BEFORE THE
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

In the Matter of: JACKSON & SON DISTRIBUTORS, INC., Dba JACKSON AND SON OIL, Seaside, Oregon, Respondent.	DOCKET NO. CWA-10-2025-0023 RESPONDENT'S SUPPLEMENTAL PREHEARING EXCHANGE

RESPONDENT'S SUPPLEMENTAL PREHEARING EXCHANGE

Respondent, Jackson & Son Distributors, Inc., dba Jackson and Son Oil ("Jackson" or "Respondent"), through the undersigned attorneys, respectfully submits this Supplemental Prehearing Exchange as follows:

I. WITNESSES

1. **Mike Gefell, Principal Scientist, Anchor QEA.** Expert Witness. Mr. Gefell is expected to testify regarding EPA's use of the Hydrocarbon Spill Screening Model at the Jackson facility and the testimony of Dr. Daniel Marshalonis PhD as set for in Exhibit CX 12.

II. EXHIBITS

RX #	Description
RX 13	Julie Fox Resume
RX 14	Mike Gefell Resume

DATED this 11th day of February 2026.

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In the Matter of *Jackson & Son Distributors, Inc., d/b/a Jackson and Son Oil*, Respondent.
Docket No. CWA-10-2025-0023

CERTIFICATE OF SERVICE

I hereby certify that the foregoing **RESPONDENT'S SUPPLEMENTAL PREHEARING EXCHANGE**, dated February 11, 2026, was sent this day to the following parties in the manner indicated below.

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Copy by OALJ E-Filing System to:

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RX 14

Michael J. Gefell, CPG, PG

Principal Scientist

Michael Gefell has more than 35 years of experience in field investigations, quantitative assessment, monitoring, and remediation of groundwater and dense and light nonaqueous phase liquids (DNAPL and LNAPL) in porous and fractured media. He has served as leader Anchor QEA's Science, Technology and Innovation Group and NAPL Secondary Practice Area.

Mr. Gefell has contributed groundwater hydraulics and solute-transport expertise to the design of numerous successful groundwater, sediment, and soil remediation projects. He has an extensive applied background in groundwater hydraulics, groundwater-surface water interaction, aquifer characterization, fractured bedrock, NAPL mobility assessment in sediment/soil and fractured media, groundwater remedial design and modeling, and innovative investigation and remedial technologies. Recent work has included a focus on PFAS fate and transport, including groundwater-surface water interaction zones and modeling of precursor transformation to regulated PFAAs in heterogeneous aquifers. Mr. Gefell has prepared or contributed to more than 150 remedial investigation/feasibility study (RI/FS) project reports and more than 75 remedial designs. He has given and overseen deponent testimony in legal cases and provided rebuttals on expert testimony. He has also served as the Technology Spotlight Editor and is an Associate Editor of *Groundwater* journal.

Mr. Gefell specializes in solving hydrogeologic and fate and transport problems in highly complex settings, and he has extensive experience in characterizing and remediating fractured bedrock. For the ITRC Fractured Bedrock Team, he was an active team member, prepared a flagship case study and he served as a web-based trainer.

Mr. Gefell has helped design 18 full-scale passive NAPL barriers for 12 clients in 13 states across the United States. Sites included utilities (such as manufactured gas plant [MGP] sites), wood treaters, oil and gas, rail, and others. NAPLs included DNAPL and/or LNAPL. Barriers included combinations of capillary barriers, impermeable barriers, and NAPL-wicking media. Hydraulic settings included sites adjacent to pristine trout-fishing rivers, bays, wetlands, creeks, along beaches with up to 10-foot tides, and in harbors and active shipping channels. None of these remedies included pumping or treating groundwater, minimizing long-term operation and maintenance costs. All have met the remedial objectives and design criteria.

As Innovation Director at his prior employer, Mr. Gefell managed 22 innovation projects involving four clients and 65 staff, producing four

Education

MS, Geology, University of California-Davis, 1989

BA, Geological Sciences, Cornell University, 1986

Licenses/Certifications

Professional Geologist (PG), Georgia, New York, North Carolina, and Pennsylvania

Professional Associations

Association of Ground Water Scientists and Engineers

National Ground Water Association (NGWA)

American Society for Testing and Materials (ASTM) – Member of Working Groups for NAPL Mobility in Sediments and Ebullition

Interstate Technology and Regulatory Council (LNAPL and Fractured Rock Teams – Web Trainer for Fractured Rock Team)

American Institute of Professional Geologists

Professional Awards

Technology Award from NGWA (2013)

Distinguished Service Award from ASTM - E3248 (2020)

Litigation Support

Provided deponent testimony and rebuttal of opposing expert testimony for cases involving solvents and polychlorinated biphenyls (PCBs) in soil and groundwater

Work History

Anchor QEA, LLC, Principal Scientist, 2015 to Present

ARCADIS U.S., Inc., Principal Geologist, Director of Site

patent applications and nine implemented or readily implementable solutions. He also oversaw 33 projects funded by the research and development budget of a major oil and gas client, including research, client staff training, and best practice development.

Investigations Discipline, Innovation Director, 2006 to 2015

Blasland, Bouck & Lee, Inc., Geologist to Principal Geologist, 1989 to 2005

Project Experience

Remediation – Selected Examples of Completed Remedies

Passive In-Situ Treatment System for PFAS and VOCs in Groundwater

Confidential Client
Connecticut

Mr. Gefell led the hydraulic and fate-and-transport aspects of the design for a passive, in situ treatment system for per- and polyfluoroalkyl substances (PFAS) and volatile organic compounds (VOCs) in groundwater at a former solvent recycling facility, which is a U.S. Environmental Protection Agency (USEPA) Region 1 Superfund Site. The system replaced a groundwater pump-and-treat system that operated from 1995 to 2018 and consisted of 10 extraction wells and a steel sheet-pile wall. The retrofit system includes engineered permeable trenches inside and outside the sheetpile wall and valved perforations through the wall. Treatment is provided by liquid activated carbon (PlumeStop) and zero-valent iron (ZVI), which were injected into the trench system. Groundwater flows through the system via ambient gradients, with no pumping and minimal operation and maintenance (O&M) and meets the target treatment levels. Hydraulic design entailed detailed groundwater flow modeling, injection-volume calculations and sequencing, specifications for trench backfill materials, comparison of treatment media particle sizes to aquifer pore sizes, and design of the performance monitoring program.

DNAPL Zone Delineation and Modeling of Dewatering System for Saturated Soil Remediation

Confidential Client
New Hampshire

Mr. Gefell led a detailed evaluation of soil and bedrock PCB analytical data to delineate the 3D zone containing DNAPL at a former paint works and storage facility. He used 3D numerical groundwater flow (MODFLOW) modeling to estimate the required dewatering rate for the soil excavation remedy, including excavation to top of bedrock inside sheet-piled cells to remove affected soils, with up to 15 feet of highly permeable, saturated sand and gravel. Mr. Gefell designed bedrock model layers based on fracture statistics and field hydraulic test results. Actual dewatering rates during implementation of the full-scale remedy confirmed that the modeled dewatering rates were reasonable but slightly conservative.

Remedial Design Modeling for Coal Tar in Sediment and Soil

Mr. Gefell supervised the hydraulic aspects of a successful remedial design for coal tar-impacted sediment and soil at a former MGP site on the west bank of the Hudson River. He used MODFLOW to simulate the groundwater flow rate and hydraulic gradients prior to remediation and predicted, post-remedy

Project Experience

Confidential Client *New York*	conditions. The model replicated tidal fluctuations in the river and adjacent hydrogeologic zones beneath the site. He developed a shoreline remedy including sheet-piling and a passive DNAPL collection trench covered with organoclay reactive core mat to address relatively shallow DNAPL in fill. Mr. Gefell performed DNAPL mobility calculations to confirm that DNAPL would effectively separate from groundwater within the trench, even with tidal "pumping." He showed that deeper DNAPL within thin sand seams separated by silt layers would not impact sediments but could be effectively addressed using a line of deep DNAPL monitoring/removal wells.
Pre-Design Investigation, Remedial Design, and Installation of Passive NAPL Barrier *Confidential Client* *Massachusetts*	Mr. Gefell served as technical advisor at a former coal tar processing facility. He oversaw pre-design investigations to delineate potentially mobile coal tar LNAPL and DNAPL and characterize groundwater hydraulics adjacent to a harbor with 10-foot+ tidal cycle. Mr. Gefell used MODFLOW to simulate tidal influence on hydraulic gradients and measured NAPL and soil characteristics to calculate NAPL mobility. He provided hydrogeologic support in the design of a passive NAPL migration barrier, including an impermeable barrier wall and NAPL collection trenches at either end, LNAPL baffles, DNAPL sumps, and organoclay. The remedy successfully mitigated surface water sheens.
DNAPL Mobility Evaluation for Sediment Reactive Cap *Confidential Client* *Vermont*	Mr. Gefell used detailed, transient vertical hydraulic gradient data measured at multiple depths below a canal bed, and calculated coal tar DNAPL mobility beneath the canal, to support the remedial design of a sediment remedy for a USEPA Region 1 Superfund site. He evaluated the potential rate of DNAPL migration upward through sediment by various mechanisms, including two-phase flow and ebullition based on field observations from diver surveys. The completed, successful remedy included sorptive mats with organoclay to contain the calculated DNAPL mass flux for decades.

Project Experience

Multi-Well Hydraulic Containment System *Confidential Client* *Georgia*	Mr. Gefell oversaw the design, operation, and monitoring of a hydraulic containment system for PCBs, chlorinated VOCs, and metals at a former industrial facility in residuum and folded, fractured limestone. He delineated the 3D groundwater capture zone—approximately 250 acres and more than 200-feet-deep—based on measured hydraulic heads, water-balance calculations, and groundwater monitoring results. He oversaw hydraulic monitoring and capture-zone verification and reporting for the combined system—approximately 15 extraction wells and one basement tunnel dewatering system—for approximately 18 years. He also negotiated groundwater monitoring reductions that reduced the monitoring cost by approximately half by abandoning redundant, low-yield wells or converting them to water level monitoring only, and reducing the sampling frequency and analyzed parameter list. These changes were supported with concentration trend statistics.
DNAPL Mobility Assessment in Upland and Sediments in Support of Sediment Remedy *Confidential Client* *West Virginia*	Mr. Gefell quantitatively assessed coal tar DNAPL mobility in uplands and sediments of a coal tar processing facility on the Ohio River based on DNAPL physical properties, permeability, entry pressure of geologic media and sediments, and hydraulic gradients. Sediment assessment included DNAPL saturation measurements before and after laboratory centrifugation. Ebullition-driven mass flux was assessed by sheen frequency measurement and sheen-net samples. The outcome of this work was the construction of a successful NAPL barrier cap consisting of organoclay with an armor layer, with minimal dredging as required to maintain original riverbed elevation.
Modeling and Remedial Design for Passive LNAPL and DNAPL Containment *Confidential Client* *New York*	Mr. Gefell directed MODFLOW modeling focused on NAPL containment at an MGP site where LNAPL and DNAPL coal tar were previously identified migrating toward and beneath the lock- and dam-controlled Mohawk River. The MODFLOW model was calibrated to steady-state and transient hydraulic heads, including seasonal 10-foot river-level changes. Simulations predicted hydraulic gradient changes associated with remedial alternatives including barrier walls and capping. Mr. Gefell quantitatively evaluated LNAPL and DNAPL mobility associated with hydraulic gradients predicted by MODFLOW, soil physical properties, and measured physical properties of NAPL samples collected at the site. The results of these evaluations were used to design the successfully completed remedy.

Project Experience

Remedial Design Modeling for Coal Tar in Sediment and Soil

Confidential Client
New York

Mr. Gefell supervised the hydraulic aspects of a remedial design for coal tar-impacted sediment and soil at a former MGP site on the east bank of the Hudson River. He used MODFLOW to estimate the groundwater flow rate into a dry-dredge area with a final sediment excavation depth approximately 20 feet below the initial water level inside a sheet-pile cofferdam within the river. Model results predicted strong upward vertical hydraulic gradients during the deepest portions of the excavation process. He simulated options to mitigate the adverse upward gradients, leading to an innovative design with passive vertical pressure relief "wells." Dewatering rates closely matched model predictions, and passive relief wells operated as designed. Coal tar that could not be removed safely due to depth below the river level was contained in-place within a passive NAPL barrier consisting of flowable fill and sheet-piling, which was later cut off at the mudline.

DNAPL Cutoff Trench with MNA for Dissolved Phase Plume

Confidential Client
Illinois

Mr. Gefell designed a DNAPL interceptor trench for a major wood-treating site. The remedy included relocating a creosote-impacted creek channel, installing passive DNAPL barrier trenches beneath a former creek channel to separate creosote from groundwater via gravity, and planting phreatophytes to remove groundwater from the former stream channel location. Mr. Gefell used MODFLOW to simulate pre- and post-remedy groundwater hydraulics associated with a passive DNAPL barrier trench, phytoremediation, and creek re-routing. He used analytical DNAPL mobility calculations to design a barrier trench and solute-transport calculations to predict the fate of the dissolved plume. The remedy was implemented using a one-pass trencher to install two passive NAPL barrier trenches, each 500 feet long and 35 feet deep, with a perforated bottom pipe and sump. More than 17,000 gallons of creosote were collected from the fractured clay formation in the first 9 years of operation with no pumping or treatment of groundwater, which is undergoing monitored natural attenuation (MNA).

Project Experience

Remedial Design and Remedial Action *Confidential Client* *Newark, New Jersey*	Mr. Gefell managed hydrogeologic aspects of remedial design/remedial action at a former solvent recycling NAPL site adjacent to the Newark Bay. He demonstrated via MODFLOW modeling that a perimeter barrier wall would reduce groundwater flow through the site by approximately 90% and direct discharge to the river from the shallow fill layer by 94%, even without groundwater extraction. The successful, completed remedy consists of sealed pavement and a fully encompassing HDPE wall installed in a slurry trench with no groundwater or NAPL pumping or treatment. Groundwater levels inside the barrier wall stabilized below grade. Observed steady-state water levels and gradients verify the accuracy of the MODFLOW model used for remedial design.
DNAPL Zone Soil Remediation at Superfund Site *Confidential Client* *Upstate New York*	Mr. Gefell provided hydrogeologic expertise in the design and implementation of a saturated soil excavation remedy adjacent to the Oswego River at a USEPA Region 2 Superfund Site. He oversaw field investigations to delineate the 3D DNAPL zone in detail. Mr. Gefell performed USGS-MOC modeling to delineate the soil removal area required to achieve groundwater restoration. He monitored dewatering and soil excavation within a frozen earth cofferdam (FreezeWall). Soil containing DNAPL was excavated more than 10 feet below river level in sand and gravel, treated on site by low-temperature thermal desorption, and backfilled. Groundwater achieved maximum contaminant levels (MCLs) without groundwater extraction/treatment within one year following thawing of FreezeWall, confirming his remedial design modeling.
Dual-Phase, High-Vacuum Extraction Dewatering System Design Modeling *Confidential Client* *Georgia*	Mr. Gefell oversaw modeling as part of remedial design for landfill containing DNAPL (solvents, polycyclic aromatic hydrocarbons [PAHs], and PCBs). He used MODFLOW and accounted for potentiometric and pneumatic stress of approximately 50 high-vacuum extraction wells. The system successfully dewatered the landfill for effective soil vapor extraction remediation, met the performance standards, and was decommissioned.

Project Experience

Coal Tar DNAPL Mobility Evaluation and Sub-River Containment System *Confidential Client* *Massachusetts*	Mr. Gefell directed MODFLOW modeling and coal tar DNAPL mobility calculations to evaluate DNAPL migration toward the base of a sheet-pile-contained sediment excavation in the Housatonic River. Subsequent sediment removal found coal tar within the shallow sediment. A passive DNAPL collection system was designed and constructed within the backfill beneath the remediated riverbed for long-term DNAPL monitoring and removal.
Design and Field-Verification of Groundwater Containment System *Confidential Client* *Puerto Rico*	Mr. Gefell designed and field-verified a groundwater containment system for a USEPA Region 2 Superfund Site to hydraulically control a trichloroethene (TCE) source area related to a regional groundwater plume. He used WinTran modeling to locate two extraction wells that operate at combined rate of more than 100 gallons per minute (gpm). Measured water levels demonstrate effective hydraulic control of the source area. He used these data, natural attenuation data, and information regarding regional saltwater intrusion to shut down a downgradient extraction well operating at 580 gpm.
Remedial Design to Mitigate PCB Oil Seeps *Confidential Client* *Tennessee*	Mr. Gefell contributed hydrogeologic and NAPL mobility calculations to support design of a full-scale remedy to mitigate PCB oil seeping from fractured, semi-karstified limestone into a river. Remedial design included installation of a groundwater collection system beneath a multi-layer liner to separate the river from the groundwater system and oil seeps, pumping the system to remove dissolved phase PCBs, and permeable, sorptive, wicking materials below the liner to prevent oil droplet/sheen discharge to the river, even during flood conditions.
Groundwater and Sheen Investigation at Pipeline Release Site *Confidential Client* *Arkansas*	Mr. Gefell developed work plans and oversaw groundwater monitoring network installation, sampling within affected floodplain areas, and sheen sampling on surface water as part of an initial response to a crude-oil pipeline release in a residential area and riparian and lacustrine setting in the eastern United States. He also assisted in developing the remedial response, which successfully abated the sheens on surface water.
Sheen Mitigation Barrier *Confidential Client* *Montana*	Mr. Gefell provided groundwater hydraulics and NAPL mobility expertise to the design of a successful sheen barrier at an oil refinery site along a major river valued for trout fishing. Oil and sheens had been periodically observed emanating from gaps in a dilapidated sheet-pile wall next to the river. Mr. Gefell used MODFLOW modeling to design a replacement wall to stabilize the existing wall and allow groundwater discharge, while trapping oil and sheens. The completed remedy included sheet-piling with

Project Experience

	engineered perforations for groundwater pressure relief, organoclay mat for sheen wicking and oil monitoring/removal wells.
Bedrock Structural and Hydrogeologic Assessment in Support of In-Situ Bioremediation Remedy *Confidential Client* *West Virginia*	Mr. Gefell directed field investigations and quantitative bedrock assessment, and developed a hydrogeologic conceptual site model (CSM) for fractured rock at an active electronics manufacturing facility on a cliff above the Monongahela River. The source area contained 1,2-DCA DNAPL in overburden. Mr. Gefell characterized bedrock lithology, hydraulic gradients, hydraulic apertures, matrix parameters, and lineament trends. Mr. Gefell developed a comprehensive CSM that linked the source area to an impacted groundwater seep high on the side of a tributary ravine. The CSM provided the basis for a successful in situ bioremediation remedy using emulsified vegetable oil in the overburden source area, which remediated the affected seep.
In-Situ Chemical Oxidation Remedy for Former DNAPL Zone in Fractured Sedimentary Bedrock *Confidential Client* *New Jersey*	Mr. Gefell oversaw the planning, testing, design, and implementation of a successful chemical oxidant remedy in fractured siltstone and shale at a former electronics site. He oversaw laboratory oxidant-demand tests and performed WinTran and CRAFLUSH modeling to design a field pilot test to measure potassium permanganate ($KMnO_4$) consumption and TCE oxidation. Sodium bromide (NaBr) was used as a conservative field tracer and provided a benchmark to calculate permanganate consumption between injection and extraction wells. Mr. Gefell used the pilot test results to design an extended application involving low-cost, intermittent oxidant injection events. One permanganate injection every 2 years in the source zone has dramatically reduced concentrations there and in downgradient groundwater at residential properties, eliminating the need for off-site remediation.
Remedial Design for a Regional Plume of TCE in Groundwater *Confidential Client* *Central Michigan*	Mr. Gefell supervised remedial design for a regional plume of TCE in groundwater in a complex glacial kame/outwash downgradient of a former electronics manufacturing site. He oversaw multi-well pumping tests, soil borings, grain-size analysis, double-ring infiltrometer measurements, and 3D MODFLOW groundwater flow modeling, and designed a multi-well groundwater extraction, treatment, and reinfiltration system with a pumping rate of 250 gpm.
Remedial Design Modeling for Overburden and Bedrock Hydraulic Containment *Confidential Client*	Mr. Gefell supervised the design, installation, hydraulic testing, and operation of a 750-foot-long sheetpile wall, 12 overburden groundwater extraction wells, and 23 piezometers as part of a non-time-critical removal action for an overburden DNAPL and

Project Experience

Central Connecticut	LNAPL zone at a USEPA Region 1 Superfund Site. Primary constituents of interest included VOCs and 1,4-dioxane. He subsequently designed, installed, tested, and/or started four groundwater containment wells to contain the bedrock DNAPL zone. He performed aquifer testing and designed and calibrated the regional MODFLOW model using kriged and contoured hydraulic conductivity data from more than 100 monitoring wells. He developed and implemented a private well monitoring plan and wetlands mitigation plan, and prepared demonstration of compliance reports documenting effective hydraulic containment.
Remedial Design *Confidential Client* *Kentucky*	Mr. Gefell developed a successful remedial design for a site where creosote NAPL was migrating above and below grade to an adjacent stream. The first component of the remedy included shallow French drains to intercept surficial creosote seeps and divert flow through an engineered treatment basin. The second component of remedy was a passive barrier trench to intercept subsurface DNAPL migration. The treatment basin and barrier trench were backfilled and/or lined with a porous, permeable, sorptive, wicking medium to remove DNAPL droplets and sheens from flowing groundwater. Phytoremediation was also included along the barrier trench to assist in removing groundwater and enhance sorption capacity adjacent to the creek. No sheens have been observed downgradient of the passive barrier trench or the locations of the former creosote seeps. Groundwater is undergoing MNA with no pumping or treatment.
Groundwater Extraction Trenches *Confidential Client* *Upstate New York*	Mr. Gefell designed, simulated, and field-verified 1,600-foot-long and 250-foot-long groundwater recovery trenches in fill, glacio-lacustrine, and till units and at a Regional Conservation and Recovery Act (RCRA) facility. He evaluated hydraulic performance during full-scale operation and confirmed the predicted groundwater extraction rates and hydraulic effectiveness.

Selected Pilot Studies and Remedial Alternative Evaluations

Groundwater Flow Modeling and Coal Tar DNAPL Mobility *Confidential Client* *Upstate New York*	Mr. Gefell calculated hydraulic gradients and groundwater extraction rates required to mobilize and recover free-phase coal tar at a former MGP site adjacent to a harbor of the Mohawk River. He designed a recovery well and a recovery trench and oversaw the hydrogeologic aspects of a DNAPL extraction pilot test and evaluated the demonstration results, which indicated effective DNAPL extraction via the recovery trench but limited potential for site-wide remediation via DNAPL extraction.

Project Experience

Chemical Oxidation Field Pilot Test in Fractured Crystalline Rock *Confidential Client* *Maine*	Mr. Gefell designed and implemented an in situ chemical oxidation pilot study for a fractured bedrock site (phyllite). He used WinTran to simulate groundwater hydraulics and CRAFLUSH to simulate the influence of matrix diffusion. He managed the removal of soils containing PCBs and facilitated a field pilot test of in situ chemical oxidation. He managed the subsequent pilot field test in which potassium permanganate was released into the top of steep bedrock fractures using trenches hoe-rammed into the bedrock surface. Oxidant delivery, migration, and consumption rates were found to be consistent with pilot test design calculations and assumptions. Mr. Gefell performed detailed mass balance to calculate oxidant half-life and efficiency in destroying PCE.
Groundwater Modeling for Acid Tar Excavations Adjacent to Fjord *Confidential Client* *Norway*	Mr. Gefell oversaw construction, calibration, and predictive dewatering simulations using 3D MODFLOW for proposed excavations of acid-tar containing soils within 15 meters of an adjacent fjord in Norway. Transient dewatering simulations accounted for a "rolling" excavation sequence with simultaneous backfilling of excavated soils. Mr. Gefell conducted a sensitivity analysis to account for the potential range of backfill permeability, overburden permeability, and recharge, as well as the hypothetical presence of a bedrock fracture zone connecting the excavation to the adjacent sea.
Groundwater Modeling for Corrective Measures Study *Confidential Client* *Florida*	Mr. Gefell directed MODFLOW/MT3D modeling of groundwater flow and solute transport at a former manufacturing facility. Four separate 2D models were used to simulate groundwater flow and transport of tetrachloroethylene (PCE), TCE, 1,1-dichloroethene (DCE), and/or 1,4-dioxane plumes covering up to approximately 200 acres in four thin aquifers between the water table and a total depth of approximately 160 feet below grade. Plumes and site-specific transport parameters were imported for predictive MT3D simulations. Simulated remedial options included MNA, extraction and injection wells, trenches, and passive vertical drains below trenches. The actual pumping rates confirmed that the predicted pumping rates were reasonable but slightly conservative.

Project Experience

Remedial Alternatives Assessment to Mitigate Cement Kiln Dust Leachate *Confidential Client* *Southeast Michigan*	Mr. Gefell supervised regional MODFLOW modeling and remedial design to mitigate cement kiln dust leachate with elevated pH entering a creek at an operating limestone quarry and cement plant. He calibrated the model to head values and observed groundwater discharge rate from a thin sand horizon into the adjacent creek. He used the model to simulate remedial options, including pumping systems and/or barrier walls to cut off impacted groundwater discharge to a creek. He identified an effective, non-pumping barrier wall alternative to protect a creek by deflecting groundwater downward into an unsaturated, underlying limestone formation.
Groundwater Flow Modeling *Confidential Client* *Detroit, Michigan*	Mr. Gefell used MODFLOW to support an interim response activity for mercury in groundwater at a site on the Detroit River. He computed the volume of groundwater that could be stored in the subsurface onsite. He used MODFLOW to estimate pumping rates in perimeter collection trenches inside a full-perimeter slurry wall and sheet-pile wall, with a double-layer synthetic surface cap, and infiltration galleries to re-infiltrate groundwater extracted from the trenches. Mr. Gefell concluded that groundwater recirculation would enable the site owner to maintain an inward hydraulic gradient at the perimeter of the site for decades with no off-site water disposal or discharge, and minimal groundwater treatment prior to infiltration.
Simulation of Hydraulic Displacement (Waterflood) System for LNAPL and DNAPL *Confidential Client* *Connecticut*	Mr. Gefell used analytic element modeling at a USEPA Region 1 Superfund Site as part of an FS. He optimized well spacing to uniformly achieve gradients required to displace NAPL pools based on site-specific measurements of NAPL and soil properties.
Remedial Design for Passive NAPL Barrier *Confidential Client* *New York*	To support the FS for a former MGP site, Mr. Gefell performed a laboratory flow-through column test to evaluate the effectiveness of sand, granular activated carbon, organoclay, and coke breeze at sequestering neutrally buoyant coal tar NAPL from flow water. He ran columns for 25 days in re-circulation mode completing more than 20,000 water pore volume exchanges. He dissected the post-test columns and visually inspected solids for presence of NAPL using direct observation, ultraviolet light, and sheen production on immersion in clean water. He concluded that only organoclay hindered NAPL movement and sheen production.
Supplemental Remedial Investigation	Mr. Gefell investigated coal tar distribution at a site adjacent to a dam. He characterized groundwater and DNAPL distribution and

Project Experience

Confidential Client *Upstate New York*	flow in the overburden and underlying fractured bedrock. He measured hydraulic interactions between these units and the adjacent river during a transient river lowering upstream of the dam performed for dam maintenance. He assisted in evaluating hydraulic aspects of remedial alternatives, including various combinations of limited soil/sediment excavation, sheet-piling, bedrock grout curtain, passive DNAPL collection, and groundwater extraction.
Modeling of Groundwater Flow and Dissolved VOC Plume *Confidential Client* *North Adams, Massachusetts*	Mr. Gefell directed MODFLOW/MT3D modeling of groundwater flow and a dissolved volatile organic compounds (VOCs) plume in a glaciated alluvial valley. He used the models to simulate groundwater flow under existing conditions, historical VOC plume migration, implications with respect to water supply wells, and potential remedial alternatives.
Assessment of In Situ Remedial Technologies *Confidential Client* *Connecticut*	Mr. Gefell performed a detailed assessment to treat Cr+6 in groundwater in fractured granitic gneiss. To create pH and redox conditions favorable to reducing Cr+6 to Cr+3, he compared alternatives, including hydrogen release compound (HRC), zero-valent iron (Fe0, or ZVI), molasses, calcium polysulfide (Cascade), bimetallic nanoscale particles, and an electrochemical fence. He selected molasses for in situ treatment of Cr+6 source zone.

Additional Fractured Bedrock Experience

Bedrock Fracture System Characterization at Coal Ash Basin Sites *Confidential Client* *Southeastern U.S.*	Mr. Gefell oversaw bedrock characterization in support of corrective action plans for several coal ash basin sites in the Piedmont and Blue Ridge provinces. Fracture system characterization included: structural analysis of bedrock fracture orientation statistics; calculation of vertical transmissivity profiles based on heat-pulse flowmeter data; calculation and depiction of bedrock hydraulic aperture and spacing versus depth; calculation and depiction of representative primary and secondary fracture sets on cross sections based on apparent dip and vertical exaggeration; and characterization of the influence of the bedrock fracture network on depths and directions of groundwater flow in bedrock. He also provided peer review during the development of Corrective Action Plans and the installation, testing, and adaptive management for pilot and full-scale groundwater remediation systems in saprolite, transition zone, and crystalline bedrock.

Project Experience

VOC Plume Delineation in Deep, Fractured Bedrock Based on Modeling

Confidential Client
Southington, Connecticut

Mr. Gefell used a combination of site-specific bedrock fracture data, 3D visualization, groundwater flow modeling, and solute-transport modeling to delineate a plume of VOCs associated with a multi-component DNAPL zone deep in fractured bedrock at a USEPA Region 1 Superfund Site. DNAPL was encountered in bedrock fractures 200 feet below an adjacent river. Down-dip projection along those fractures, combined with site topography and property access constraints, indicated that drilling locations further down dip would require drilling 400 to 500 feet to empirically delineate the DNAPL and the associated dissolved phase plume. In lieu of expensive drilling, site data were used to show that fractures close with depth. 3D MODFLOW modeling was used to depict groundwater flow directions, and solute-transport (CRAFLUSH) modeling indicated that the plume length is negligible below a depth of 300 feet. Modeling results for shallower flow paths were used to select two feasible monitoring locations where shallower wells were installed to complete the plume delineation.

Peer Review of Fractured Bedrock Site Characterization at Oil-Shale Research Site

Confidential Client
Colorado

Mr. Gefell provided peer review of a hydrogeologic site characterization prepared by another consultant at an oil-shale research facility in western Colorado. The review included detailed assessment of hydrogeologic documents and data collected from mine tunnels regarding bedrock fracture orientations, apertures, and spacings; field observation of bedrock and fractures in mine tunnels; review of proposed tracer-test design; and calculations of fate and transport of light oil, which was expected to be produced from the kerogen-rich "Mahogany Zone" bedrock using the client's proprietary, high-temperature, in situ extraction method.

Bedrock Vertical Profiling with Tracer Dye

Confidential Client
Connecticut

During a fractured bedrock investigation at a USEPA Region 1 Superfund Site, Mr. Gefell added fluorescein dye to drilling water to assist in determining when bedrock intervals had been purged enough to allow collection of representative groundwater samples. He conducted extraction packer tests and compared purge water to a 95% groundwater standard, prepared by diluting one part of drilling water (with approximately 20 parts per million [ppm] fluorescein) with 19 parts clean potable water. At the few intervals that did not reach the dye-clarity standard, he submitted purge water and drilling water for fluorescein analysis to quantify the fraction of drilling water remaining in the sample.

Project Experience

Lab Study of LNAPL Mobility in Vertical Bedrock Fractures
Internal Research and Development

Mr. Gefell performed laboratory tests of LNAPL mobility using matched slabs of natural sandstone (Lyons Formation, Lyons, Colorado) and readily available LNAPLs. He performed two studies with two different LNAPLs. In each case, he placed bedrock slabs together along original fracture surfaces, oriented vertically and placed into water baths to approximately 75% fracture submergence. In the first study, he used vegetable-based LNAPL (solid at room temperature), heated rock slabs and water to above the melting point of the LNAPL, melted LNAPL, and injected it into the top of the fracture. He allowed LNAPL to come to equilibrium, then allowed the entire system to cool to room temperature. In the second study, he maintained the system at room temperature and injected colored LNAPL with sufficient aromatic content to dry and solidify. In both cases, he opened fractures and photographed the distribution of LNAPL along the experimental water-table position.

Structural Hydrogeologic Evaluation at Stray-Gas Site
Confidential Client
Pennsylvania

Mr. Gefell conducted a detailed review of structural hydrogeologic data, following reports of elevated methane concentrations and turbid water at private water wells in the region of active drilling and hydraulic fracturing for gas production in the Marcellus Shale region. The focus was to assess the potential pathway(s) of stray gas from two production wells, which were found to have incomplete annular grout seals thousands of feet below grade. Mr. Gefell contributed structural geologic and hydrogeologic expertise to a summary report regarding potential relationships, or lack thereof, between production wells and areas with elevated methane readings.

Bedrock Fracture Statistical Analysis for Fate and Transport Assessment
Confidential Client
New Hampshire

Mr. Gefell analyzed bedrock fracture data measured by the U.S. Geological Survey (USGS) at a riverbank outcrop to assess liquid elemental mercury and dissolved phase fate and transport at a former chlor-alkali facility. He used stereonet charts for 3,485 fracture data to calculate fracture set populations, accounting for sampling bias associated with the 3D geometry of the outcrop. He illustrated a representative10-foot cube of bedrock with average fracture orientations, spacing, and length. He evaluated the fate and transport of mercury in the fracture system based on liquid density, fracture orientations, and hydraulic gradients. He calculated fracture hydraulic apertures and fracture porosity and applied these data to calculate groundwater velocities in fractures, which closely matched prior tracer test results.

Project Experience

Bedrock Groundwater Investigations in Fractured Limestone *Confidential Client* *Georgia*	Mr. Gefell oversaw investigations at a former transformer manufacturing facility. Investigation techniques included soil borings; bedrock coring; heat-pulse flowmeter, gamma, conductivity/ resistivity, temperature, and caliper measurements; reverse-flow packet testing for vertical groundwater quality profiling and hydraulic conductivity measurements; bedrock outcrop mapping and fracture orientation measurements in streambeds and quarry; photo-lineament analysis; multi-well pumping tests; downhole NAPL FLUTe ribbon; and bedrock core analysis for porosity, bulk density, permeability, and organic carbon content.
Field Investigations of a Coal Tar DNAPL Zone *Confidential Client* *Massachusetts*	Mr. Gefell provided senior technical guidance in alluvial overburden and fractured crystalline bedrock at a former MGP site adjacent to a river. Field investigation methods included bedrock coring; down-hole acoustic televiewer logging; heat-pulse flow meter with and without pumping; bedrock matrix physical analysis for bulk density, porosity, organic carbon content, permeability, and oxidant demand; packer testing/groundwater sampling; and pump testing/packer testing of a nearby private water-supply well. He calculated DNAPL driving forces in bedrock fractures to compare conceptual models of DNAPL migration to a distant down-valley location where coal tar was encountered in bedrock.
LNAPL Mobility Evaluation *Confidential Client* *New York*	Mr. Gefell calculated displacement pressures and hydraulic gradients required to mobilize transformer oil with PCBs in fractured dolomite bedrock. He used bedrock core samples and packer tests to estimate bedrock fracture spacing and aperture. He performed an LNAPL removal demonstration using existing wells.
Investigation of Hydraulic Head Conditions *Confidential Client* *Michigan*	Mr. Gefell supervised the detailed investigation of conditions between a dewatered limestone quarry site and an adjacent river using continuous multi-chamber tubing wells.

Additional Modeling Projects

Modeling of Groundwater Discharge to Tidal Urban Waterway *Confidential Client* *New York*	Mr. Gefell oversaw groundwater modeling to estimate the distribution and magnitude of groundwater discharge to a 3.8-mile long, tidal urban waterway at a Superfund Site in New York. Groundwater discharge was evaluated using electromagnetic seepage meter data recorded over multiple tidal cycles by the USGS, and seepage rate estimates were calculated based on data from paired long-term monitoring piezometers installed in the sediment below the waterway. The latter calculations included

Project Experience

	water density corrections and calculation of Serfes' average head levels. The hydraulic effects of low-permeability bulkheads were also considered, in addition to regional groundwater elevation data published by the USGS. Results were used to calculate uplands transmissivity, which was compared to published data, confirming that the results were reasonable. The study also included regional water-balance assessment, including the effects of recharge from precipitation, artificial recharge from leaking waterlines, groundwater drainage by submerged sewers, subway dewatering, and groundwater remediation systems.
Modeling PFAS Fate and Transport in Groundwater, With and Without Precursor Transformation *Independent Anchor QEA R&D Project* *2021*	Mr. Gefell supervised the design and application of a MODFLOW/MT3D model to simulate precursor and PFOA fate and transport in a heterogeneous alluvial aquifer. The goal of the project is to assess how the presence of unregulated precursors may affect the outcome of groundwater remedial actions targeting regulated PFAS. The model incorporates transformation of a precursor to the regulated terminal end-product (PFOA). Source zone conditions during plume development included a constant flux of precursor or PFOA, as bounding conditions. After simulating plume development for 25 years, remediation scenarios were simulated for 50 additional years, including: source removal/stabilization with capping; pump-and-treat; and permeable reactive barrier with granulated activated carbon (GAC). This is the first modeling study we are aware of that included explicit simulation of precursor transformation to a mobile, regulated, daughter PFAS, and PFAS fate and transport in a heterogeneous aquifer. With future improvements in precursor characterization, similar modeling approaches will become increasingly important for successful remedial design and decision-making at PFAS sites.
TCE Plume Transport from Deep DNAPL Zone in Fractured Bedrock *Fairview, North Carolina*	Mr. Gefell served as a technical expert supporting Anchor QEA's project team in characterizing and evaluating hydrogeology and remedial options for a plume of chlorinated solvent VOCs in regolith and bedrock associated with a DNAPL source. He assisted the investigation of the bedrock hydraulics and fracture network characteristics, and the VOC plume depth in fractured bedrock downgradient of the source area. He also assisted with the design and use of a regional, 3-dimensional numerical groundwater flow (MODFLOW) model to evaluate the transport and potential discharge locations for VOC-affected groundwater for a range of remedial options, accounting for the hydraulic influences of private water supply wells and surface-water features.

Project Experience

Modeling of Semi-Karstified Limestone for Quarry Expansion Plan *Confidential Client* *Northwest Michigan*	Mr. Gefell supervised regional MODFLOW modeling of an operating quarry and cement plant. The quarry is adjacent to Lake Michigan, and the current condition bottom is approximately 100 feet below lake level. Mr. Gefell calibrated the model to match measured head values and permitted dewatering flow rate of 11.5 million gallons per day. He used the model to predict the potential effects of several quarry expansion options, including total pumping rate, effects on groundwater levels in the surrounding area, and fraction of groundwater discharge due to mapped karst-related features, hydraulic gradients beneath the quarry floor, the potential maximum transient pumping rate (due to storm events) considering historical peak pumping rates and precipitation events, and potential future impact on water supply wells in the surrounding region. The client used the results to evaluate economics, impacts, and potential risks of quarry expansion.
Modeling of Seasonal Groundwater Flow *Confidential Client* *San Jose, California*	Mr. Gefell supervised MODFLOW modeling of seasonal groundwater flow in alluvial valley. He optimized the model calibration using Model-Independent Parameter Estimation and Uncertainty Analysis (PEST) to estimate recharge rates, including infiltration from an ephemeral streambed. Mr. Gefell submitted soil samples from the site for comparative analysis of total soil perchlorate concentrations and perchlorate leaching via Synthetic Precipitation Leaching Procedure. He used MODFLOW model results and laboratory analytical results to calculate perchlorate soil screening levels protective of groundwater.
Groundwater ACL Modeling and Solute Transport Assessment *Confidential Client* *San Diego, California*	Mr. Gefell oversaw MODFLOW/MT3D, BIOCHLOR, and SOLUTE modeling of plume migration at a Department of Defense facility near San Diego Bay. Modeling was performed to develop Alternate Concentration Limits (ACLs) for metals and VOCs in groundwater.
TCE DNAPL Delineation, Groundwater Modeling, and Solute Transport Assessment *Confidential Client* *San Diego, California*	Mr. Gefell oversaw an investigation at an active manufacturing facility adjacent to San Diego Bay using hydrophobic dye, DNAPL monitoring/collection wells, and continuous multi-chamber-tubing wells. He also supervised multi-layer MODFLOW modeling of groundwater discharge to the bay from a DNAPL zone within an active manufacturing facility. He calculated travel times for metals and VOCs and end-point VOC concentrations. Results were used to design a porewater sampling program to empirically quantify discharge concentrations of groundwater to the bay.

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Groundwater Flow and Transport Modeling *Confidential Client* *New York*	Mr. Gefell developed a regional MODFLOW model to simulate site-wide groundwater flow and assist in solute transport evaluation for VOCs at a major manufacturing facility adjacent to the Mohawk River with complex, discontinuous glacial deposits. He used MODFLOW to calculate groundwater flow directions and velocities, and to identify groundwater discharge areas associated with the site, including the effect of two large concrete culverts below the water table. Based on the MODFLOW prediction of the groundwater flow field, he used BIOCHLOR to simulate transport and degradation of dissolved DCE and vinyl chloride via reductive dechlorination under existing conditions and potential future conditions, assuming source reduction. The flow and transport models were both calibrated to current conditions using the PEST parameter optimization code.
Fractured Bedrock Solute-Transport Simulation *Confidential Client* *West Virginia*	Mr. Gefell used CRAFLUSH to simulate dissolved benzene transport through fractured shaley limestone bedrock from a waste disposal area toward a downgradient private water supply well. The simulation included sensitivity analyses for fracture spacing, fracture aperture, groundwater velocity, fracture dispersivity, matrix porosity, matrix fraction of organic carbon, matrix tortuosity, degradation half-life, and transport duration. Modeling results showed that natural attenuation of the dissolved benzene plume should prevent its migration to potential offsite receptors.
Model to Evaluate Groundwater Hydraulics and Remedial Alternatives *Confidential Client* *Upstate New York*	Mr. Gefell supervised the design, development, calibration, sensitivity analysis, and use of a regional MODFLOW model to evaluate groundwater hydraulics and remedial alternatives adjacent to Onondaga Lake. The model included seven overburden layers of variable thickness and extent and two bedrock layers. Mr. Gefell performed sensitivity analysis and evaluated numerous physical and hydraulic remedial alternatives to contain groundwater impacted by VOCs, PAHs, and inorganics.
Modeling to Simulate Groundwater Flow and Potential Remedial Alternatives *Confidential Client* *New York*	Mr. Gefell oversaw MODFLOW modeling for an MGP site where LNAPL and DNAPL coal tar were identified to be migrating toward and discharging into an adjacent creek. MODFLOW model was used to estimate the current groundwater discharge rate into the creek and groundwater discharge associated with various remedial alternatives including barrier walls and creek re-routing.

Project Experience

Groundwater Modeling for Landfill Remedy *Confidential Client* *Long Island, New York*	Mr. Gefell supervised the design, calibration, sensitivity analysis, and verification of a regional-scale MODFLOW model to simulate groundwater flow in complex glacially derived deposits and Cretaceous marine deposits as part of a remedial design for impacted groundwater associated with a municipal landfill. He used the model to evaluate municipal pumping well capture zones and design a groundwater remedy including three groundwater extraction wells, engineered recharge basins, and spray irrigation at a golf course.
Model to Simulate Groundwater Flow *Confidential Client* *Southington, Connecticut*	Mr. Gefell supervised the design and calibration of a regional-scale MODFLOW model in glacially derived overburden units comprising flow till, basal till, kame, and outwash, and the underlying fractured New Haven Arkose bedrock at a USEPA Region 1 Superfund Site. He calibrated the model to account for field-scale, horizontal, and vertical anisotropy in the overburden and bedrock to match the observed plume morphology and to match measured stream flow data. He used the model to simulate various overburden and bedrock groundwater containment remedies, including pumping wells, blasted bedrock trenches, phytoremediation, constructed wetlands, thermal remediation, and MNA, with or without pumping at nearby municipal supply wells.
Model to Simulate 3D Capture Zone *Confidential Client* *New York*	Mr. Gefell used the MODFLOW numerical groundwater flow model to simulate the 3D capture zone of a recovery well screened at the base of a thick, heterogeneous overburden aquifer beneath an electronics manufacturing facility. He used analytical groundwater flow and solute-transport models and calculations to evaluate the time required to remediate a TCE DNAPL zone to MCLs at this New York Superfund Site, including DNAPL solubilization, advective flushing of permeable zones, and diffusion from low-permeability strata.

Project Experience

Additional Site Characterization Examples

Remedial Investigation/ Feasibility Study for a USEPA Region 1 Superfund Site

Confidential Client
Central Connecticut

Mr. Gefell supervised an RI and contributed to the FS for a USEPA Region 1 Superfund Site with the focus of attaining a technical impracticability (TI) waiver for the groundwater Applicable or Relevant and Appropriate (ARAR) waivers. He worked with Dr. Bernard H. Kueper to delineate the DNAPL zone and regulatory VOC plumes, characterize DNAPL mobility in the soil and fractured arkose bedrock, and calculate subsurface VOC mass. He used bedrock core samples, the Borehole Image Processing System, and packer tests to estimate bedrock fracture spacing, orientation, and aperture. He used these data to estimate VOC retardation in bedrock due to matrix diffusion. To support the FS, Mr. Gefell prepared a stand-alone TI evaluation. He also performed a detailed review of published results from 19 completed pilot and full-scale field demonstrations of in situ thermal treatment technologies at DNAPL sites. Technologies included steam injection, in situ thermal desorption (thermal wells and blankets), and six-phase resistive heating. He used reported cost information to formulate site-specific, scale-up cost estimates. In support of remedial design, he calculated soil cleanup standards for VOCs and oversaw MODFLOW modeling of hydraulic conditions near overburden NAPL zone during potential thermal remediation.

NAPL Mobility Assessment in Tidal Urban Waterway

Confidential Client
New York

Mr. Gefell oversaw NAPL mobility assessment in a complex urban waterway to support remedial decision-making. A total of 103 cores were collected at 33 core stations, with sampling through the soft sediment into the underlying native material. More than 430 core sections were slabbed and photographed under white light and ultraviolet light, and intervals with most notable NAPL presence selected for a multi-tier battery of laboratory NAPL mobility tests. Consistent with ASTM methods, mobility testing included centrifugation and, for select locations and depths, flexible wall permeameter tests. The evaluation concluded that NAPL in sediment and native material is immobile and/or stable and cannot migrate upward via advection.

Characterization of Groundwater Discharge to a Dynamic River

Confidential Client
Ohio

Mr. Gefell led a groundwater/surface-water interaction study along a major regional river using two innovative methods to improve data quality and cost effectiveness in a challenging setting. River levels fluctuate by tens of feet in response to individual storm events and seasonal precipitation/snowmelt. Anchor QEA measured vertical hydraulic conductivity of fresh sediment core samples in the field using an innovative, cost-

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	effective gravity drainage technique that avoids sample shipment, and installed two water-tight piezometers in the riverbed with continuously recording dataloggers. The combined datasets provide the required information to characterize temporal variations in hydraulic gradients groundwater discharge for fate and transport assessment.
LNAPL Mobility Assessment and Cessation of Active LNAPL Recovery *Asheville, North Carolina*	Mr. Gefell served as senior technical advisor and worked with Anchor QEA's project team to evaluate the mobility of light, non-aqueous phase liquid (LNAPL) composed of petroleum hydrocarbons in regolith. Field methods included LNAPL thickness gauging and sampling and analysis for physical fluid properties, hydraulic testing of monitoring wells and groundwater sampling. Those data were evaluated to calculate the LNAPL pore entry pressure, maximum stable LNAPL pool size, and velocity if migrating, using ASTM standards. The evaluation also included calculating the LNAPL hydraulic conductivity and transmissivity. Results indicated the LNAPL is stable and cannot migrate under current conditions, and LNAPL recovery is no longer practicable or beneficial. These findings were corroborated by the decrease in free-product extent based on observations in wells, and the absence of VOCs in downgradient monitoring wells after decades of monitoring. Results were accepted by the NC DEQ, which determined that active LNAPL recovery is no longer required, although traces of LNAPL are still occasionally observed in wells.
Characterization of NAPL Mobility and Groundwater Discharge in an Intertidal Zone *Confidential Client* *Virginia*	Mr. Gefell used laboratory NAPL mobility tests and physical soil and NAPL parameters to quantify NAPL flux by advection and time-lapsed photographs to estimate NAPL flux by ebullition. He developed a weigh-of-evidence method to interpret NAPL mobility based on laboratory mobility test results, which was later included in ASTM guidance. He also developed an innovative approach to measure groundwater seepage at an intertidal zone, where traditional seepage meters could not be used. The method involved installing cylindrical rings into the exposed, subaerial mudline during low tide, pumping out the water inside the cylinder periodically as it accumulated from the underlying sediment, and monitoring field parameters. These data provided an empirical, conservative measurement of groundwater discharge during low-tide (high-flow) conditions. These data were collected adjacent to a piezometer that was installed below mudline, with one transducer in the piezometer and another at the mudline outside the transducer. These devices recorded water levels continuously and provided vertical hydraulic gradient data during seepage data collection and also over multiple tidal cycles before and after. The results were then applied over the entire tidal cycle

Project Experience

	to calculate the net, long-term average discharge rate, including periods of positive and negative flow.
Floodplain Groundwater Investigation at Pipeline Release Site *Confidential Client* *Montana*	Mr. Gefell developed work plans and oversaw groundwater monitoring network installation and sampling within affected floodplain areas of a river as part of an initial response to a crude oil pipeline release in a major, scenic river in the western United States. Included sampling of domestic, irrigation, and cattle watering wells.
Hydrogeologic Analyses and Major Interpretative Sections of Hydrogeologic Reports *Confidential Client* *Upstate New York*	Mr. Gefell supervised soil and groundwater sampling, rock coring, geologic classification, overburden and bedrock groundwater monitoring- and recovery-well installations, overburden and bedrock in situ permeability testing, and aquifer testing at a major active industrial facility under RCRA regulation. He also oversaw a high-resolution seismic-reflection survey to assess the locations, orientations, and offsets along bedrock fault zones suspected to behave as hydraulic conduits. He prepared regional and site-specific hydrogeologic analyses and major interpretative sections of hydrogeologic reports.
Remedial Investigation/ Feasibility Study and Technical Impracticability at a Superfund Site *Confidential Client* *Pennsylvania*	Mr. Gefell served as technical advisor for the development of a technical impracticability evaluation to support the waiver of groundwater cleanup requirements due to the presence of DNAPL deep in fractured rock beneath the site. Based on the RI, FS, and risk assessments completed at the site, the USEPA Region 3 issued a Record of Decision in 1999 that incorporated a "front-end" TI waiver of groundwater remediation in the DNAPL zone and a natural attenuation remedy for dissolved-phase contaminant plumes outside the DNAPL zone.
Analysis of Phytoremediation Groundwater Containment Zone *Confidential Client* *Alameda, California*	Mr. Gefell used 3D analytical groundwater hydraulics solutions to estimate the 3D containment zone that would be achieved by 500 phreatophytic trees. This analysis, which was based on empirical data regarding seasonal water uptake rates by trees, seasonal climatic data, and hydrogeologic data, concluded that the proposed plantation would intercept most or all of a targeted TCE plume.
Investigations at USEPA Region 2 Superfund Site *Confidential Client* *New York*	Mr. Gefell served as project hydrogeologic specialist and field hydrogeologic director for a project to characterize the groundwater hydraulics and contaminant transport properties of an impacted sand and gravel aquifer and overlying a semi-

Project Experience

	confining layer. His responsibilities included oversight of the installation of monitoring wells for DNAPL assessment, soil sampling to delineate the TCE DNAPL zone, groundwater sampling using a Hydropunch device to delineate the dissolved-phase plume, aquifer testing to estimate aquifer hydraulic parameters, supervision of a hot-air/steam stripping pilot study for soils remediation, and design of horizontal extraction wells and a compliance piezometer network.

Additional Experience

DNAPL Mobility and Porewater Characterization in Sediment *Riggs Engineering* *Hamilton, Ontario*	Mr. Gefell characterized NAPL mobility and porewater chemistry to support the design of a sediment reactive cap at Hamilton Harbor. PAH-rich DNAPL mobility assessment entailed selecting sediment core locations and depths, evaluating detailed core photographs under ultraviolet light, selecting specific depths for laboratory mobility testing via centrifuge, and evaluating test results. Test results were assessed using multiple lines of evidence – including DNAPL hydraulic conductivity calculations - that indicated the DNAPL is immobile in sediment. To characterize dissolved phase mass flux, separate bulk sediment samples were centrifuged to drain pore fluids, and those materials were filtered using ceramics to separate NAPL and sheens and produce pure, aqueous porewater samples for analysis of NAPL components dissolved in porewater.
DNAPL Mobility Characterization in Sediment *Honeywell* *Edgewater, New Jersey*	Mr. Gefell quantified coal tar DNAPL mobility to support the Feasibility Study for sediment at the Quanta Superfund Site on the tidally influenced Hudson River. The DNAPL mobility assessment entailed a detailed evaluation of laboratory water-drive test results using multiple lines of evidence, DNAPL hydraulic conductivity calculations, and quantitative calculations of DNAPL velocity and mass flux. The results were also supported by DNAPL flux calculations using DNAPL seep and sheen photographs of the shoreline intertidal area during low tide. Calculated DNAPL loading to a hypothetical DNAPL sequestration cap accounting for fluxes from DNAPL advection, gas ebullition, and potential post-capping sediment consolidation.
Shoreline Area Groundwater and DNAPL Containment *Northwest Natural* *Portland, Oregon*	Mr. Gefell serves a lead hydrogeologist for the Former Gasco Manufactured Gas Plant adjacent to the tidally-influenced Willamette River. He oversees the following essential site management tasks: 1) groundwater modeling of remedial alternatives in support of the Feasibility Study for the upland site and sediment beneath the river; 2) hydraulic gradient verification monitoring of a fully-automated system of 25 groundwater

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	extraction wells; 3) DNAPL recovery monitoring, and DNAPL mobility assessment. DNAPL mobility in the upland adjacent to the river was quantified based on measured DNAPL recovery rates over time at pumped extraction wells and un-pumped monitoring wells, laboratory DNAPL mobility tests in soil samples, and detailed evaluation of boring logs and TarGOST data. DNAPL recovery rates and laboratory test results indicate DNAPL transmissivity values that are below the threshold of practical DNAPL recovery based on ITRC Guidance. DNAPL collects in wells but is essentially immobile at a site scale. The DNAPL mobility assessment in sediment indicated that DNAPL cannot migrate upward toward the river.
Deponent Testimony *Confidential Client* *New Jersey*	Mr. Gefell provided deponent testimony for an insurance settlement regarding subsurface investigations at a former electronics research and manufacturing facility.
Ultra-Low-Flow Groundwater Sampling Procedure for Sites with PCB Monitoring *Several Confidential Clients* *Various Locations*	Mr. Gefell developed a procedure that minimizes turbidity and "false-positive" results regarding PCB mobility. The effectiveness of the procedure was demonstrated at environmentally sensitive areas along rivers at two sites in Michigan and New York. Ultra-low-flow sampling results commonly produce nondetectable PCB concentrations at wells that previously had PCB detections using other sampling methods. Results showed no PCB impacts above regulatory criteria where previous data from traditional and low-flow sampling had suggested PCB mobility at concentrations above criteria. The results were used to avoid unnecessary remediation.
Aqueous Sampling with NAPL Exclusion using Porous Ceramic Samplers *Anchor QEA Innovation – R&D to Field Application at Multiple Sites*	Mr. Gefell led a research team that developed, tested, verified, and published the use of porous ceramics to accurately sample water in direct contact with NAPLs. The study included: wettability tests, which confirmed porous ceramic is hydrophilic; entry pressure tests using air and NAPL; and water sampling by diffusion-based equilibration or pumping. Results confirmed that economical, readily available porous ceramic cups provide a practical option to collect aqueous-phase PAH and VOC samples without fouling by NAPL. Anchor QEA has applied ceramic sampling during field investigations at twelve sites across the US and in Canada. Raw porewater or groundwater samples – which were collected from NAPL-containing sediments or soils using temporary wells, piezometers, pushpoints, drill casings, and by centrifuging whole sediment samples - contained visible NAPL and/or sheens. After

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	ceramic filtration, the water samples lacked any visible NAPL or sheen, and also contained markedly lower turbidity. This development represents an important breakthrough in characterizing risk and developing remedial options, particularly in groundwater/surface-water interaction zones.
Measurement of NAPL Hydraulic Conductivity and NAPL Mobility Assessment *Multiple Confidential Clients* *Oregon, Ohio, Virginia, New York, New Jersey, Ontario, New Hampshire, and Massachusetts*	Mr. Gefell developed and published the use of laboratory NAPL mobility test results (including water-drive and centrifuge methods) to calculate the effective hydraulic conductivity of NAPL, providing a valuable additional line of evidence to assess NAPL mobility and quantify pore-scale NAPL velocity, NAPL flux and recoverability for remedial alternatives assessment and remedial design.
Vertical Hydraulic Conductivity Measurement by Gravity Drainage Anchor QEA Innovation – R&D to Field Application at Multiple Sites	Mr. Gefell led a research team that developed, tested, verified and published the use of gravity drainage to measure vertical hydraulic conductivity, which is a crucial parameter for porewater seepage measurement. Fresh sediment samples up to 5 feet long are kept intact and vertical in their original sampling tube and allowed to drain by gravity through a perforated bottom cap with filter material for a period of an hour to multiple days, depending on sample texture and drainage rate. The test can be performed easily and cost-effectively in the field, avoiding shipment and disturbance, reducing cost and increasing data quality. Anchor QEA has applied vertical drainage tests at five sites across the US. Test results compare favorably to those produced by more expensive ASTM flexible-wall permeameter methods, which can only test sample lengths of 1 foot or less and are prone to compress and alter soft sediments. This development represents an important breakthrough in characterizing vertical permeability, particularly in groundwater/surface-water interaction zones.
Model to Simulate Transport of Various Solutes *Multiple Confidential Clients* *Maine, Connecticut and New Jersey*	Mr. Gefell used CRAFLUSH model to simulate transport of various solutes, including VOCs and permanganate, to evaluate plume mobility and assist the design of in situ chemical oxidation systems in several types of bedrock. CRAFLUSH accounts for advection and dispersion in fractures, diffusion into the matrix, sorption, and decay.
Bedrock Fracture and Solute-Transport Database *Several Confidential Clients*	Mr. Gefell compiled a detailed bedrock fracture and solute-transport database from 15 projects involving 11 types of sedimentary, igneous, and metamorphic bedrock in the United States and Europe. Parameters included matrix permeability; bulk

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	density, porosity, and organic content; fracture spacing, aperture, and permeability; and retardation due to matrix diffusion.
Fractured Bedrock Site Characterization and Assessment of Fate and Transport	Mr. Gefell completed a detailed literature search and review and prepared a Best Practice manual regarding characterization and assessment of fate and transport in fractured bedrock. The document included background information and definitions; fundamental characterization methods such as outcrop mapping, geologic maps, fracture trace analysis, coring, hydraulic conductivity testing at wells, interpreting groundwater flow directions, and groundwater sampling; advanced methods such as packer tests vertical profiling downhole fracture data collection; solute transport, including groundwater velocities, matrix diffusion, and differences between various rock types; transport of NAPLs; and fractured rock remediation.
No-Purge Groundwater Sampling	Mr. Gefell has provided guidance regarding field demonstrations and data presentations to regulators that led to replacing low-flow sampling with no-purge methods at sites in California, Connecticut, Michigan, New Jersey, North Carolina, and Texas. Chemical constituents have included VOCs, 1,4-dioxane, and metals. Switching to no-purge sampling reduced groundwater sampling costs by at least 50%. Mr. Gefell completed a detailed literature search and review, and prepared a Best Practice manual regarding no-purge groundwater sampling. The document included the technical basis for no-purge sampling, cost comparisons, detailed procedures for use, and approach to site-specific demonstration versus pumping methods. The document covered the use of passive diffusion bags, HydraSleeve, Snap Sampler, discrete interval sampler, Pneumo-Bailer, Kabis sampler, Kemmerer well sampler, dialysis sampler, bailer grab sampler, and rigid porous polyethylene sampler.
Physical Aquifer Model	Mr. Gefell designed and constructed a physical sand-tank model to investigate the hydraulics of recovery wells in unconfined aquifers. He performed and documented quantitative groundwater flow experiments that confirmed a hydraulic principle that is critical to LNAPL recovery that is little known among English-speaking hydrogeologists. He published and presented the results of these studies in technical journals and groundwater remediation conferences.
Development, Testing, and Commercialization of Zipliner Direct-Push Sampling Liners	Mr. Gefell worked with ARCADIS' U.S. legal counsel and Technical Knowledge and Innovation leaders to bring to the United States an invention known as "Zipliner" technology, which originated at ARCADIS U.K. in 2010. Zipliner is an internal sampling sleeve that

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works with standard direct-push soil and sediment sampling equipment but does not require any type of cutting tool to open, thus improving safety. Mr. Gefell worked with ARCADIS' legal counsel to complete a non-provisional U.S. Patent Application. He vetted potential plastic extrusion manufacturing companies and established a non-disclosure agreement with Geotech Environmental Equipment, Inc. (Denver, Colorado). He evaluated and tested prototypes for AMS PowerProbe dual tubes in the field. He established licensing and manufacturing agreement with Geotech and worked with Zebra Environmental and Geotech to develop, test and commercialize Zipliner for Geoprobe macrocore tooling. Mr. Gefell was honored with the National Ground Water Association's 2013 Technology Award for this work.

Professional Qualifications

- Analytical Element Modeling of Groundwater Flow
- Applied Modeling of Solute Transport in Groundwater using USGS/MOC
- DNAPLs in Porous and Fractured Media
- Migration and Remediation of Dissolved Organic Contaminants in Groundwater
- MODFLOW for Simulation of Groundwater Flow and Advective Transport
- Subsurface Barrier Technologies

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Saroff, S.T., G.M. Thomas, and M.J. Gefell, 1998. *Hazardous Waste Site Remediation Cost Savings Using Technical Impracticability and Intrinsic Remediation Guidance*. American Power Conference (Chicago); April 14-16, 1998.

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Gefell, M.J, 1997. *A Comparison Between Low-Flow and Traditional Groundwater Purging and Sampling Results for Volatile Organics*. API/NGWA Conference on Petroleum Hydrocarbons & Organic Chemicals in Groundwater (Houston); November 12-14, 1997.

Gefell, M.J, 1993. *Reassessment of Pumping Well Hydraulics in an Unconfined Aquifer: Results from Steady-State Flow Tests in a Physical Aquifer Model*. 29th Annual Conference of the American Water Resources Association (Tucson); August 29-September 2, 1993.

Gefell, M.J., and G.M. Thomas, 1993. *A Reassessment of Recovery Well Hydraulics in Unconfined Aquifers, with Implications for Groundwater Remediation Programs in Upstate New York*. Conference on Groundwater Remedial Investigations and Groundwater Remedial Engineering, sponsored by the University of Rochester Civil Engineering Department, the Buffalo Association of Professional Geologists, and the Rochester Chapter of the American Society of Civil Engineers (Rochester, New York); April 13, 1993.

Gefell, M.J., G.M. Thomas, and S.J. Rossello, 1992. *Maximum Potential Water-Table Drawdown at a Single Pumping Well in an Unconfined Aquifer - Implications for Pump-and-Treat Programs*. National Groundwater Association Conference on Aquifer Restoration: Pump-and-Treat and the Alternatives (Las Vegas); September 30-October 2, 1992.

Gefell, M.J., E.M. Moores, and R.J. Twiss, 1989. *Ductile and Brittle Shear Sense for the Melones Fault Zone, Northern Sierra Nevada, California*. GSA Conference (Spokane); April 1989.

Awards and Honors

- 2013 National Ground Water Association Technology Award
- 2020 ASTM Distinguished Service Award (from NAPL Mobility in Sediments Working Group)

RX 13

Julie Fox, PWS

Managing Scientist/Biologist

Julie Fox is a Professional Wetland Scientist (PWS) certified by the Society of Wetland Scientists with formal training in wetland delineation, soil assessments, and plant identification. Ms. Fox has 18 years of experience as a wetland scientist and natural resource biologist specializing in delineation of wetlands and non-wetland waters, environmental and biological surveying and sampling, and associated analysis, reporting, and permitting.

Ms. Fox manages and supports a variety of planning and permitting projects requiring compliance with Sections 401 and 404 of the Clean Water Act; National Environmental Policy Act (NEPA); State Environmental Policy Act (SEPA); Endangered Species Act (ESA), and other state and local requirements and regulations. Her expertise includes compensatory wetland and vegetated corridor mitigation planning and monitoring, impact assessments, and functions and values assessments using the Habitat Equivalency Assessment (HEA) Method, Hydrogeomorphic (HGM) Approach, Oregon Rapid Wetland Assessment Protocol (ORWAP), Oregon Stream Function Assessment Method (SFAM), Washington State Department of Ecology Rating System, and Florida State Uniform Mitigation Assessment Method (UMAM).

Ms. Fox serves as a subject matter expert and provides strategic guidance, technical expertise, and regulatory compliance support for environmental planning, ensuring projects meet federal, state, and local requirements, including sites subject to compliance under Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

Additional environmental services provided by Ms. Fox include wildlife and habitat assessments, avian surveys, marine mammal monitoring, water quality monitoring, and sediment sampling. Ms. Fox is also experienced in statistical analysis and modeling for the evaluation of data for assessing risk to human and ecological receptors.

Ms. Fox is skilled in GPS field data collection and using the ArcGIS suite for spatial analysis and mapping. Ms. Fox is experienced in managing and preparing reports; coordinating with local, state, and federal regulatory agencies; and preparing local, state, and federal permit applications including Joint Section 404/Removal-Fill Permit Applications.

Julie Fox
Managing Scientist/Biologist

Education

BS, Biology, University of Oregon, 2004

Certifications and Training

Professional Wetland Scientist
#3694, 7/28/2023

Wetland Delineation Certification, Wetland Training Institute, Inc.

Field Indicators of Hydric Soils Advanced Certification, Wetland Training Institute, Inc.

Wetland Plants of the Pacific Northwest Certification, Portland State University Environmental Professional Certificate Program

40-hour HAZWOPER Training

Memberships

Society of Wetland Scientists

Project Experience

Chehalis River Basin Flood Damage Reduction Project *Office of Financial Management* *Pe Ell, Washington*	Ms. Fox assisted in the development of a NEPA Environmental Impact Statement (EIS) with the U.S. Army Corps of Engineers (USACE) for the proposed development of a flood retention facility and airport levee improvements in Lewis County, Washington. She conducted technical analyses to evaluate potential impacts to terrestrial habitats and wetlands and waters of the United States. She also served as a field lead for wetland and ordinary high water mark delineations within the 1,400-acre study area in the Chehalis River Basin to document existing sensitive areas to support the project.
Lower Columbia River Channel Maintenance Project *USACE and Sponsor Ports* *Oregon, Washington*	Ms. Fox served as the natural resources lead assisting in the development of a joint Dredge Material Management Plan and Environmental Impact Statement (DMMP-EIS) under NEPA. She led and coordinated natural resources work group meetings with the USACE and Ports of Longview, Woodland, Kalama, Vancouver, and Portland (Sponsor Ports) in strategic decision-making, addressing public comments on the draft DMMP-EIS, and led the revisions to the natural resource sections of the document.
NEPA Documentation for Oregon TriMet *Federal Transit Administration/TriMet* *Portland, Oregon*	Ms. Fox served as a subject matter expert on biological resources and ESA on behalf of the Federal Transit Administration as a 139(j) contractor and conducted sufficiency reviews for transportation projects seeking federal funding for numerous TriMet projects including the 82nd Avenue MAX Station Modernization, Columbia Bus Base, Merlo Garage Electric Bus Charging Infrastructure, Powell Garage Electric Bus Charging Infrastructure, Oregon City Transit Center, Beaverton Transit Center, North Downtown Bus Layover, and Powell Modifications.
Environmental Permitting Project *CalPortland* *DuPont, Washington*	Ms. Fox managed the environmental permitting to support quarry expansion for the South Parcel Project in DuPont, Washington. She led multiple field efforts to support permitting and planning of ongoing operations and maintenance at the DuPont Aggregate Facility, including wetland delineations, wetland and stream mitigation monitoring, bat surveys, and tree inventory surveys including forest and tree health assessments. She authored and managed reports and coordinated with technical teams and state agencies.
Goldendale Energy Storage Project Environmental Impact Statement	Ms. Fox served as the natural resources lead assisting in the development of the EIS for a large-scale utility project. She authored the biological resources sections of the EIS, including

Washington Department of Ecology *Klickitat County, Washington*	the assessment of impacts to wetlands and waters, ESA-listed species and habitats, state-listed species, and priority species and habitats.
Bear Creek Culvert and Molalla Avenue Shoulder Widening Project *Clackamas County* *Clackamas County, Oregon*	Ms. Fox managed the environmental permitting for the Bear Creek Culvert and Molalla Avenue Shoulder Widening Project. She served as a lead certified wetland delineator for wetlands and non-wetland waters. She developed the wetland delineation report and Joint Section 404/Removal-Fill Permit Application. She managed the development of wetland and stream functional assessments, an hazardous materials corridor study, and an archaeological resource study. She also managed and coordinated ESA SLOPES V and Oregon Department of Fish and Wildlife fish passage compliance requirements.
Watters Quarry Expansion Project *Knife River Corporation Northwest* *Columbia County, Oregon*	Ms. Fox managed the permitting and natural resource assessments, including agency coordination and regulation and code review for a proposed aggregate quarry expansion project. She prepared a Joint Section 404/Removal-Fill Permit Application and Compensatory Mitigation Plan. She prepared ORWAP and SFAM functions and values assessments for onsite wetlands and non-wetland waters. She conducted habitat mapping and rare and ESA-listed plant surveys to support the USFWS Biological Assessment. Ms. Fox also performed a delineation of wetlands and non-wetland waters and prepared a wetland delineation report to support permitting.
Epping Quarry Expansion Project *Knife River Corporation Northwest* *Marion County, Oregon*	Ms. Fox served as a lead certified wetland delineator for wetlands and non-wetland waters for a proposed aggregate quarry expansion project. She prepared a USFWS Biological Assessment and wetland delineation report to support permitting the quarry expansion.
Sundial Facility Mitigation Monitoring Project *Knife River Corporation Northwest* *Multnomah County, Oregon*	Ms. Fox managed the annual compensatory mitigation monitoring of a shoreline mitigation site for impacts related to the authorized maintenance dredging of river sediment for improvement of navigation access to the Knife River dock in compliance with permits issued by the USACE under Section 404 of the Clean Water Act, as well as by the Oregon Department of State Lands (DSL) under the Oregon Removal-Fill Law. She led the vegetation survey and as-built conditions and authored the annual report.
Rehabilitation of Parkwide Water and Wastewater Systems Project *National Park Service*	Ms. Fox served as a lead certified wetland delineator for wetlands and non-wetland waters on the Everglades National Park Rehabilitation of Parkwide Water and Wastewater Systems project. The project involved replacing the potable water

Everglades National Park	distribution and wastewater collection systems in the Flamingo District, the Pine Island District, the Shark Valley District, and the Loop Road District including the Tamiami Ranger Station, Loop Road Environmental Education Center, and the Trail Center housing area. She assessed wetland functions and values using the Uniform Mitigation Assessment Method. She authored the wetland delineation report and wetland and floodplain statement of findings report and managed the development of the biological assessment report. She coordinated with regulatory agencies to ensure compliance and effective project outcomes.
Terminal 4 Site Project *Port of Portland* *Portland, Oregon*	Ms. Fox performed annual interim monitoring of the head of Slip 3 cap and Wheeler Bay shoreline stabilization following completion of the Terminal 4 Phase 1 Removal Action work and prepared monitoring reports for submittal to the U.S. Environmental Protection Agency. She was the field lead for a habitat survey field effort along the entire Terminal 4 shoreline as part of the CWA Section 404(b)(1) Analysis for the final remedial design and to ensure protection of ESA-listed fish species. She used the Habitat Equivalency Analysis (HEA) approach to determine potential mitigation required for the implementation of the remedial design.
Hillsboro Airport Runway Safety Area Project *Port of Portland* *Portland, Oregon*	Ms. Fox performed delineations of wetlands and non-wetland waters to support future airfield safety improvement and wildlife hazard reduction projects in the Runway Safety Area and surrounding areas at the Hillsboro Airport. She prepared wetland delineation reports and coordinated with agencies.
Gasco Sediments Site Project *Northwest Natural* *Portland, Oregon*	Ms. Fox served as a lead certified wetland delineator for wetlands and non-wetland waters for the Gasco site. She was the field lead for a habitat survey field effort along the entire Gasco shoreline as part of the CWA Section 404(b)(1) Analysis for the final remedial design and to ensure protection of ESA-listed fish species. She used the Habitat Equivalency Analysis (HEA) approach to determine potential mitigation required for the implementation of the remedial design.
Pipeline Projects *Northwest Natural* *Various Counties, Oregon*	Ms. Fox served as a certified wetland delineator of wetlands and non-wetland waters for pipeline repair projects in various counties across Oregon, including preparation of reports to support project work.

Wapato Lake National Wildlife Refuge Bridge Replacement Projects *U.S. Fish & Wildlife Service* *Portland, Oregon*	Ms. Fox served as a certified wetland delineator of wetlands and non-wetland waters to support two separate proposed bridge replacement and wetland restoration projects located in and adjacent to the Wapato Lake National Wildlife Refuge. Her project responsibilities included leading delineation field efforts, conducting wetland functions and values assessments, and preparing a wetland delineation report and Section 404 Joint Permit Applications.
Residential Development Projects *West Hills Land Development* *Washington, Multnomah, and Clackamas Counties, Oregon*	Ms. Fox performed determinations and delineations of wetlands and non-wetland waters for numerous prospective residential development projects in Washington, Multnomah, and Clackamas counties. She conducted Clean Water Services' natural resource assessments, wetland functions and values assessments using the HGM Approach, and significant natural resource inventories; developed reports, permit applications, and mitigation and restoration plans for submittal to and in coordination with regulatory agencies to obtain individual Joint Section 404/Removal-Fill Permits.
Amberglen South Property Residential Development Project *The Wolff Company Washington* *Hillsboro, Oregon*	Ms. Fox served as a certified wetland delineator of wetlands for a prospective residential development project in Hillsboro, Oregon. Her project responsibilities included conducting a Clean Water Services' natural resource assessment and wetland functions and values assessments and reporting, including preparation of a Section 404 Joint Permit Application for submittal to regulatory agencies.
Commercial Development Projects *Panattoni Development Company, LLC* *Tacoma, Washington*	Ms. Fox served as a lead certified wetland delineator of wetlands and non-wetland waters for numerous prospective commercial development projects at multiple sites in Oregon and Washington. Her project responsibilities included leading delineation field efforts, assessing wetland functions and values using the most current version of Ecology's wetland rating forms, preparing wetland delineation reports, mitigation planning, and agency coordination.
Berth Maintenance Dredging Project *Port of Longview | Longview, Washington*	Ms. Fox conducted biological and water quality monitoring activities in the Columbia River and prepared data results for agency submittal during maintenance dredging and deepening operations in the Port's berths to ensure dredging operations were in compliance with state and federal permit conditions and to ensure protection of ecological receptors.
Avian Predation Program Monitoring *U.S. Army Corps of Engineers*	Ms. Fox served as field support to construct and maintain avian predation program monitoring infrastructure on East Sand Island, including construction of observation blinds, walk-in

Portland, Oregon	tunnels, and fencing. She conducted passive integrated transponder tag recovery from the cormorant colony area on East Sand Island, including identifying and mapping double-crested cormorant and Brandt's cormorant nests by structural characteristics to support ground verification surveys.
Seattle Seawall Projects *City of Seattle* *Seattle, Washington*	Ms. Fox performed marine mammal monitoring for the City of Seattle Seawall and Pier 62 Replacement Project and Waterfront Park Emergency Pier Demolition Project during in-water construction activities. Ms. Fox monitored the marine environment for all marine mammal species, including the Humpback whale (*Megaptera novaeangliae*) and the resident Killer whale (*Orcinus orca*).
Interstate 405 (I-405) Road Widening Project *Washington DOT* *Seattle*, Washington	Ms. Fox served as a certified wetland delineator of wetlands and non-wetland waters for the I-405 road widening project. Her project responsibilities included assessing wetland functions and values using the most current version of Ecology's wetland rating forms and providing GIS support for wetland rating figures.
Woodson Property Project *K&L Gates, LLP* *Westport, Oregon*	Ms. Fox evaluated an approximately 1000-acre site for its potential as a mitigation bank along the Columbia River in Westport, Oregon. She investigated the site for wetland and upland features that may qualify for enhancement, creation, or restoration according to Oregon Department of State Lands policy to inform the viability of mitigation banking development on the site
Communications Facility Project *Verizon Wireless* *Yelm, Washington*	Ms. Fox performed land-based waterfowl and migratory bird surveys to monitor waterfowl and migratory bird species movement patterns in relation to wetlands and the use of habitat corridors in the vicinity of the proposed Verizon Wireless Lake Lawrence – New Build Communications Facility Project.
Skykomish River *Confidential Client* *Monroe, Washington*	Ms. Fox served as a lead certified wetland delineator of wetlands and non-wetland waters to support compliance with the CWA, and authored and managed the associated reporting and permitting, including extensive agency coordination.
Thea-Foss Waterway NPDES Permit Compliance Project *City of Tacoma* *Tacoma Washington*	Ms. Fox assisted the City of Tacoma with its annual stormwater monitoring program and compliance with municipal separated storm sewer system National Pollutant Discharge Elimination System (NPDES) permitting requirements. She helped the City characterize stormwater runoff from various land uses, and the effectiveness of stormwater management programs and best management practices. She provided technical assistance in the

City's statistical analysis of its stormwater database to identify time and spatial trends in stormwater quality. Ms. Fox contributed to the preparation of annual NPDES Stormwater Monitoring Reports and Comprehensive Environmental Response, Compensation, and Liability Act Source Control Reports.