

**The Role of Underground Injection
in the Management of Aqueous PFAS Waste**

**Groundwater Protection Council
Salt Lake City**

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Texas Molecular

- Commercial hazardous and non-hazardous wastewater management facility located in Deer Park, TX. In operation for over 40 years.
- Inject 90 to 100 million gallons each year.
- Provide utility-like service to a variety of industries
- State of Texas and USEPA permits including a Federal EPA No Migration Petition (NMP) for 3 Injection Wells at Deer Park, TX.
- TCEQ Compliance Rating of 0, “High” Performance
- Active member of Deer Park Citizens Advisory Council and Deer Park Local Emergency Planning Committee
- Managed and injected over 80,000,000 gallons of hazardous and non-hazardous waters contaminated with PFAS in the past 4.5 years.
- One additional No Migration Petition well in Corpus Christi, TX

The Role of Underground Injection in the Management of Aqueous PFAS Waste

- Traditional Uses of Class 1 Underground Injection
- Benefits of Class 1 Underground Injection
- Why Underground Injection for Aqueous PFAS Waste?
- EPA Programs and Regulatory Drivers
- EPA Interim Guidance on Destruction and Disposal of PFAS Waste
- Non-Regulatory Drivers
- Environmental Justice
- Limitations of Underground Injection
- Summary
- References and Information Sources

Traditional Uses of Underground Injection (pre-PFAS)

- Industries
 - » Chemicals
 - » Oil Refineries
 - » Terminals
 - » Landfills
 - » Metal Finishing (Galvanizing and Plating)
- Use
 - » In lieu of, or in support of wastewater treatment
 - » Protect people and the environment from toxic constituents
 - » About 9 billion gallons of hazardous wastewater are injected annually
 - » Captive and commercial wells

Traditional Uses of Underground Injection Typical Applications – Range of Capabilities

- Acids and bases without neutralization
- Soluble and miscible organics
- Waters with a flash point (D001 high TOC subcategory)
- Waste codes up to and including most D, F, K, U, and P codes.
- Waters subject to various NESHAPs, e.g. Benzene (FF), Organic Chemicals (B), Ethylene Operations (XX), Pharmaceuticals (GGG) and high VOCs (CC).
- Some emulsions and high solids streams
- Some toxic vapors like ammonia, H₂S, etc.
- Special handling of other constituents like formaldehyde.
- Applications are limited by the individual permit as well as the design of the surface facility.

Benefits of Class 1 Underground Injection

- **Purpose of Underground Injection Program: Protection of Underground Sources of Drinking Water**
- No discharges to waterways
- No discharges to drinking water sources
- No/low air emissions (CO₂, SO_x, NO_x, HAPs)
- Very low carbon footprint compared to other technologies
- Energy efficient. No thermal processes except vapor control
- EPA Report 570/9-91-031: “Class I Underground Injection wells are safer than virtually all other waste disposal practices”
- **EPA Interim Guidance on Destruction and Disposal of PFAS, 12/18/20: Underground Injection is listed as “least uncertain” among available treatment and disposal options.**

Why Underground Injection for Aqueous PFAS Waste? All the Benefits of Class 1 Injection Wells plus.....

- EPA Interim Guidance Document
 - » “Least uncertain” disposal technology
 - » Available now
 - » EPA No Migration Petition for hazardous wells
- Potential to meet current and possible future regulations, waste designations, and programs (hazardous wells)
- Non-Regulatory Drivers
- Proven no discharge, no thermal process technology
- Most widely used technology for on-site hazardous waste in the United States.

Why Underground Injection for Aqueous PFAS Waste?

Current Uses for Aqueous PFAS Wastes

- Wastewater (Hazardous and Non-Hazardous)
 - » PFAS and AFFF producers and users
- Firefighting water (Hazardous and Non-Hazardous)
 - » Oil refineries, terminals, airports, military installations
- AFFF rinse water
- Landfill leachate (Hazardous and Non-Hazardous)
- Groundwater (Hazardous and Non-Hazardous)
- Concentrates from on-site water reduction technologies like membranes (Hazardous and Non-Hazardous)
- No discharge projects
- Finite projects with short time requirements

EPA Programs and Regulatory Drivers

- **PFAS future is becoming more certain**
- **General direction of PFAS regulations can be ascertained by the totality of recent EPA programs and proposals.**
 - » EPA Response to New Mexico Petition on listing as a hazardous waste, 10/26/21.
 - » EPA Roadmap for PFAS Regulation, 10/18/21
 - » Preliminary Effluent Guidelines Program Plan 15, 9/21
 - » EPA Multi-Industry PFAS 2021 Preliminary Report , 9/16/21.
 - » TSCA. US Congress, Proposed PFAS Reporting. 6/21/21.
 - » EPA Interim Guidance on PFAS Disposal and Destruction, 12/18/2020.
 - » PFAS Action Act, HB 2467 (House passage only), 7/21/21.
 - » TRI. Currently 176 PFAS constituents
 - » **Health Advisory (HA). EPA issued revised HA for PFOA (.004 ppt), PFOS (.02 ppt), and established new HA for PFBS (2000 ppt) and Gen X (10 ppt). 6/15/22.**
- **Incineration Issues**
 - » 2 States (NY and IL) have banned incineration of PFAS and AFFF
 - » DOD has suspended shipments of PFAS and AFFF to all incinerators
 - » EPA is working on incineration combustion conditions, products of incomplete combustion, as well as air transport issues.

EPA Programs and Regulatory Drivers

EPA Response to New Mexico Petition

- New Mexico petitioned EPA on June 23, 2021 to act on listing PFAS compounds as hazardous wastes under Subtitle C. The basis of the request included the toxicity and impact of PFAS on water supplies, agriculture, dairy, and tourism. A number of states also made comments.
- EPA response to New Mexico petition on October 26, 2021
 - » EPA plans to add 8 carbon PFOA and PFOS, 4 carbon PFBS, and 6 carbon GenX to Appendix VIII, RCRA Hazardous Constituents.
 - » That would make the 4 PFAS subject to corrective action requirements and provide a **framework from which to regulate them and other PFAS compounds as listed hazardous wastes.**
 - » Consistent with EPA's PFAS Strategic Roadmap

EPA Programs and Regulatory Drivers

EPA Strategic Roadmap for PFAS Regulation

- Published October 18, 2021.
- Active support by EPA Administrator, Michael Regan
- Directives in Roadmap: Research, Restrict, Remediate
- Proposed Actions
 - » Testing 20 different PFAS categories to obtain information on 2000 similar compounds
 - » Designate some PFAS as a Hazardous Substance (CERCLA) and propose others (2022 and ongoing)
 - » Set timelines for data collection and rulemaking for Effluent Guideline Limitations (EGL) for 9 industrial categories
 - » Reduce PFAS discharge through NPDES program. (Winter 2022)
 - » Review past actions under Toxic Substances Control Act (TSCA) to determine what additional action is required for additional protection. (Summer 2022 and ongoing)
 - » Enhance PFAS reporting under TRI (spring 2022)
 - » Continue and increase monitoring and data collection (ongoing)
 - » **Final toxicity assessment for other PFAS including GenX, PFBA, PFHxS, PFNA, and PFDA to develop health advisories (late 2021 and on-going)**
 - » PFAS regulatory discharge limits from industrial sources (2022 and ongoing)
 - » Environmental Justice is an important part of all regulations.

EPA Programs and Regulatory Drivers

Preliminary Effluent Guidelines Program Plan 15

- Issued September 2021
- PFAS management and rulemaking are included
- Covers direct (NPDES) and indirect discharge (POTW)
- Focus on Point Source Categories (PSC) with highest discharges, e.g. top 5 and top 25%.
- PFAS Focus: Organic Chemicals, Plastics, Synthetic Fibers, Pulp and Paper, Chrome Plating, and Commercial Airports. Detailed studies on landfills and textile mills are planned.
- Equity and Environmental Justice will be a part in Effluent Limitations Guidelines (ELG) Planning.

EPA Programs and Regulatory Drivers

PFAS Action Act – FYI - Not Yet Passed

- HB 2467 passed US House of Representatives on 7/21/21 with bipartisan support, 241-183. It is unlikely that the Senate will accept it without several revisions.
- Provisions
 - » Requires PFOA and PFOS to be added to Hazardous Substance list (CERCLA) within one year.
 - » Assess all other PFAS for addition to Hazardous Substance list within 5 years.
 - » Determine if PFAS should be considered a toxic pollutant under the Clean Water Act.
 - » Set discharge limits for various industries
 - » Start clean ups at PFOA and PFOS sites
 - » Require EPA to come up with incineration standards within 6 months.
 - » Seems to require that PFAS would be considered like a hazardous waste for incineration and perhaps all other waste management technologies.
 - » Funding for POTWs.

EPA Programs and Regulatory Drivers

EPA Multi-Industry 2021 Preliminary Report

- Expands on the Preliminary Effluent Guidelines Program
- 5 Point Source Categories studied Including the manufacture, use, and discharge of PFAS chemicals
 - » Pulp & Paper
 - » Textile
 - » Metal Finishing
 - » Organic Chemicals, Plastic, and Synthetic Fibers
 - » Commercial Airports
- Study includes results of work with specific PFAS manufacturers, users, and industry organizations.
- Good reference for PFAS information and technologies for treatment.

EPA Programs and Regulatory Drivers

Proposed New Regulation, TSCA PFAS Reporting

- Published in Federal Register on June 28, 2021. 60 days comment period ended on August 27, 2021.
- Requires detailed reporting on all aspects of PFAS management including amounts, potential exposures to workers, and disposal (air, land, water, on-site treatment, and off-site disposal).
- Includes manufacturers and importers of PFAS to include manufactures of byproducts. No exemption for “small” manufacturers.
- Includes 1346 PFAS compounds, of which 669 are active in US commerce.
- Excludes pesticides, food additives, cosmetics, drugs, and devises.
- Intention is to give EPA better idea of exposure and potential health and environmental impacts.
- Report is for all covered activity since 1/1/2011.
- “Reasonably ascertainable” standard. Reasonable estimates based on all normal resources.
- Initial report will be due 6 months after 6 months of final rule (1 year total)

EPA Programs and Regulatory Drivers

EPA Interim Guidance on PFAS

- EPA issued an Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Perfluoroalkyl Substances on December 18, 2020. It should be updated in 2023.
- What was the reason for report?
 - » Meet requirements of FY 2020 NDAA
 - » Provides information on current commercially available technologies to manage PFAS materials.
- What PFAS Materials does it cover?
 - » Aqueous Film Forming Foam (AFFF)
 - » Soil and Biosolids
 - » Textiles
 - » Spent water treatment materials like filters, granular activated carbon, ion exchange resins.
 - » Landfill Leachate
 - » Waste streams from facilities that use PFAS.

EPA Programs and Regulatory Drivers

EPA Interim Guidance on PFAS, continued

- What the guidance does not do
 - » Set treatment or discharge standards
 - » Does not specify or limit what technology to use. Guidance only.
- Includes additional research for new technologies.
- Includes consideration of potential vulnerable populations at TSDFs accepting PFAS wastes
 - » Releases
 - » Identify vulnerable populations
 - » Health effects
 - » Participation of vulnerable populations in permitting
 - » Vulnerability as part of risk assessment
 - » Community engagement
- Ranks available technologies in terms of levels of uncertainty concerning environmental and health risk.
- Interim Guidance to be updated in 2023.

Disposal and Destruction Options In Order of “Lowest Uncertainty”

- Storage
- Class 1 Hazardous Underground Injection
- Class 1 Non-Hazardous Underground Injection
- Hazardous Waste Landfill, Subtitle C
- Non-Hazardous Waste Landfill, Subtitle D
- Hazardous Waste Incineration
- Other Thermal Treatment

Disposal and Destruction Options

Class 1 Non-Hazardous Underground Injection

Positives

- Low/No discharge or emissions
- Easier permit process
- Minimize migration of fluid

Uncertainties

- Concern about fate of fluid
- Siting criteria is less stringent than hazardous waste wells
- Transportation cost to commercial facilities
- Capacity
- Future “hazardous” regulations or designation

Disposal and Destruction Options

Class 1 Hazardous Underground Injection

Positives

- No discharges or emissions
- Manage as if hazardous waste (permits, facility)
- Address future regulations, e.g. RCRA, CERCLA, TRI
- Rigorous geologic siting and chemical safety criteria as part of EPA No Migration Petition (NMP).
- Use with volume reduction technologies like Reverse Osmosis and Soil Evaporation

Uncertainties

- Stringent siting criteria
- Permitting process for new wells is long and potentially difficult.
- Primarily for liquids
- Capacity
- Cost of transportation

Non-Regulatory Drivers

- Voluntary actions by generators or facilities to reduce liability
 - » Disposal or on-site treatment by generators
 - » Restrictions imposed by TSDFs, POTWs and landfills.
 - » “Zero” discharge
 - » Trucking Company
 - » Truck Washes
- Consent orders
- Lawsuit settlements
- Vulnerable populations/Environmental Justice
- General duty clauses in permits
- Retroactive liability.

Environmental Justice

- Environmental Justice (EJ) is to be considered in all rules and legislation across all government departments.
- EJ is a part of all Congressional action and all EPA PFAS programs
 - » Guidelines for Disposal and Destruction of PFAS
 - » HR 2467, PFAS Action Act (not enacted)
 - » EPA Roadmap for PFAS
 - » Generator and receiving facilities
 - » Effluent Limitations Guidelines
- EJ Screen. Easy to use tool to be used by regulators or anyone regarding any PFAS generating facility or PFAS waste receiving location. It provides information concerning vulnerable populations (education, language barriers, income, racial makeup, and proximity to chemical hazards).
- EJ requires community communication, participation in permitting, and risk reduction.

Underground Injection for Aqueous PFAS Disposal

Limitations of Underground Injection

- Aqueous PFAS Waste. Low solids, no debris or solid treatment residues
- Water needs to be compatible with formation and other water, and be able to be filtered for injection
- Transportation cost to commercial facilities is a factor based on risk decisions
- Volume and/or capacity may be a consideration
- Obtaining permits for new wells
 - » Must have geology to support siting of an injection well
 - » Non-hazardous. State permit. May take about a year.
 - » Hazardous. EPA No Migration Petition. May take 4 or 5 years

Underground Injection for Aqueous PFAS Disposal Summary

- Underground injection should play an important role in the management of aqueous PFAS waste well into the future
- Class 1 Underground Injection is a proven technology to manage constituents of concern, including PFAS with a no discharge technology
- Hazardous Injection Wells provide an additional layer of security based on the RCRA permits and the rigorous geologic and permitting requirements of an EPA 10,000 Year No Migration Petition.
- Hazardous wells manage wastes subject to RCRA Hazardous Waste regulations as well as CERCLA wastes.
- Injection wells can complement on-site reduction technologies.
- Limitations include compatibility, solids, filtration, distance, and capacity. Permitting time and location requirements are major factors.

References and Information Resources, PFAS

- EPA Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances, December 18, 2020. <https://www.texasmolecular.com/wp-content/uploads/2020/12/EPA-Interim-Guidance-on-Disposal-and-Destruction-of-PFAS-12-18-20.pdf>
- TSCA Section 8(a)(7) Reporting and Recordkeeping Requirements for Perfluoroalkyl and Polyfluoroalkyl Substances, Federal Register, Volume 86 FR 33926, June 28, 2021. [federalregister.gov/citation/86-FR-33926](https://www.federalregister.gov/citation/86-FR-33926).
- EPA Preliminary Effluent Guidelines Program Plan 15, September 2021. EPA-821-R-21-003. [epa.gov/eg/preliminary-effluent-guidelines-program-plan](https://www.epa.gov/eg/preliminary-effluent-guidelines-program-plan)
- EPA Strategic Roadmap: EPA's Commitment to Action 2021 -2024. October 18, 2021, https://epa.gov/system/files/documents/2021-10/pfsas-roadmap_final-508.pdf.
- EPA Multi-industry PFAS 2021 Preliminary Report, EPA 821-R-21-004, September 16, 2021
- EPA Response to New Mexico Petition, October 26, 2021. https://www.epa.gov/system/files/documents/2021-10/oct_2021_response_to_nm_governor_pfas_petition_corrected.pdf
- PFAS Action Plan of 2021, H.R.2467. <https://www.congress.gov/bill/117th-congress/house-bill/2467>.
- Environmental Justice Screening and Mapping Tool. www.epa.gov/ejscreen

References and Information Resources, UIC

- “Class I Underground Injection Control Program: Study of the Risks Associated with Class I Underground Injection Wells” EPA Report 816-R-01-007, http://water.epa.gov/type/groundwater/uic/wells/_class_1.cfm
- EPA 816-K-10-004, March 2012, Protecting Drinking Water through Underground Injection Control, http://water.epa.gov/type/groundwater/uic/upload/pocketguide_uic_protecting_dw_thru_uic.pdf
- EPA Report 570/9-91-031, “Class 1 Underground Injection Wells are safer than virtually all other waste disposal practices”
- Texas Molecular website, www.texasmolecular.com/pfas/

Questions

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