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Engineering & Natural Resources, Inc.
Engineers, Scientists, and Natural Resource Planners

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50 California St. #500
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Subject: Landfill permit by rule proposal, Docket ID No. EPA–HQ–OLEM–2019–0361

Dear Flora;

This letter describes our technical evaluation of the U.S. EPA permitting proposal for coal combustion residual (CCR) disposal landfills.

Summary of Opinion

The proposed "permit by rule" scheme for certain new and expanded CCR landfills, set forth in proposed rule § 257.128, will not adequately support the existing regulatory requirements at 40 CFR part 257 subpart D. We disagree with the contention in the proposed rule that design, operation, and monitoring requirements for landfills which would meet the permit by rule criteria is straightforward enough to be exempt from permit review. We provide information showing landfill design and construction deficiencies are the leading controllable factors causing landfill failures which pollute groundwater and the environment. The design and construction process benefits and environmental risks are significantly lessened by adequate EPA oversight and site-specific permitting review.

Background

U.S. EPA is proposing to implement rules under the Resource Conservation and Recovery Act (RCRA) for permitting of CCR disposal facilities. The proposed rule is published at 85 Fed. Reg. 9940 and is open for public comment. We were tasked with providing technical review and opinion of EPA's proposed permitting of certain new and expanded landfills using a "permit by rule" scheme, set forth in proposed rule § 257.128. The permit by rule would allow owners of new or expanded CCR landfills that meet certain criteria to permit the facility simply by complying with the relevant landfill design and operation criteria at 40 CFR part 257 subpart D. Permit by rule is in effect an exemption from a site-specific permitting and proposed engineering review performed by EPA. Permit by rule is also an exemption from public review in that the public is not offered an opportunity to provide further information or to comment on the proposal for the landfill. Permit by rule is proposed to apply to design, construction, and operation of the landfill. Our task was to evaluate potential issues that could arise from the absence of agency and public oversight for this proposed permit by rule.

To complete our review, we looked at relevant scientific literature, case studies, and performance audits of landfills and landfill groundwater monitoring system. The landfill performance literature includes studies of the leakage rates of properly designed and operated RCRA subtitle D landfills, reviews of the impacts of design, construction, and operation & maintenance (O&M) deficiencies on landfill leakage, as well as case studies of landfill failures and lessons learned. Much of the information available on landfill performance is from the municipal solid waste (MSW) and hazardous waste (subtitle C) sphere, owing to the fact that CCR has only recently been federally regulated and past CCR disposal practices rarely met subtitle D landfill design specifications; although there are a few older CCR landfills that were the subject of our referenced performance design studies. These published MSW and hazardous waste studies are relevant to CCR landfill permitting because the design, construction, and O&M of CCR facilities share much in common with these other RCRA regulated landfills and many of the lessons learned during the three decades of operation of other RCRA landfills apply equally to CCR landfills.

Our review is also informed by our own professional experience evaluating and remedying pollution at CCR facilities, including our knowledge of site-specific conditions which have led to pollution of groundwaters at CCR facilities. Our experience has also shown that involving the public in CCR facility regulatory decisions benefits that process because members of the public often have additional site specific knowledge and their input and review improves both management and pollution prevention at CCR disposal facilities.

Problem description

Design and construction deficiencies are the leading controllable factors causing landfill failures which pollute groundwater and the environment. The problem of landfill leakage and failures is well described in scientific and landfill industry literature and is summarized in the sections below. Even the best landfills leak and leakage rates from properly designed and operated landfills have been measured to be greater than anticipated during design (EPA 2017). When landfill design, construction and operation are deficient, leakage and pollution from landfills are more severe.

Groundwater monitoring systems at landfills must also be carefully designed so that they are capable of sampling contamination which may be leaking and migrating from landfills. If the monitoring system is deficient, it may not be recognized that there is a failure at the landfill.

Optimal engineering design and construction plans for landfills, and monitoring systems require consideration of site-specific conditions. In addition to this, a robust quality assurance program is needed to ensure design and performance standards are met. The following sections provide further detail on the most common causes of landfill and monitoring system failures and provide recommendations on how the proposed CCR permitting program can best address these issues.

Design, construction, and operational deficiencies

Bonaparte et al. (2002) provide one of the only wide-ranging reviews available of landfill failure type and cause at U.S. landfills. Their analysis of the principal causes of landfill failures determined that the principal human factors contributing to landfill failure were design (48%) and construction (38%) related deficiencies; operational deficiencies accounted for 14% of failures. It is our opinion that failure rates of new permit by rule CCR landfills would exceed those reported by Bonaparte (et al. 2002) because of no agency oversight or public review. The RCRA permitting system should focus on methods to address landfill design and construction deficiencies and thereby reduce the incidence of landfills not meeting performance criteria and negatively impacting the environment.

Landfill Design

The proposed rule implies that landfills which meet the permit by rule criteria (§ 257.128) are somehow easier to design, construct, and operate than other CCR facilities which do require a site-specific individual permit.

The proposed rule states (85 Fed. Reg. 9955):

> *"Because the requirements in subpart D applicable to the CCR units meeting the proposed criteria in § 257.128(a) are fairly straightforward, EPA does not believe issuance of an individual CCR permit*

> *would add significant value as far as clarifying applicable requirements, Agency review of an application, or public comment."*

Clearly, future CCR landfills will be located in exceptionally different physiographic, climatic, hydrogeologic, geotechnical, and water supply/quality settings. Assessing each planned landfill site is required for applying standard engineering design principles and this is not straightforward. Each proposed landfill requires a unique design and a cookie-cutter approach is problematic, prone to errors, and agency and public review is merited. Our opinion is that the requirements in subpart D which are applicable to CCR units for which a general or individual permit is proposed are no less straightforward than the criteria which need to be met for landfills which meet the permit by rule criteria. Designing, constructing, and operating a CCR landfill is no less complex, prone to error, and requires no less exacting standards than performing those for a surface impoundment. In either case, the design process benefits and environmental risks are significantly lessened by adequate oversight and site-specific permitting review. EPA has not provided sufficient evidence to the contrary.

There are many examples of how permitting oversight would benefit the design process. A permit writer would have in-depth knowledge, credentials, and access to information on how specific landfill design and components have performed in similar settings. The permit writer would have the ability to apply lessons learned at other regional facilities to advise design and engineering of the landfill to ensure that the performance criteria in the Federal CCR Rule are met. Third-party contractors hired by EPA to review landfill and construction plans as part of a permit program would also have the credentials and experience to improve facility design, construction, and operation.

The permit writer would help to ensure that landfill design includes the correct liners, engineering standards, adequate quality control and assurance, and number of monitoring wells, but also meets the performance standards of the Federal CCR Rule. This point is critical, meeting the environmental protection standards at § 257.50-257.104 requires more than selecting the correct landfill components to meet regulatory criteria. Those components must also be constructed, operated, and maintained to meet the performance criteria in the regulations. Landfill contractors may incorrectly install components either by error or purposely to save money. For example considering regulation § 257.70 (b), without adequate permit oversight and quality assurance you may get "the lower component consisting of at least a two-foot layer of compacted soil" but not "with a hydraulic conductivity of no more than 1×10^{-7} centimeters per second (cm/sec)." The agency and public oversight that comes with an individual site-specific permit would greatly increase the likelihood that performance criteria are met.

EPA's own landfill performance review (Bonaparte et al. 2002) is clear with respect to the need for adequate oversight and quality assurance review: "Procedures exist to avoid the types of issues and problems identified in this report. Unfortunately, as most clearly demonstrated by Appendix F of this report, landfill industry personnel do not always utilize adequate design, testing, construction, and operation/maintenance practices." And that report was written in part by people who consult for the coal power industry.

Quality Assurance

In the absence of individual permit review, the quality assurance required by Federal CCR Rule is extremely limited, relying only on the certification of a professional engineer to attest that the regulatory criteria are met. For example, with regards to landfill construction § 257.70 (f) requires:

> *"certification from a qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority that the design of the composite liner (or, if applicable, alternative composite liner) and the leachate collection and removal system have been constructed in accordance with the requirements of this section."*

The concept that a qualified professional engineer certification is sufficient for designing and constructing significant facilities that last in perpetuity, such as CCR landfills, is simply inadequate. The engineering world encourages critical third party review of significant facility designs in an effort to improve facilities and protect public health and the environment. EPA's permitting system should provide for unbiased review by a qualified professional engineer.

Existing provisions § 257.70 (e) and (f) allow the landfill owner/operator to construct and operate a new or expanded CCR landfill without certification of a professional engineer if approval is instead provided by the participating state director or EPA. In these cases, EPA or the approved state permitting program *must* ensure their permit review includes approval by a qualified professional engineer. If EPA is intending with the permit by rule proposal that a landfill could receive "approval" – in lieu of certification by a qualified professional engineer – without *any* review by any professional engineer, that will not provide adequate protection that landfills are designed and constructed adequately for site specific conditions.

Review of the quality assurance plan by a qualified professional engineer is critically important because the likelihood of design and construction defects increases as oversight lessens. Numerous authors and case studies have reported on the need for a robust quality assurance program during landfill design and construction (NRC 2007, Bonaparte et al. 2002, Montoro et al. 2015). Landfill liner components rely on proper installation to minimize defects and to ensure that composite liners provide effective backup leakage control for failures in the primary geomembrane and independent quality control staff are recommended to oversee installations (Meegoda et al. 2016).

A primary reason the quality assurance is so important is that most landfill components such as composite liners and leachate collection systems are buried after waste is placed in the landfill. It is therefore impossible to monitor for component defects until performance problems appear elsewhere, such as in groundwater monitoring (NRC 2007).

Examples of design and construction deficiencies which can be addressed by robust design and construction quality assurance programs are abundant:

1. Construction quality assurance is needed to ensure geomembranes are not damaged during installation (NRC 2007). Geomembrane damage is commonly caused by punctures and tears due to construction equipment and activities, exposure of the liner to solar heating, and defective seam welding. Adherence to a site specific quality assurance plan will limit the potential for performance deficiencies resulting from installation damage.

2. Bonaparte et al. (2002) show how temperature-induced wrinkles in a plastic geomembrane, which can occur from solar heat during installation and early stages of landfill operation, will remain and lessen liner leachate retention ability as well as shorten liner service life.

3. Thiel and Richardson (2005) demonstrate how geosynthetic clay liners (GCLs), commonly used for composite liners and cover systems, can shrink and fail as observed in actual field setting, from a small number of wet-dry cycles.

4. GCL liners can separate due to moisture and temperature extremes before they are covered with waste (NRC 2007).

5. Shrink/swell-caused desiccation cracking occurs in both GCLs and compact clay liners (CCLs) when they are left exposed during construction or operation, leading to increased hydraulic conductivities that do not meet regulatory performance criteria. This is common in applications where there is not sufficient overburden pressure, such as where the bottom liner is exposed for a long period of time. It

is also common in the conditions typical of a top liner throughout its service life, because top liners are exposed to higher temperatures from solar heating of the landfill cap (NRC 2007).

6. To avoid construction-caused holes in GCLs, more care (greater construction quality assurance) must be taken during liner construction and placement of the waste that when a compact clay liner is used (NRC 2007).
7. Leachate collection systems are prone to clogging by inorganic precipitates (Fleming et al. 1999; Maliva et al. 2000). Geotextiles and drain piping are prone to clogging (Rowe et al., 2004; Bonaparte et al. 2002). Appropriate leachate collection and drainage system design should consider the specific physical and chemical properties of the coal ash.

Site specific permitting would allow permitting agency to assure that construction uses a state-of-the-practice construction quality assurance (CQA) program to ensure that § 257.70 criteria are met in the constructed landfill. The benefits of a robust site-specific quality assurance plan are well described in the literature:

1. Forget et al. (2005) show leak densities to be significantly lower for systems installed with state-of-the-practice CQA programs compared to those installed without one.
2. Bonaparte et al. (2002) detail that landfills that used conventional CQA programs for geomembrane liners had substantially lower leakage rates.
3. Bonaparte et al. (2002) determined that cover system design and liner construction are the most common causes of failure, both of which can be better addressed by improved design review and CQA methods.
4. State-of-the-practice design and CQA programs for geomembrane puncture resistance are described in part in the Puncture protection of geomembranes series published by Wilson-Fahmy et al. (1996); Narejo et al. (1996); Koerner et al. (1996).
5. Stormwater runoff and ponding caused by design deficiencies contribute to runon problems and increased leachate generation at landfills. Runon/runoff controls need to be tailored to the specific soils and climate of a site to prevent liner and cover system displacement. Landfill designs need adequate surface water runon controls and operation plans should be site specifically tailored to limit the active area of the landfill to keep leachate volume within system capacity (Bonaparte et al. 2002).

Groundwater Monitoring System Design

CCR landfills designed to Federal CCR Rule specifications rely on the groundwater monitoring system to detect leakage and monitor for landfill failures. Most landfill components such as composite liners and leachate collection systems are buried after waste is placed in the landfill. It is therefore impossible to monitor for component defects until contamination is detected, typically during groundwater monitoring (NRC 2007). Monitoring systems must be adequately designed to be able to perform this job. Adequate oversight and quality assurance are needed to ensure groundwater monitoring systems are designed and constructed correctly.

It is essential that groundwater monitoring wells be designed based on site-specific conditions. Groundwater and hydrogeologic conditions are commonly complex and heterogenous, resulting in challenges to designing a monitoring system capable of measuring impacts from a landfill. The groundwater monitoring system criteria at § 257.91 are not ensured without permit oversight because there is a disincentive for CCR landfill owners to install wells at appropriate locations and depths because they are more likely to detect pollution. Our experience is it is also common for facility owners to discontinue monitoring of background wells and rely on intra-well analyses to define background conditions partly in an attempt to limit the amount of groundwater data that is publicly available.

Landfill monitoring systems commonly have severe deficiencies in their ability to capture contaminant plumes. This is partly because leakage from landfills will occur from isolated punctures, tears, and construction failures such as poor welds in the liner. The contaminant plume from such a failure is often not detected by a limited network of conventional monitoring wells. Research shows that groundwater contaminant plumes from landfill leaks are characterized by poor dispersion and narrow plumes, reflecting the need for downgradient monitoring wells to be carefully sited based on site specific hydrogeology (Cherry 1983; MacFarlane et al. 1983). The spacing of monitoring wells in both the vertical and horizontal directions (depth and aerial spacing) is commonly too large to detect the main impacts of the type of landfill leakages or spills most likely to cause groundwater contamination (Cherry 1990).

§ 257.91 requires a monitoring system to both "accurately represent the quality of groundwater passing the waste boundary of the CCR unit" and "all potential contaminant pathways must be monitored." The way to ensure this is by site specific permit review of hydrogeologic conditions and monitoring well location and construction. Without agency oversight, dishonest players in the industry are afforded the ability of purposely designing monitoring systems that appear to, but do not, meet requirements under 257.91.

Site-Specific Review

Site-specific factors affect all CCR disposal facilities. The proposed rule provides for site-specific review of a CCR facility covered by an individual permit (85 Fed. Reg. 9959):

> *"At a minimum, this would include information about the locations of any floodplains, wetlands, endangered species, fault lines or unstable areas, measured and modeled groundwater elevations, subsurface lithology including any confining units, surface water features, soil and subsoil characteristics, groundwater well locations and uses and adjacent land uses."*
>
> *"<u>These features have the potential to impact every aspect of the CCR unit and the effectiveness of the compliance approaches</u> to be incorporated in the CCR permit. These include impacts to the effectiveness of the liner, stability of the unit, operation of the unit and its control structures, the effectiveness of proposed monitoring approaches and well locations, determination of background concentration of regulated contaminants, the appropriateness of proposed closure procedures, considerations of other applicable federal requirements listed in proposed § 257.122, and the appropriateness or effectiveness of any corrective action remedy, including monitoring to assess the effectiveness of that remedy." (underline added for emphasis)*

These site-specific factors have similar potential effects on the performance of landfills which are proposed to be covered by permit by rule and would be exempt from site-specific permit review. EPA has not provided sufficient information to show otherwise. The likelihood of design and construction defects increases as oversight lessens; this includes the absence of agency oversight and public review which would occur under a permit by rule implementation.

Members of the public often have irreplaceable knowledge of local hydrogeology, soil, geology/seismic, and climatic conditions which are relevant to siting and construction of CCR landfills. It's our professional experience that state natural resource agencies and geologic surveys and researchers at nearby colleges and universities often have the most accurate and in-depth knowledge of these site specific conditions. Consultants who work for coal plant owner/operators may be from out-of-state and lack this site-specific knowledge. In a permit by rule process, there is less incentive for those consultants to seek out local site-specific knowledge. A public process is needed to ensure this local site-specific knowledge is included in planning for landfill design, construction, and O&M and to ensure these meet Subpart D technical requirements.

Site-specific review, public comment, and conditioning of individual permits to site conditions is needed for EPA to have the necessary information to understand the proposed design, construction, and O&M plans and to be able to question engineering designs, identify sensitive receptors, and issue an accurate protectiveness determination for a landfill.

Agency oversight of rule compliance

Our professional experience with the current self-implementing scheme for the Federal CCR Rule is that some CCR facility owners chose not to comply with the full requirements of the rule, either due to an error in interpreting the rule or because it is costly to comply with all of the criteria. Site-specific individual permit review would help to eliminate the occurrence of CCR facilities which are not fully compliant with Federal CCR Rule criteria. This is because EPA would presumably apply its interpretation of the rule uniformly for CCR units it permits across the nation and because potential "bad actors" would be prevented from skirting rule requirements.

To give just a couple of examples of CCR facilities that we are aware of where owner/operators are not fully compliant with the existing Federal CCR Rule:

1. Talen Montana, LLC is co-owner and sole operator of the Colstrip Steam Electric Station in Montana. Talen does not consider the "STEP A Cell" leaky coal ash surface impoundment at the site to be regulated under the Federal CCR Rule (Table 2 of Appendix A of Geosyntec, 2019). No documentation has been provided for this surface impoundment per § 257.105 - 257.107. Other available documentation from the site indicates that coal ash in the STEP A Cell still contains free liquids, defined under the rule as "liquids that readily separate from the solid portion of a waste under ambient temperature and pressure" (40 CFR § 257.53). Table ATT-2-1-2 of Geosyntec (2019) shows that STEP A Cell contains 30 feet of "Fly ash, saturated." The Federal CCR Rule applies to inactive surface impoundments at active electric utilities, defined as impoundments that no longer receive CCR on or after October 19, 2015 and still contain both CCR and liquids on or after October 19, 2015 (40 CFR § 257.50 (c) and § 257.53). Closure requirements that apply to inactive surface impoundments include §257.102 (d)(2)(i), which requires that free liquids be eliminated before final cover is installed.

Talen appears to have interpreted free liquids to mean only standing water at the surface of a CCR impoundment. <u>The STEP A Cell coal ash impoundment has caused known severe groundwater contamination issues that have impacted public human health. Despite this it is currently falling through the cracks of a federal regulatory system with a lack of agency oversight.</u>

2. Luminant Generation Company LLC owns and operates the Martin Lake Steam Electric Station in Rusk County, Texas. The A1 Landfill was built in 1980 upon 70-170 feet of mine spoil comprised of various clays and presents significant site-specific risks associated with potential clay saturation and settling or mass movement of mine spoil. Luminant's Unstable Area Demonstration acknowledges these risks but presents a professional engineer's certification without providing any supporting information or references (Golding Associates 2018). The Unstable Area Demonstration states that historic design and geotechnical investigative information were reviewed; but no one outside of the company's sphere has access to that information. This is the type of information vacuum that the Federal CCR Rule is intended to avoid. There is simply no way for anyone to check that the engineer made the correct decision in certifying the landfill and addressing dangers to human health and the environment. <u>This is an example of the type of deficient information reporting and absence of unbiased review by a qualified professional engineer that will occur in a permitting system without agency oversight.</u>

Conclusions

Optimal design and construction plans for landfills and monitoring systems requires consideration of the site-specific conditions and a robust quality assurance program to ensure design and performance standards are met. Landfill design and construction deficiencies are the human-caused factors that led to the majority of landfill failures. Design and construction are also the processes that can be most easily improved by better oversight and review during a permitting process. The evidence shows that individual permitting is needed to allow EPA to determine how the technical criteria in subpart D apply to a CCR facility's specific operations and site conditions.

No other regulatory program lacks agency oversight and permitting for design and construction of significant facilities that are in place in perpetuity. Without agency and public review, and a defined permitting process with third party review, there will undoubtedly be increased CCR landfill failures under the new proposed rule through engineering miscalculations, construction error, or by a deception from a few dishonest players. Our opinion is that all CCR landfills will benefit from site-specific review of design, construction, and O&M plans. Individual permitting provides a high level of site-specific review. Permit by rule does not adequately ensure that site-specific conditions are considered. Public comment afforded by the individual permitting process allows members of the public with site-specific knowledge to assist EPA in identifying relevant permit conditioning so that it meets Subpart D performance requirements and is protective of the environment.

Qualifications

We express the opinions and recommendations in this letter based on our qualifications as consultants working on RCRA facilities and coal ash sites. Our qualifications are summarized here; full resumes are attached.

Scott M. Payne, Ph.D., P.G.

Dr. Payne has over 34 years of experience as a professional hydrogeologist and environmental consultant. He has extensive experience in planning, project management, environmental assessment, surface and groundwater protection, and environmental analysis and permitting. He has extensive experience in toxic waste site studies and cleanup, lined impoundment design, landfill assessment, Superfund and RCRA regulatory support. He has worked on dozens of other CERCLA and RCRA facilities across the U.S. Dr. Payne is the author of *Strategies for Accelerating Cleanup at Toxic Waste Sites* published internationally by Lewis Publishers of New York. In his book, he outlines streamlining regulatory processes, effectively negotiating decisions and actions, environmental leadership, and applying practical solutions to remedy environmental problems. Dr. Payne served as an adjunct professor at Montana State University and taught surface and groundwater modeling for graduate and undergraduate students in the Environmental Science and Land Resource Department.

Ian Magruder

Mr. Magruder has 20 years' professional experience working on toxic and hazardous waste site characterization, remediation, and water quality protection. He has worked extensively in recent years reviewing cleanup plans for coal ash sites written under state and federal regulatory authority and working with State of Montana Department of Environmental Quality to better understand coal ash groundwater contaminant remediation plans. Mr. Magruder writes and reviews sampling and analysis plans and work plans for contaminated site remediation and waste characterization studies. He has taken hundreds of soil and groundwater samples for inorganic and organic contaminants including metals, inorganics, petroleum contaminants, solvents, PCBs, pesticides, and radionuclides. He has provided construction and health and safety oversight of remediation construction projects. Mr. Magruder has served for 17 years as a technical advisor for a Superfund committee in Butte, Montana and has evaluated the risks inherent in mine waste and wood treatment chemicals to humans and the environment. That experience includes review of EPA risk assessment, feasibility, remedial investigation, and remedial action plans. Mr. Magruder has a Master of Science degree in in Geology with a hydrogeologic emphasis. He has an extensive background in modeling and formerly studied under one of the industry’s leading authors of applied groundwater modeling.

Best Regards,

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Principle Scientist
KirK Engineering & Natural Resources, Inc.

Ian Magruder, M.S.
Senior Hydrogeologist
KirK Engineering & Natural Resources, Inc.

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SCOTT M. PAYNE, Ph.D., P.G.

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SUMMARY

Dr. Payne has 34 years of experience as a principal hydrogeologist, Superfund, and RCRA specialist.

EXPERIENCE

Dr. Payne has over 34 years of experience as a professional hydrogeologist and environmental consultant. He has extensive experience in planning, project management, environmental assessment, surface and groundwater protection, and environmental analysis and permitting. He has extensive experience in toxic waste site studies and cleanup, lined impoundment design, landfill assessment, Superfund and RCRA regulatory support; monitoring physical and chemical conditions of surface water and groundwater, interpreting surface and groundwater interaction and chemistry; waste water treatment; environmental and water policy development; and conducting analytical and numerical surface water and groundwater flow / solute transport models. Dr. Payne served as an adjunct professor at Montana State University and taught surface and groundwater modeling for graduate and undergraduate students in the Environmental Science and Land Resource Department.

Dr. Payne gained his hazardous waste management experience through work conducted for the U.S. Navy in California. He previously served as the program manager for environmental activities at the Fleet Industrial Supply Center, Oakland, California, under the Comprehensive Long-term Environmental Action Navy (CLEAN) Contract. He has worked on dozens of other CERCLA and RCRA facilities across the Western U.S.

Dr. Payne is the author of *Strategies for Accelerating Cleanup at Toxic Waste Sites* published internationally by Lewis Publishers of New York. In his book he outlines streamlining regulatory processes, effectively negotiating decisions and actions, environmental leadership, and applying practical solutions to remedy environmental problems.

Dr. Payne's litigation support experience for hazardous waste site legal proceedings includes providing expert witness support in cases involving a proposed Controlled Groundwater Area associated with a RCRA corrective action site. Here he reviewed the project for completeness and technical merit in terms of impact the proposed plan would have on adjacent properties. His hazardous waste litigation work also includes a State of Montana CECRA Superfund site where the public was exposed to groundwater and vapor intrusion from leaked solvent organic contaminants. As an expert witness, he provided professional opinions on monitoring well construction, water use from wells, and groundwater flow and solute transport modeling.

EMPLOYMENT HISTORY

- KirK Engineering & Natural Resources, Inc., 1998 - Present (business owner)
- Tetra Tech EM Inc., Program Manager, 1991 - 1998
- Hydrometrics, Sr. Hydrogeologist, 1988 - 1991
- University of Montana, Research Assistant/Teaching Assistant, 1987 - 1988
- Environmental Solutions, Inc. (now TRC), Hydrogeologist, 1985 – 1986

EDUCATION

- B.S., Earth Science, Northland College, 1985
- M.S., Geology with a Hydrogeology Emphasis, University of Montana, 1989
- Ph.D., Geosciences with a Hydrogeology Emphasis, University of Montana 2009

SCOTT M. PAYNE, Ph.D., P.G

FIELD EXPERIENCE

- Designed, installed and logged over 200 monitoring wells, boreholes, water wells
- Designed, installed and logged over 50 water supply and production wells
- Performed over 75 aquifer tests and numerous slug / packer tests, and interpreted results
- Mapped geology and groundwater systems throughout the western US
- Numerous field applications of electromagnetic, resistively, and magnetic geophysics
- Collected over one thousand groundwater and surface water quality samples
- Collected over three thousand soil samples
- Interpreted thousands of organic, metals, & common ion water and soil chemistry reports
- Measured hundreds of stream flows on streams and rivers
- Completed over 100 miles of riparian assessments in western Montana
- Completed dozens of CERCLA, RCRA, UST, TSCA, CWA studies at various scales
- Completed dozens of water supply, water conservation, & water rights studies
- Completed dozens of watershed chemical, physical, and biologic assessments
- Completed multiple groundwater and surface water hydrology & solute transport models

PROFESSIONAL CREDENTIALS, AFFILIATIONS, AND COMMUNITY SERVICE

- Professional Geologist, Wyoming, PG-1676, 1993 - present
- Professional Geologist, California, RG-6199, 1995 – present
- Private Pilot 3547110
- National AWRA member
- Madison County Airport Board

PUBLICATIONS AND PRESENTATIONS

Donohue, D.A., Huffsmith, R.L., Payne, S.M., 1994, Identification of a High Yield Aquifer Deep in the Helena Valley, West-Central Montana. October 13 and 14 AWRA Conference, Missoula, Montana.

Payne, S.M., 1988, Modeling of Hydrogeologic Conditions and Groundwater Quality Near an Oil Well Reserve Pit in Richland County, Montana. Montana Bureau of Mines and Geology Open File Report.

Payne, S.M., 1993, Implementing Preremedial Investigation Cleanup on Large Multiple-Site Projects. Proceedings from the 74th Annual American Association for the Advancement of Science, Pacific Division, June 20 - 24, 1993.

Payne, S.M., 1994, Implementing Accelerated Cleanup on Large Multiple-Site Projects. The Proceedings of the NWWA Eighth Annual National Outdoor Action Conference, May 23 - 25, 1994. S. Payne presentation speaker at conference.

Payne, S.M., 1997, Integrating Technical Decision-making and Environmental Leadership. HazWaste World Superfund XVIII December 2 - 5, 1997 Conference Proceedings, Washington DC.

Payne, S.M., 1997, Strategies for Accelerating Cleanup at Toxic Waste Sites. Lewis Publishers/CRC Press, NY, December.

Payne, S.M. 2001, Nutrient Reduction in the Flathead Basin. October, AWRA Conference, Missoula, MT

Payne, S.M., 2003, A Groundwater Classification System for Watershed Planning and Conservation of Ecotones in Basin Fill Sediments of the Rocky Mountain West, Poster Presentation, Montana Chapter AWAR Annual Conference, Butte, MT, October.

Payne, S.M., 2010. Classification of Aquifers. Ph.D. Dissertation, University of Montana. 0

Payne, S.M., I. Magruder and W. Woessner, 2013. "Application of a Groundwater Classification System and GIS Mapping System for the Lower Ruby Valley Watershed, Southwest Montana," Journal of Water Resource and Protection, Vol. 5 No. 8, pp. 775-791. doi: 10.4236/jwarp.2013.58079.

Payne, S.M. and Holston, M. 2000, Overview of the Flathead Lake Voluntary Nutrient Reduction Strategy (VNRS). Clark Fork Symposium 2000 Posters, Missoula, MT.

Payne, S.M. and Woessner, W.W. 2010. An Aquifer Classification System and GIS-based Analysis Tool for Watershed Managers in the Western US, Journal of American Water Resources,v46, no.5, pp1003-1023.

Reiten, J.C. and Payne, S.M. 1991. Impacts of Oil Field Wastes on Soil and Groundwater in Richland County, Montana. Part III. Montana Bureau of Mines and Geology, Open File Rept. 237-C.

Woessner, W.W., Lazuk R., Payne S.M., 1989, Characterization of Aquifer Heterogeneities using EM and Surface Electrical Resistivity Surveys at the Lubrecht Experimental Forest, Western Montana. The Proceedings of the NWWA Third Annual National Outdoor Action Conference, May 22 - 25, 1989. S. Payne presentation speaker at conference.

IAN MAGRUDER, M.S.

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SUMMARY

Mr. Magruder has 20 years of experience as a professional hydrogeologist and environmental consultant with extensive expertise working on toxic and hazardous waste sites, remediation planning, and Superfund.

EXPERIENCE

Mr. Magruder has 20 years' experience as a professional hydrogeologist and environmental consultant and has extensive experience working on toxic and hazardous waste characterization, contaminated site remediation, and Brownfields redevelopment. He has written cleanup and disposal plans for coal ash facilities and reviews coal ash groundwater remediation plans. He has significant experience writing and reviewing sampling and analysis plans and work plans for contaminated site remediation. He has extensive waste characterization and cleanup verification sampling experience for remediation projects and excels at working in difficult and remote field sites. He has taken hundreds of soil samples for inorganic and organic contaminants including, phytosanitary, metals, petroleum contaminants, solvents, PCBs, pesticides, and radionuclides.

Mr. Magruder has served for seventeen years as a technical advisor for mine waste and wood treatment Superfund sites. For his Superfund work he has evaluated the contaminant risks inherent in toxic waste sites and has recognized contaminant pathways and human and environmental risks which were not identified by other federal or private studies. This experience includes review of EPA risk assessments, remedial investigation and feasibility studies, remedial action plans, and records of decision.

Mr. Magruder has an extensive background in modeling and formerly studied under one of the industry's leading authors of applied groundwater modeling. His modeling includes geochemical fate and transport, discharge chemistry and mixing zones, groundwater-surface water interactions, and land application of discharge water.

EMPLOYMENT HISTORY

- KirK Engineering & Natural Resources, Inc., Senior Hydrogeologist, 2002 – present
- Montana Bureau of Mines and Geology Research Hydrology Division, Research Specialist II, 2001
- Contract Hydrogeologist for the Ruby Valley Conservation District, 2000

EDUCATION

- M.S., Geology (hydrogeology emphasis). University of Montana, Missoula, Montana, 2006
- B.A., Geology with High Honors (environmental geology emphasis). University of Montana, Missoula, Montana, 1998

PROFESSIONAL CREDENTIALS

- Missoula County Board of Health, Water Quality Advisory Council – Council Chair, member 2006-present.
- Technical advisor, DNRC Montana Water Supply Initiative, Clark Fork/Kootenai Basin Advisory Council.
- Manuscript reviewer for the journal Ground Water, National Ground Water Association.
- Clark Fork River Task Force technical advisor 2013-2015