VA legislation could aid/force this (several bills under consideration). One bill is proposing the prohibition of application of biosolids with any detectable PFAS. If passed, this obviate this suggested intervention.	Unsure. Probably analogs.	Is this cost prohibitive? May depend on new regulatory environments/requirements. May be the financial onus of the sludge producer or distributor.	Several bills in the 2026 Virginia General Assembly are being considered right now. Will know more about regulatory considerations after the session concludes and the legislation is adopted or not.	Not readily adaptable in the near term.	None identified.	No major O&M burdens identified. There may be some for the sludge generators or distributors.
10. Regulate PFAS use	Require permits or permit-like controls for PFAS use in the watershed.	5–10 years	Limited-scale implementation (one step above pilot testing)	Largely dependent on state legislature and permitting agencies (DEQ, others?). More specifics on exact ”sources” proposed for permitting is needed. May have a model for this (for point sources) in the Occoquan PFAS law passed in 2025	No straightforward analogs. The appropriate analog will vary depending on specific PFAS sources identified for permitting.	Regulated entities (permittees) and, to a degree, the regulator (DEQ).	Significant regulatory considerations for both industry and regulating/enforcement agencies.	Flexible and adaptable.	Win/win/win: provide potential co-benefits to human and environmental health. Greater public transparency about PFAS-connected products and processes.	Dependent upon proposed regulations and enforcement effort.
11. Redevelopment plans at legacy sites	Require PFAS screening and management plans as part for redevelopment of legacy industrial/airport/fire training sites that drain to the Occoquan.	>10 years	Pilot testing has occurred	These sites are typically federal and will be challenging for localities to dictate. But not all–some could be managed through entitled process (rezoning) via proffers. Is being attempted for salt management. Enforcement always difficult.	Difficult to cost; case specific. Plans would be required of the redeveloping land owner.	Developer funded. Locality staff time to develop and vet requirements.	Not applicable.	If part of the entitlement process, could be very adaptable.	Win/lose: could improve PFAS levels in the Occoquan, but also would increase the redevelopment costs. Win/win: could also benefit local ecosystems and water quality.	Ongoing enforcement of condition proffers as part of entitlement agreements could be challenging.

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Supplementary Table 5. Continued.

Intervention	Subcommittee description / understanding	Time to Benefit	Maturity (intervention readiness level)	Utility Control (implementation requirements)	Ease of Cost Estimation	Breadth of Burden	Regulatory Considerations	Adaptability	Co-Benefits	O&M Costs
12. Sediment capture in BMPs	Capture PFAS-bearing sediment in stormwater BMPs.	0–5 years	Theoretical.	MS4s would have a high level of control on this intervention. Funding would be difficult (retrofitting many stormwater BMPs).	Direct estimates (design & construction) and unit costs (sediment removal/-maintenance). Cost estimates for design and construction could be quickly developed depending on the specific design and operational criteria.	MS4s, public, ratepayers, and private stormwater facility owners.	Disposal of captured sediment-bound PFAS–does this become HAZMAT? How would potential practice affect MS4 permits? Would other regulations then come into play (RCRA, TSCA)?	Adaptability depends on the details. Could be susceptible to watershed salts and ionic exchange dynamics from other watershed pollutants. Unsure if specialized media is being proposed here, or if this proposes relying on the current sediment capture mechanisms used in stormwater BMPs.	Win/win: Co-benefits of capturing both sediment and PFAS (and also phosphorus).	May require a different operational model than current stormwater pond management. How to dispose of captured sediment-bound PFAS?
13. Capture landfill discharge	Eliminate PFAS-laden landfill discharge in watershed or to UOSA.	0–5 years	Limited-scale implementation (one step above pilot testing)	Only known landfill discharge to UOSA is the gas collection system condensate discharge that is periodically drained into the sewage collection network, at the Fairfax I66 closed landfill. Limited testing of this discharge has occurred. Would the control be to haul this to a different POTW outside of the watershed (e.g., Noman Cole) for disposal. Potentially viable if this is the suggestion. Need more testing to understand the impacts.	Unit costs? If no treatment is required, only hauling from I66 to an accepting POTW. The costs would be estimated on the hauling schedule. Should be straightforward.	On the landfill owner (Fairfax County) or regulated landfill permittee (if applicable). Solid Waste is an enterprise fund in Fairfax County.	Other POTWs are unlikely to accept any PFAS-laden hauled discharge based on increased regulatory scrutiny on PFAS in POTW effluent. New POTW regulations could affect the viability of this intervention.	May not be adaptable. Would require alternatives to discharging hauled condensate to a POTW (destruction or treatment in lieu).	Win/lose: reduced PFAS discharge to the Occoquan through UOSA, but increased energy demand and carbon footprint if hauling or treatment is required.	Collecting, hauling, and disposing of the condensate.

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Supplementary Table 5. Continued.

Intervention	Subcommittee description / understanding	Time to Benefit	Maturity (intervention readiness level)	Utility Control (implementation requirements)	Ease of Cost Estimation	Breadth of Burden	Regulatory Considerations	Adaptability	Co-Benefits	O&M Costs
14. Divert septic sludge	Septic tank discharge transferred to wastewater treatment plant (Noman Cole).	0–5 years	Theoretical.	Is residential septic sludge a significant contributor to PFAS load at UOSA? Would not be worth the effort if the returns are small for this proposed intervention.	Simple methods could be employed. Unit costs.	Additional costs to haul elsewhere would be borne by homeowners.	May need legislation to enable refusal of residential septage at UOSA.	Probably not adaptable.	Win/lose: PFAS load to the reservoir through UOSA could be reduced, however, this does not remove PFAS, just changes where it goes, shunting problem to downstream waters. Win/win: could reduce other septage-associated contaminants entering the reservoir through UOSA.	Haulers would be required to travel greater distances, and this could potentially incentivize illicit dumping practices and could affect haulers' business models.
15. MS4 permits & ordinance requirements	Enhance MS4 permits and local stormwater ordinances to include PFAS monitoring, source tracking and BMP requirements.	5–10 years	Theoretical, currently	Need regulations/standards to drive these requirements. MS4s may have current capability to do these activities but probably not the budgets.	Nebulous; analogs are difficult and case-specific but possible with more specifity on actual requirements.	MS4s and jurisdictions (public funds). Potentially developers depending on specific ordinance requirements.	Many. Need the regulations or standards first to compell compliance with these requirements. Voluntary efforts have not been shown to be effective in many cases.	Probably flexible, but slow to adapt because of politics and permit cycles.	No co-benefits identified.	Potentially expensive, with uncertainty on efficacy of practices required. Level of maintenance on BMPs would be very challenging and resource consumptive.
16. Outreach & technical assistance	Conduct targeted outreach and technical assistance for high-risk stormwater contributors (airports, logistics centers, auto/industrial facilities) on PFAS-free products and stormwater BMPs.	5–10 years	Theoretical, currently	This has been done for other issues, so templates exist. However, may take significant effort to identify recipients, develop targeted messaging and technical materials, and optimal effectiveness. May need to better understand watershed sources to do this.	Cost estimation approach is unclear. Significant research may be needed to identify optimal targets and messaging. Development of outreach materials is relatively straightforward (time and materials for consultants to produce the desired products).	Possibly DEQ, localities/MS4s, and utilities such as Fairfax Water.	None identified.	Highly adaptable.	Win/win: may reduce use of PFAS products in watershed and increase awareness of the problem and build partnerships. Win/lose: while it might lead to reduced PFAS use in the watershed, the benefits are difficult to measure and money may be better spent on treatment-oriented solutions.	No major O&M burden identified, though recipients may need continuing technical support.

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Supplementary Table 5. Continued.

Intervention	Subcommittee description / understanding	Time to Benefit	Maturity (intervention readiness level)	Utility Control (implementation requirements)	Ease of Cost Estimation	Breadth of Burden	Regulatory Considerations	Adaptability	Co-Benefits	O&M Costs
17. Stormwater retrofit grants/incentives	Provide incentives or small grants for private facilities to retrofit stormwater systems with PFAS treatment or sorptive media.	>10 years	Theoretical, currently	This is likely highly-specialized (design/construction/installation and operational considerations, disposal, etc.) and may be difficult to implement with non-practitioners. However other models exist (flooding and WQ BMPs cost-share grants) that could be applied to the administration of such a program. Availability of effective/appropriate PFAS treatment modalities may be the challenge.	Existing analogous programs can serve as cost models. Primary costs are for program development and administration and also providing a pool of funds for disbursement of these grants.	Could be a pooled fund from multiple stakeholder contributors like MS4s, local jurisdictions, and water quality agencies. Treatment technologies may require significant funding levels which could become prohibitive.	Disposal of captured PFAS or spent media. Grants could potentially aid regulated dischargers (under any PFAS obligation) to meet their targets and expedite compliance timeframes.	Likely flexible and adaptable, depending on program design.	Win/win: May reduce PFAS loading to the reservoir and build partnerships with private entities to work on other water quality/stormwater issues of concern.	Recipients may need technical support for any specialized technologies applied.
18. Sorption media devices	Use sorption technology in surface and groundwater flowpaths at impacted sites via new structures or retrofitted BMPs.	0–5 years	Limited-scale implementation (one step above pilot testing)	Each site would need custom-designed application of this intervention.	Unit costs (materials) and direct estimates (design/construction). Unsure; not commonly used by MS4s. Need input from site-remediation practitioners.	Varied; could be impacted site owner, or partnership of impacted parties (utilities).	Disposition of spent sorbents (PFAS laden), potential use of CERCLA or RCRA to compell use of this intervention.	Likely flexible and very adaptable, depending on different applications.	Win/win: may remove PFAS and capture other non-target pollutants.	Spent media management and fouling could be significant O&M constraints.
Not relevant/infeasible/not viable:										
19. PFAS Inspectors	Fund full-time PFAS inspectors and stand-up inspection programs.	—	Theoretical, currently. Unclear what is proposed. What would be inspected?	—	—	—	—	—	—	—
20. Manufacturer outreach	Conduct outreach directly to PFAS manufacturers.	—	Theoretical, currently. Probably not viable, because there are no PFAS manufacturers in the watershed.	—	—	—	—	—	—	—

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Supplementary Table 5. Continued.

Intervention	Subcommittee description / understanding	Time to Benefit	Maturity (intervention readiness level)	Utility Control (implementation requirements)	Ease of Cost Estimation	Breadth of Burden	Regulatory Considerations	Adaptability	Co-Benefits	O&M Costs
21. Street/Lots Sweeping	Implement high-frequency street and parking lot sweeping in commercial/industrial corridors to remove PFAS bearing particulates before runoff events.	—	Although street sweeping is already in use, not clear that this would address a significant watershed source of PFAS; disposal of PFAS-laden sweeping residues could be problematic. Without further information probably not viable.	—	—	—	—	—	—	—
22. Construction materials testing	Control and test imported fill and recycled materials used in construction for PFAS before placement in the watershed.	—	Theoretical, currently. Likely very difficult to administer and enforce. Fill could possibly be tested, but testing of recycled materials could be challenging. Testing standards and implementation processes would need to be developed.Probably not viable.	—	—	—	—	—	—	—
23. Septic enforcement	Enforce septic cleaning/treatment requirements with PFAS explicitly considered.	—	Theoretical, currently. Local health departments currently oversee septic cleaning schedules, but PFAS-focused enforcement would require new authority or direction. Probably unviable.	—	—	—	—	—	—	—
24. Underdrains in stormwater BMPs	Add underdrain systems in stormwater ponds/BMPs for capturing and removing PFAS.	—	Theoretical, currently. Few stormwater ponds employ underdrains; these are usually seen in certain small/distributed infiltration practices/green stormwater infrastructure, like rain gardens and bioswales. Probably not viable.	—	—	—	—	—	—	—

Appendices/Facilitation Guides

Workshop 1 Facilitation Guide

9/25/2025

ONE PFAS Workshop #1

Meeting Objectives, Invitees, and Facilitation Guide

Objectives

1. Introduce the research team, project partners, and community leaders
2. Provide an overview of the project and what is known about PFAS sources
3. Create space for stakeholders to share their perspectives on PFAS and the challenges these compounds pose for their organizations and constituencies;
4. Discuss One Water approaches and their applicability to this issue, including an early initial list of potential interventions (along the lines of Table 1 in the proposal)
5. Brainstorm possible PFAS source control and treatment interventions across the three subsystems (stormwater, wastewater, and drinking water)
6. Outline and discuss next steps

Invitees

IN-PERSON: Participants from the following organizations (up to 3 each):

(1) Fairfax Water
(2) UOSA
(3) Prince William Water
(4) Fairfax County
(5) Prince William County
(6) Loudoun Water
(7) Fauquier County WSA
(8) NVRC
(9) VADEQ
(10) Micron Technologies
(11) City of Manassas
(12) City of Manassas Park
(13) Virginia Department of Health

REMOTE: Others from the above organizations, as well as the technical observers from the Clackamas River Water Providers and the Interstate Commission on the Potomac River Basin, may attend the opening session which will be available via video link.

Project Team Roles

Small group facilitators: Meg, Shantanu, Sydney

Timekeeper/Remote link monitor: Lauren

Notetakers: Rachel, Diver, Rhea, Andrew, Kirin

Note to the notetakers: No attribution in notes. Focus on themes, takeaways, and a few unattributed quotes. Also – because of this -- notetakers do not have to rotate with their group in the afternoon session.

Instructions Sent to Remote Observers

- We will **not** be able to field questions from the virtual audience.
- Please keep your **microphone muted** and **camera off** throughout.
- **Do not record** any portion of the workshop (no audio, screenshots, or video).
- **Do not forward** this invitation; it is for you alone at the request of a project PI or participating utility.
- There will be an approximately **45-minute lunch break around noon**. We will send an agenda before the event.

Facilitation Guide

Time	Agenda Item	Facilitation Notes
9:30	Registration and Refreshments	• Room set-up • Registration (sign-in sheet, nametags/table tents, handouts?) • A/V set-up/test • Mics? • Remote link set-up/test REMOTE Session Begins HERE

10:00	Welcome
	• Jamie Bain Hedges, Fairfax Water
	• Stan Grant, Virginia Tech
	• Kristin Rowles, Facilitator
		• Brief welcome
		• Comment on the value of this project and workshop
		• Introductions – Will come during the project overview and Why are We Here
		• Kristin – quick overview of the day
		• Kristin – operating procedures – to create an environment for discussion:
		  ○ Not recording
		  ○ Notetaking – no attribution
		  ○ Instructions for remote observers (p. 1) – NOTE: Can leave comments in the chat but we might not be able to bring those comments into the workshop today. But will review them as input for later meetings.

10:20	Project Overview Stan	• Purpose, timeline, workshops, research objectives, Tier 1/2/observers, and One Water Framework

10:40	Why are We Here	• Moderated by Kristin
		• Prepared remarks (3-5 min each, no slides) from each participating organization.
		  ○ Who is participating from your organization (Tier 1, Tier 2)?
		  ○ What are the most significant PFAS challenges in the Occoquan system and for your organization?
		  ○ What would be most important to you as a good outcome of this project for long-term PFAS management in the Occoquan?
		• If you did not submit written responses in advance – please do so on a notecard today.
		• We will actively keep time. (timekeeper: Lauren) Pauses for discussion: Time permitting, we will ask each speaker what one (brief) question they have for the prior speaker. May ask one or two people to summarize themes at break points as we move through these.
		• Note-taking: Focus on discussion more than the prepared remarks in notes
		REMOTE Session Break HERE (leave on/cut mic and camera)
		• Kristin: sensitivities exercise:
		  ○ Set-up flip chart on easel labeled Sensitivities for people to place their post its on; pass out post-its at end of discussion – We will de-brief at end of day.

12:00	Lunch	• Post-it exercise of potential sensitivities and concerns

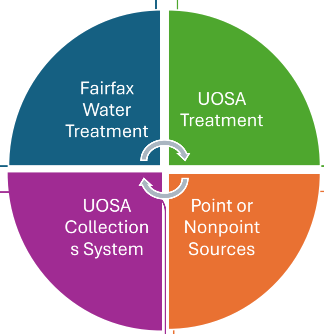
<table>
<tr><td></td><td></td><td>Remote Session – Break for lunch but return for the presentation by Stan after lunch
REMOTE Session Break Ends at HERE (restore mic and camera)</td></tr>
<tr><td>1:00</td><td>What We Know about PFAS
Stan Grant, Virginia Tech</td><td>Stan: Overview of the science – Kristin will have some prompts at break points in the presentation; notecards with questions and comments (prompts will focus on clarification about methods and interpretation)
Note-taking: Focus on discussion and comments/questions from participants
REMOTE session ends here.</td></tr>
<tr><td>2:00</td><td>Potential Interventions</td><td>Erik will present a list of potential interventions (10 min)
Exercise: Small groups in world café style – generated lists of interventions and discussing them – by water/wastewater/watershed subsystems
Kristin – NOTE on terms: Watershed subsystem includes point (other than UOSA) and nonpoint sources.
One facilitator (Meg, Shantanu, Sydney) and one notetaker for each café table; have a flip chart for the interventions lists
Facilitator: Capture interventions list on flip chart; notetaker(s): capture responses to other prompts
Break into three groups – assigned; list available 9/26
First rotation: 20 min, 2nd and 3rd rotations: 15 min (timekeeper: Lauren)
1st rotation<ol type="a">
What interventions are there for PFAS in {watershed, wastewater, or drinking water}?
Make list on flip charts
See Erik's slide on p. 5
NOTE – These can be specific (e.g., membrane treatment) or conceptual (e.g., blending, dilution, magic fairy dust, noncompliance). Creativity in conceptual response is fine and should be encouraged because not all participants in your group will be technical experts in this subsystem.
After you get to a lull in listing -- ask:
What are the benefits of these interventions? Who benefits?
What are the burdens of these interventions (financial or otherwise)? Who bears the burdens?
Do you have concerns about any (or some or all) of these interventions?
[Time permitting] What information is needed to better understand the potential use of these interventions?
2nd and 3rd rotations</td></tr>
</table>

		a) Ask the group to read the list that has been started by the prior group(s). Give them a minute or two to do so. b) Then ask them if they want to add to the list – or elaborate on items in the list. c) What concerns do you have about these interventions? d) Who benefits from these interventions? Who bears the burden? e) Do you have concerns about any of these interventions? • **Back-up prompts** – if conversation lags: o Does your organization address [this subsystem]? o How do PFAS affect your organization? o What concerns do you have in general about PFAS in the Occoquan system? o What do you think successful managers of PFAS needs to consider? • At the end of the 3rd rotation -- Kristin: Describe sticker exercise: Which do you most want to know more about (yellow -- 2)? Which do you think has the most promise (green)? o Set-up flip chart with interventions on easels or windows for people to place their stickers on; pass out stickers at beginning of 3rd rotation
3:15	Break	• Sticker exercise
3:30	De-Brief on Interventions (& Sensitivities)	Note-taking: Focus on discussion and comments/questions from participants De-brief sensitivities (Prompt: Do you have any high-level advice for the project team?)
3:45	Next Steps	Stan comments – next meeting – approx. when and what we'll do; closing remarks on today's discussion – takeaways and tidbits Ask Jamie if she wants to make a closing comment
4:00	Adjourn	

Preliminary List of Interventions

- Short-term Compliance
- Long-term PFAS goals

- Optimize Existing PFAS treatment
- New PFAS Treatment
- Quantify and remediate in-plant transformation of PFAS precursors



- Treat at known SIUs
- Identify and Treat unknown SIUs
- Identify and remediate PFAS inputs (domestic)
- Identify and remediate PFAS precursors inputs

- Remediate known PFAS Sources in Watershed
- Identify and treat unknown PFAS sources in watershed
- Identify and remediate PFAS precursors in watershed

Workshop 2 Facilitation Guide

ONE PFAS Workshop #2

February 20, 2026
Fairfax Water Griffith WTP Conference Room

Facilitation Guide

Objectives

1. Refine the "possibility space" of interventions for further analysis based on the subcommittee reports
2. Review and discuss wastewater diversion study results
3. Outline and discuss next steps

Time	Agenda Item	Facilitation Notes
9:30	Registration and Refreshments	• Room set-up • Registration (sign-in sheet, nametags, handouts) • A/V set-up/test • Mics • Remote link set-up/test REMOTE Session Begins Here
10:00	Welcome, Updates, and Project Overview *Stan Grant, Virginia Tech* *Kristin Rowles, Facilitator*	Meeting overview and logistics by Kristin (objectives, format, remote, next meeting location – ask if anyone wants to host) Explain remote observation for today – list out who is remotely observing Operating procedures – to create an environment for discussion: ○ Not recording ○ Notetaking – no attribution ○ Instructions for remote observers – NOTE: Can leave comments in the chat but we might not be able to bring those comments into the workshop today. Will review them as input for later meetings. Project updates from Stan (slides)

10:20	Subcommittee Reports – Presentations and Panel Discussion • Wastewater Interventions • Drinking Water Interventions • Watershed Interventions	5 minute intro by Kristin (slide) 10 minute presentations by each subcommittee lead Handouts: spreadsheets Comon slides: list of subcommittee members, longlist of interventions (without evaluation results), high/low/no/other slide Discussion format: Moderated questions (2), then Q&A, then more moderated questions time permitting Discussion prompts: (refine after reviewing materials) • What variables were the most important in your discussions and your selections – and why • Did the results come out as you expected or were you surprised by the results • How did your discussions overlap with the other subsystems (subcommittees) • What is your main takeaway from the subcommittee's work
11:30	Diversion Study Results *Stan Grant, Virginia Tech*	Stan will tie this back to the project
11:55	The Intervention Possibility Space *Erik Rosenfledt, Hazen and Sawyer* *Stan Grant, Virginia Tech*	Explain what we mean by possibility space and what Erik and Stan's group will do with the identified interventions (costs, water quality) Explain the limits of this work and what limits that places on the # of interventions in the possibility space (for the next steps) REMOTE Session Ends Here
12:10	Lunch	
1:00	Refining the Intervention Possibility Space *Small Group Discussions*	• Kristin will introduce to plenary (5 minutes) • Two sessions of small groups, 3 groups meet each session (one for each subsystem) – 35 minutes each session

		• Each group will have subcommittee members for that subsystem, a team member facilitator and notetaker, and self-selected participants • Each participant that will participate in 2 groups (not all 3); subcommittee members might choose to stay in their subsystem for both groups – or participate in another group for one of the sessions • Objective: Each session will select 4-5 interventions for the "possibility space" for that subsystem; the possibility space is the set of interventions that will be evaluated in the next stage of the project
2:30	Break	Prepare slides with the lists from the groups
2:45	De-Brief on the Intervention Possibility Space *Kristin Rowles*	Plenary discussion Prompts: TBD
3:20	Next Steps *Stan Grant and Kristin Rowles*	
3:30	Adjourn	

Small Group Discussion – Facilitation Guide

Logistics

- Kristin will introduce to plenary (5 minutes)
- Two sessions of small groups, 3 groups meet each session (one for each subsystem) – 35 minutes each session
- Each group will have subcommittee members for that subsystem, a team member facilitator and notetaker, and self-selected participants
- Each participant that will participate in 2 groups (not all 3); subcommittee members might choose to stay in their subsystem for both groups – or participate in another group for one of the sessions.

Objective

Each session will select 4-5 interventions for the "possibility space" for that subsystem; the possibility space is the set of interventions that will be evaluated in the next stage of the project

Output

2 lists of interventions for each subsystem to include the possibility space (4-5)

Handouts

Spreadsheet from subcommittee evaluation, slide with high/low/other evaluation results based on subcommittee report

Flip Chart

Track what's on the list of selected interventions for this subsystem

Prompts

- [Make sure you have some subcommittee members in the group in both sessions.]
- Do you have any questions for the subcommittee members?
- The subcommittee picked these items as their highest priorities for the possibility space. (Put them on the flip chart) List the high priority items (not the others yet).
    - Subcommittee members – do you agree with that list? Any comments you would like to share about the priorities list with this group?

> Drinking Water (Kristin-facilitator, Megan - notetaker)
>
> Wastewater (Shantanu – facilitator, Rhea - notetaker)—They have a list of high/low/non-viable interventions. There are 7 high priority ones. Will need to nudge them to prioritize.
>
> Watershed (Meg – facilitator, Lauren - notetaker) Need to define some of the interventions more (see question on that). Also -- waiting for the list of high priority interventions as a starting point from Shannon.

    - Others in group – What do you think of this list? Do you agree? Do you have questions about it for the subcommittee members?

- If this is the interventions possibility space for this project and this subsystem, what are we leaving out? Anything that anyone wants to make a case for? From the low priority or not viable lists?
- Watershed Group: The subcommittee noted that they wanted more definition of several items in this list (watershed interventions). Let's look at the spreadsheet. For those that are marked as needing definition (see Other Considerations) – that might also be high priority for the possibility space -- can you help to explain more of what is involved?
- Does anyone have ideas for out-of-the-box interventions that were not evaluated?
- If the list is longer than 4-5 items – then you need to do some prioritization. Two options:
    - You can try asking if there is anything you can clearly cut from the list and see where the discussion leads.
    - And/or you can do a "sticker exercise" and ask each person to put a sticker on 3 items that they think should be in the list. See what ranking comes out of that and discuss. (We'll have some stickers there if needed.)
- Other prompts (if needed):
    - Can we give any further guidance to define some of more general interventions that were selected for the possibility space – those where there were questions about definition from the subcommittee?
    - Can you offer any guidance to the Erik and Stan that might help them in assessing costs and water quality benefits of these interventions?
    - Are these the results you expected?
    - Which of these interventions are the most promising to you and why?
    - How do these interventions affect/interact with other subsystems?

<u>Second session</u>

Participants will self-select into another subsystem group. Make sure you have some subcommittee members in the session. Same discussion prompts as 1st session. At the end you can compare lists with the prior group (but hold that till late in the discussion.)

<u>After 2nd session</u>

Let the group go to a break. Small group facilitators will use the lists to make some slides during the break.