BEFORE THE WATER QUALITY CONTROL COMMISSION
FOR THE STATE OF NEW MEXICO

In the Matter of:	)	
	)	
PROPOSED	)	
AMENDMENTS TO GROUND	)	
AND SURFACE WATER	)	**No. WQCC 17-03(R)**
PROTECTION REGULATIONS,	)	
20.6.2 NMAC	)	
	)	

NEW MEXICO MINING ASSOCIATION'S NOTICE OF INTENT TO PRESENT TECHNICAL TESTIMONY ON REBUTTAL

The New Mexico Mining Association (NMMA) hereby submits this Notice of Intent to Present Technical Testimony in this proceeding. This Notice is for written rebuttal testimony in accordance with the applicable orders of the Hearing Officer. NMMA hereby states:

1. **Person for whom the witness(es) will testify:**

   The witnesses will testify for NMMA and its members.

2. **Identify each technical witness the person intends to present and state the qualifications of that witness including a description of their educational and work background:**

   NMMA presents the following witness to present rebuttal testimony. The witness's educational and work background is presented in the Direct Testimony:

   Michael Neumann
   Lynn Lande
   Daniel Stephens or Neil Blandford

3. **Attach the full written direct testimony of each technical witness, which shall include an express basis for all expert opinion offered:**

   The direct testimony is attached.

4. **Include the text of any recommended modifications to the proposed regulatory change:**

NMMA's recommended modifications and amendments are included in the attached Direct Testimony.

5. Identify and attach all exhibits to be offered by the person at the hearing:

EXHIBIT #	DESCRIPTION
NMMA E	Rebuttal Testimony of Michael Neumann
NMMA F	Rebuttal Testimony of Lynn Lande
NMMA G	Resume of Lynn Lande
NMMA H	Rebuttal Testimony of Daniel Stephens/Neil Blandford
NMMA I	Resume of Daniel Stephens
NMMA J	Resume of Neil Blandford

WHEREFORE, NMMA respectfully requests that the Water Quality Control Commission accept this document on behalf of NMMA. Further, NMMA reserves the right to supplement this pleading and its attachments in accordance with the applicable rules and Scheduling Order.

Respectfully Submitted,

GALLAGHER & KENNEDY, P.A.

Dalva L. Moellenberg, Esq.
Rikki-Lee Chavez, Esq.
1239 Paseo de Peralta
Santa Fe, NM 87501
(505) 982-9523
(505) 983-8160
DLM@gknet.com
Rikki-Lee.Chavez@gknet.com

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing Notice of Intent was served by email to the addresses below on October 27, 2017:

Ms. Pam Castañeda, Administrator
Water Quality Control Commission
Room N-2168, Runnels Building
1190 St. Francis Dr.
Santa Fe, New Mexico 87505
Pam.castaneda@state.nm.us

New Mexico Environment Department
Office of General Counsel
John Verheul
Lara Katz
P.O. Box 5469
Santa Fe, New Mexico 87502
John.verhaul@state.nm.us
Lara.katz@state.nm.us

New Mexico Environmental Law Center
Jaimie Park
Douglas Meiklejohn
Johnathan Block
Eric Jantz
1405 Luisa Street, Suite 5
Santa Fe, New Mexico 87505
jpark@nmelc.org
dmeiklejohn@nmelc.org

Michael L. Casillo
AFLOA/JACE
1500 West Perimeter Rd. Suite 1500
Joint Base Andrews, MD 20762
michael.l.casillo2.civ@mail.mil

William Brancard
Cheryl Bada
Energy, Minerals and Natural Resources Department
1220 South St. Francis Drive
Santa Fe, NM 87505
bill.brancard@state.nm.us
chervl.bada@state.nm.us

Dalva L. Moellenberg
1239 Paseo de Peralta
Santa Fe, NM 87501
DLM@gknet.com

Rachel Conn
Projects Director
Amigos Bravos
P.O. Box 238
Taos, NM 87571
rconn@amigosbravos.org

Pete Domenici
Lorraine Hollingsworth
Domenici Law Firm, P.C.
320 Gold Ave. SW, Suite 1000
Albuquerque, NM 87102
pdomenici@domenicilaw.com
lhollingsworth@domenicilaw.com

Louis W. Rose
Kari Olsen
P.O. Box 2307
Santa Fe, NM 87504
lrose@montand.com
kolson@montand.com

Timothy A. Dolan
Office of Laboratory Counsel
Los Alamos National Laboratory
P.O. Box 1663, MS A187
Los Alamos, NM 87545
tdolan@lanl.gov

William C. Olson
14 Cosmic Way
Lamy, NM 87540
billjeanie.olson@gmail.com

John Grubesic
Office of the Attorney General
Post Office Drawer 1508
Santa Fe, NM 87504-1508
jgrubesic@nmag.gov

Michael L. Cassillo
AFLOA/JACE
1500 West Perimeter Rd. Ste. 1500
Joint Base Andrews. MD 20762
michael.casillo2.civ@mail.mil

Michael Bowen
Executive Director
1470 St. Francis Drive
Santa Fe, NM 87505
nmma@comcast.net

Russell Church, President
NMML EQA Subsection
NM Municipal League
P.O. Box 846
Santa Fe, NM 87504
rchurch@redriver.org

Stuart R. Butzier
Christina C. Sheehan
American Magnesium, LLC
Rio Grande Resources Corporation
New Mexico Copper Corporation
P.O. Box 2168
Albuquerque, NM 87103-2168
Stuart.butzier@modrall.com
Christina.sheehan@modrall.com

Dalva Moellenberg

NMMA EXHIBIT E

WRITTEN REBUTTAL TESTIMONY OF MICHAEL NEUMANN ON BEHALF OF THE NEW MEXICO MINING ASSOCIATION

A. Introduction and Qualifications

My name is Michael Neumann and I currently serve as President of the Board of Directors of the New Mexico Mining Association ("NMMA") and present this testimony in that capacity. I am employed by Energy Fuels Resources as Manager of its New Mexico Operations. Previously I have been employed by Neutron Energy Inc. as Vice President, Environment (2007-2013) and as manager of the Environmental Group at Montgomery Watson/Terramatrix (1994-2000). I am experienced in a wide variety of environmental regulatory matters, including supervising work under the Commission's regulations, 20.6.2, such as discharge permit applications. I hold a Bachelor of Science degree in Range Management from the University of Wyoming. I previously provided the Commission with written direct testimony, and a copy of my current resume was attached as NMMA Exhibit B to its Notice of Intent to Present Written Direct Testimony and is not duplicated with this testimony. I present this testimony based on my general regulatory work and experience, and not as a technical expert in any particular field. NMMA's proposed amendments are offered to the Commission based largely upon policy considerations.

My testimony addresses the following topics: Variances (20.6.2.1210 NMAC), Ground Water Quality Standards (20.6.2.3103 NMAC), Fees (20.6.2.3114 NMAC), and the Abatement Regulations (20.6.2.4103, .4104, .4106 and .4108 NMAC). For the Commission's convenience and clarity, I present the NMMA's position on each of these topics as it relates to the others parties' positions, even though my testimony does not necessarily rebut the testimony of each party.

B. Importance of Reasonable Rules to Industry and the New Mexico Economy

I will begin this testimony by giving some perspective on behalf of the NMMA and the mining industry. I have been involved in obtaining permits for mining projects for many years, and can tell you that it is a very lengthy, time-consuming and resource intensive process. Obviously, the mining industry, and any industry for that matter, must obtain all of the necessary permits to construct and operate their facilities. The mining industry, as well as the other extractive industries and manufacturing industries, provide some of the highest paying jobs with benefits that New Mexico is so much in need of these days. Consequently, permit procedures and requirements that impose undue and unnecessary burdens on industry and that serve to delay sound projects not only affect our businesses, they also affect job creation and the much-needed benefits that those jobs supply to New Mexicans.

Moreover, I can tell you that businesses who are considering establishing operations in New Mexico look closely at the permitting requirements and timeframes when they are doing their due diligence. Particularly in a capital intensive industry such as mining, reasonable certainty regarding permitting timeframes and the likelihood that a permit can be obtained is absolutely essential. In our industry, millions of dollars—often tens of millions--are spent to acquire land positions, to explore for minerals, to develop and design mines and the processes by which minerals can be recovered, and to obtain the necessary permits and approvals, before any revenue is generated from those operations to begin to repay the large capital investments, let alone produce a profit. Rules that increase permitting timeframes and that increase the uncertainty regarding whether and when a permit will be issued will discourage new businesses from even considering New Mexico for their operations. Consequently, the Commission should carefully scrutinize rule proposals that will make permitting more uncertain and difficult and be convinced that such

provisions are absolutely necessary to meet the objectives of the Water Quality Act before adopting such proposals.

C. Variances

NMMA Position: NMMA supports the Department's proposed amendments to the variance provision, 20.6.2.1210 NMAC, with some clarifying changes to the Department's proposed Subsection E, as discussed in my direct written testimony. NMMA opposes all of the amendments to 20.6.2.1210 offered by Amigos Bravos and the Gila Resources Information Project (referred to as AB/GRIP) in their Statement of Position filed on July 27, 2017 and also opposes the amendment offered by Mr. Olson and addressed in his Direct Written Testimony.

Mr. Olson proposes one amendment to 20.6.2.1210.A(5) NMAC which would require that a petitioner not only identify the water body or watercourse affected by the discharge but also "provide an analysis of present and foreseeable future uses of water that may affected [sic] by the variance." Mr. Olson asserts that ground water is used extensively for drinking, agricultural and industrial uses and that it is the source of 90% of drinking water in New Mexico. Mr. Olson provides no source for the 90% figure, though I would acknowledge that ground water is an important source of drinking water. That said, in my view, an analysis of a variance's "effect on present and foreseeable future uses of water," would be a particularly costly and highly speculative exercise that likely would cause argument rather than provide clarity.

In my opinion, rather than a conceptual analysis of the potential effect of a variance on present and foreseeable future uses of water, it is more useful to the Commission to have factual information on locations of existing ground water wells and nearby land uses, such as residences, agricultural operations and industrial sites. That type of information typically would be required by the Department either as part of a permit application connected with the variance or as part of

an abatement plan or other assessment performed in connection with ground water cleanup. With that information, the Department and the Commission can make their own assessments of whether it is appropriate to grant a variance and to impose conditions on a variance. In contrast, the type of assessment that Mr. Olson proposes would, in my view, only serve as a basis for arguments over the scope, factors and conclusions of the analysis.

A variance may be sought in at least three different contexts. Most typically, a variance is sought for approval of "alternative abatement standards" under 20.6.2.4103 NMAC. In that case, most likely, a contaminant plume exists already and the site will have been characterized, either through an abatement plan under 20.6.2.4106 NMAC or perhaps another program if the one of the exemptions under 20.6.2.4105 NMAC applies. A variance also may be sought from specific rule requirements, such as specific technical design or monitoring requirements under the Copper Rule, 20.6.7. In that case, technical information will have been obtained through the permit application requirements, and the variance may not affect ground water quality at all. The third type of variance would be to allow a discharge that would not otherwise be permitted under 20.6.2.3109.C NMAC because the discharge would cause the standards of 20.6.2.3103 to be exceeded. In that case, the information in a permit application also should be available. In any case, the existing language of 20.6.2.1210.A requiring a description of the facility or activity for which the variance is sought, its location, and the water body or watercourse affected gives the Department and the Commission sufficient authority to require that those descriptions include the factual information that the Department and the Commission need to assess and make a decision on the variance petition. If information is lacking, the Department can recommend denial of the petition and the Commission can act accordingly.

With regard to the AB/GRIP proposed amendments to 20.6.2.1210 NMAC which NMMA opposes, I have reviewed the direct written testimony of AB/GRIP and it appears that AB/GRIP failed to present any testimony in support of the amendments and the statement of reasons for those amendments as presented in AB/GRIP's Statement of Position filed on July 27, 2017. Consequently, due to the lack of any direct testimony to support those amendments, there is no testimony to rebut at this time.

D. Ground Water Quality Standards and Toxic Pollutants

NMMA Position: NMMA generally does not oppose the changes to the definition of "toxic pollutant" and the changes to 20.6.2.3103 as proposed by the Department. NMMA has proposed two additional changes to the human health-based standards in 20.6.2.3103.A for chromium and fluoride to conform to the current Safe Drinking Water Act Maximum Contaminant Levels (MCLs), as addressed in my direct testimony, and I provide rebuttal testimony addressing the Department's reasons for not proposing changes to those standards to conform to MCLs. NMMA notes that the Municipal League supports the same change to the standard for fluoride. NMMA does not take a position at this time on the changes proposed by the Municipal League or the Air Force relating to the standards for toxic pollutants. NMMA has made a proposal regarding the Note following 20.6.2.3103.C and stands by that proposal. Notwithstanding that proposal, NMMA believes that there is merit to the Commission considering the City of Roswell's proposal to codify the Note as a new Subsection D, provided that such a codification should include the NMMA's alternative language regarding "hazard to public health." NMMA does not support the Municipal League proposal to rely upon the section 20.6.2.4103.C NMAC instead of the Note because this would limit the "grandfathering" effect of the Note to abatement standards only, and the Note as it currently exists and as proposed by the Department may also apply to discharge permits. NMMA

opposes the changes offered by AB/GRIP, and notes that AB/GRIP offered no direct testimony to support those amendments, so no rebuttal is necessary at this time.

I offer the following rebuttal testimony to the testimony of the Department witness Mr. McQuillan regarding the reasons for the Department's position to retain the ground water quality standards in 20.6.2.3103.A for chromium and fluoride. According to Mr. McQuillan on page 33 of his direct testimony, the Department is not proposing to amend the standard for chromium to conform to the current MCL because EPA is currently evaluating new scientific data and may propose to amend its standard in the future. Mr. McQuillan does not provide the Commission with the specifics or timing of EPA's review. As a result, in my view, whether EPA will change the standard is speculation at this time, and it may be years before such a change is made, if at all. Speculation regarding future standards changes is not a sufficient reason for the Department's position and relying on such speculation makes it more difficult for the Commission to have a consistent policy regarding its standards. Consequently, the Commission should adopt a standard for chromium consistent with the current MCL and EPA's official evaluation of the effect of chromium in drinking water on human health.

With regard to fluoride, Mr. McQuillan on pages 33 and 34 of his testimony acknowledges that the current MCL for fluoride for protection of human health is 4.0 mg/l, but states that the Department did not propose to change the standard in 20.6.2.3103.A to conform to the current MCL. The reasons given are that, in addition to the human-health based MCL of 4.0 mg/l, EPA also adopted a non-human health based level of 2.0 mg/l for fluoride, and the Department does not wish to set two standards. There is no dispute that the current health-based standard is 4.0 mg/l. If the Commission wishes to maintain the integrity of its human health-based standards and consistently adopt standards that conform to the MCLs, it should adopt the 4.0 mg/l standard for

fluoride under 20.6.2.3103.A. The Department could have, but did not, propose a non-health based standard for fluoride under 20.6.2.3103.B consistent with the EPA non-health based standard of 2.0 mg/l, so that issue is not up for consideration by the Commission. The existence of the non-health based standard should not be considered relevant to the appropriate health-based standard. Mr. McQuillan's testimony provides no basis for the Commission to retain the current standard of 1.6 mg/l as a human health-based standard. It is not disputed that the 1.6 mg/l level was based upon an old standard that has been replaced by the 4.0 mg/l standard. With the MCL now set at 4.0 mg/l, and lacking any technical testimony that supports the current 1.6 mg/l level as a health-based standard, in my view it would be arbitrary for the Commission to retain the current 1.6 mg/l standard as a health-based standard under 20.6.2.3103.A NMAC.

E. Fees

NMMA Position: NMMA does not oppose the Department's addition of "amendments" to 20.6.2.3114.E NMAC, although NMMA does not believe this is necessary because section 20.6.2.3114 does not impose any fees on applications for discharge permit amendments. NMMA opposes AB/GRIP's proposed changes to section 20.6.2.3114. Because AB/GRIP did not provide any testimony to support its proposed changes to 20.6.2.3114 NMAC, NMMA's position is that the AB/GRIP changes identified in their July 27, 2017 Statement of Position should not be considered, and there is no reason for me to offer rebuttal testimony.

F. Abatement

NMMA Position: NMMA opposes the Department's proposal for a new abatement standard for subsurface water contaminants and the related change to 20.6.2.4105.B and provides rebuttal testimony on that point through another witness. NMMA opposes Laun-Dry's proposed amendments to the existing language of section 20.6.2.4103.B(2) NMAC, which is the same as

the renumbered Subsection C under the Department's proposal; proposes a different version of Laun-Dry's proposed change to existing 20.6.2.4103.D NMAC regarding the number of samples sufficient to consider abatement to be complete; and does not object to Laun-Dry's proposed changes to the provisions regarding alternative abatement standards. NMMA does not object to the Municipal League's alternative to existing 20.6.2.4103.B or renumbered Subsection C under the Department's proposal, subject to the NMMA's position and testimony regarding the note to 20.6.2.3103 NMAC, as set forth above, including the incorporation of the "hazard to public health" language if the Commission adopts the Municipal League proposal.

NMMA opposes the Department's proposal to delete the current 20.6.2.4103.E NMAC providing for technical infeasibility determinations by the Department as well as the related change to 20.6.2.4109 NMAC and I offer rebuttal testimony on that point. Notwithstanding that position, NMMA does not object to adding the technical infeasibility criteria as a separate grounds for petitioning for an alternative abatement standard, as that approach adds a more specific and useful alternative criteria for adoption of an alternative abatement standard when a constituent level exceeds 200% of the standard of 20.6.2.3103 NMAC. NMMA supports the Dairies' proposed changes throughout the abatement rules. NMMA opposes the AB/GRIP proposed changes to 20.6.2.4103.F NMAC (criteria for alternative abatements standards) but does not provide rebuttal testimony because AB/GRIP provided no testimony to support their proposed changes (see July 27, 2017 filing) and, therefore, the Commission should not consider those changes.

NMMA opposes the Department's proposed amendment of 20.6.2.4104.C NMAC as addressed in my rebuttal testimony. NMMA opposes Mr. Olson's proposed changes to 20.6.2.4103 and .4108 NMAC and I offer rebuttal testimony.

With regard to the Department's testimony in support of its proposal to delete the provision on technical infeasibility determinations by the Department, 20.6.2.4103.E NMAC, I offer the following rebuttal. The Department, in Mr. Vollbrecht's testimony on pages 16-17, asserts that 20.6.2.4103.E is not consistent with Section 74-6-4(G), the Water Quality Act provision on variances. I am not a legal expert, and NMMA will address the legal aspects of this issue in its closing argument, but I would note that this provision has been a part of the Commission's rules for over 20 years since their adoption in 1996, and the Commission must have concluded that this was a legally valid provision when it adopted it. I do not see that the technical infeasibility determination on its face changes the applicable abatement standards. Technical infeasibility determinations are a useful tool as a basis to conclude environmental cleanup projects under the abatement rules. When there is a statistically valid showing that no further cleanup can be accomplished or only at exorbitant cost with minimal or insignificant improvement in water quality, this provision allows the Department to determine that further actions toward cleanup would be in vain and to suspend further abatement actions. The Commission also should consider that requiring a variance hearing on matters that currently can be handled through a technical infeasibility determination would consume additional resources of the Department, the Commission and responsible persons conducting abatement. As to public notice, the abatement plan itself is subject to public notice, comment, and the opportunity for a public hearing, and questions regarding the effectiveness of the proposed abatement plan can be raised at that time. For these reasons, the Commission should not remove the existing technical infeasibility determination provision.

Regarding the changes to 20.6.2.4103 NMAC proposed by Laun-Dry, the "existing condition" language has always been a part of the standards of 20.6.2.3103 NMAC and relates to

the conditions that existed prior to a discharge. In particular, my understanding is that under the "existing conditions" language, if a constituent level exceeds one or more of the numerical standards of 20.6.2.3103 when a discharge commences, the "existing condition" or contaminant level is treated as the standard, such that the discharge must not cause an increase in the contaminant level beyond the "existing condition." It follows that the discharger should not be responsible for abatement of contamination that does not exceed the "existing condition." I do not understand Laun-Dry's explanation for removing that language and relying on the definition of "background," which by its terms has a limited application.

I partially agree with Laun-Dry's testimony regarding the need to change the requirement for eight consecutive quarters of sampling to conclude that abatement is complete to address the situation when the Department approves of less-frequent sampling at a particular station. However, I hesitate to recommend that the period over which compliance samples must be collected be left entirely to the Department's discretion, which would be the result of Laun-Dry's proposed amendment. Consequently, NMMA proposes that this provision should read as follows:

> D. Subsurface-water and surface-water abatement shall not be considered complete until a minimum of eight (8) consecutive quarterly samples from all compliance sampling stations approved by the secretary meet the abatement standards of Subsections A, B and C of this section, provided that if the Department has approved a sampling frequency of less than quarterly for a compliance sampling station, the Department can approve completion of abatement based upon a sufficient number of samples from that station. Abatement of water contaminants measured in solid-matrix samples of the vadose zone shall be considered complete after one-time sampling from compliance stations approved by the secretary.

As discussed above, NMMA also opposes the Department amendment of 20.6.2.4104.C NMAC to allow the Department to require financial assurance from responsible parties who do not and have not held a discharge permit. The Department's testimony on this point, provided in Ms. Hunter's testimony, does not identify any statutory authority to require financial assurance

under those circumstances. I would add that requiring financial assurance from some responsible parties could result in a financial burden that they cannot meet. Also, the Commission has not adopted any specific rules regarding financial assurance, so the means to comply with such a requirement are unclear.

Finally, I offer rebuttal testimony to Mr. Olson's proposed amendments to section 20.6.2.4103 and to require additional public notice for petitions for alternative abatement standards. Mr. Olson proposes that the Commission delete the language in the Department's proposal, and in the current rule, which provides a basis for an alternative abatement standard "if compliance with the [abatement standard] would not be feasible by the maximum use of commercially accepted abatement technology." Mr. Olson's sole basis for deleting this criterion is that it is "redundant" to the next subparagraph. I disagree and believe that the two provisions serve different purposes. The provision that Mr. Olson proposes to delete allows the Commission to consider an alternative abatement standard not based upon cost, but based upon the lack of a commercially accepted abatement technology, as distinguished from unproven, experimental technologies. In contrast, the provision that Mr. Olson proposes to retain addresses whether a responsible party has the financial means to pay for abatement. In my opinion, both provisions should be maintained. Also, Mr. Olson proposes language similar to his proposal in the variance section requiring an analysis of present and reasonably foreseeable future uses of water. I refer to my rebuttal testimony above on that point.

Regarding Mr. Olson's proposal for additional public notice requirements in 20.6.2.4108, the current requirements are for public notice of the Commission hearing in accordance with the variance proceeding to consider alternative abatement standards, which would require publication of notice and notice to a facility specific list. In particular, that approach should provide notice to

persons who have expressed an interest in a site subject to an abatement plan. In addition, the Commission provides notices of its meetings, hearings and matters on its website, which typically includes agendas and all petitions and pleadings filed in a matter. Additional notice is not required under the Water Quality Act, and in my view the existing public notice provisions will provide sufficient notice.

This concludes my written rebuttal testimony on behalf of the NMMA.

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Michael Neumann

STATE OF NEW MEXICO
BEFORE THE WATER QUALITY CONTROL COMMISSION

IN THE MATTER OF PROPOSED AMENDMENTS TO GROUND AND SURFACE WATER PROTECTION REGULATIONS, 20.6.2 NMAC	)))))	**No. WQCC 17-03(R)**

NMMA EXHIBIT F

WRITTEN REBUTTAL TESTIMONY OF LYNN LANDE
ON BEHALF OF THE NEW MEXICO MINING ASSOCIATION

A. Introduction and Qualifications

I offer this testimony on behalf of the New Mexico Mining Association for this proceeding. I have a BA degree from Kean University in Earth and Planetary Science and attended graduate school at Idaho State University in geology. I have over 26 years of mining experience dealing with mineral exploration and mine geology, as well as mine operation and reclamation activities.

Currently, I am employed by Freeport McMoRan and serve as a Chief Environmental Engineer. My current responsibilities include the management of the Chino and Tyrone closure discharge permits and Chino Mine expansion projects. I previously testified before the Commission in the proceedings regarding the Copper Rule, and I also participated as a Freeport representative on the Technical Committee for the development of the Proposed Rule and attended all of the Copper Rule Advisory Committee meetings. Prior to this position, I have served as a Senior Geologist at the Chino Mine where I held the positions of Ore Control Department Supervisor and Mine/Exploration Geologist. Prior to that I worked as a geologist at the Morenci Mine in Arizona, the largest copper producing mine in North American, and in

Nevada I worked in two world class gold deposits as a geologist for Barrick Goldstrike and Newmont Mining.

A copy of my resume is provided as NMMA Exhibit G. It is accurate and up-to-date.

B. Discharge Permit Amendments

NMMA Position: NMMA generally supports the Department's proposals in various rule sections regarding discharge permit amendments. NMMA has proposed an alternative definition of "discharge permit amendment" as addressed in the direct written testimony of Michael Neumann. NMMA opposes all of the changes on this topic proposed by Amigos Bravos and the Gila Resources Information Project (AB/GRIP) and provides this rebuttal testimony in response. In particular, the testimony offered by AB/GRIP does not take into account the complexity and detail in discharge permits and the critical need for mining operations to be able to obtain minor permit amendments in a timely manner as necessary to make operational adjustments during the term of a permit.

AB/GRIP's direct written testimony on the topic of discharge permits was presented through witness Kathy Martin who attempts to characterize the history of discharge permit amendments as an abuse of authority and improper. I have personal experience with a number of applications for discharge permit amendments, and I can tell you that the Department carefully scrutinized each one of those to make sure that it did not qualify as a "discharge permit modification" as defined in the Commission's regulations. The Department has provided a more detailed history of discharge permit amendments in its direct written testimony, and that history is generally consistent with my experience. In my experience, if the Department was in doubt, then it required the application to be treated as a "discharge permit modification" subject to advance public notice and other public participation requirements.

I also will note at the outset of my testimony that an allowance for discharge permit amendments is crucial to our operations. Ms. Martin's testimony does not consider the nature of our mining operations, and her qualifications do not indicate experience with a complex, active mine. Mining operations are subject to constant change due to changes in economic conditions, changes in mineral discoveries, changes in technology, mining activities that affect facility and monitoring locations, and unexpected circumstances, including changes resulting from corrective and contingency actions. When changes are required that necessitate a change to one or more of our permits, prompt action is often required. In my experience, action on a permit modification requiring public notice, agency administrative and technical review, publication of a draft permit, a second public notice and comment period, potential hearing requests, and final action takes at least several months, and often takes years. Such a process may be appropriate for significant facility changes that may impact our neighbors, but for minor permit changes need to adjust internal operations, such a process is simply too slow, as well as resource intensive for both our company and the Department. Moreover, as the Commission is well aware, we have a number of discharge permits that have been pending renewal for many years. When possible, we try to deal with permit modifications and renewals at the same time for the sake of efficiency, and that can mean even more delays.

Over time, permit conditions and requirements have become more and more specific and detailed, resulting in more restrictions on our operations. The number of permit details have increased the need for a mechanism to make minor permit changes to address the detailed permit requirements.

Our particular mining operations cover a large number of mining facilities spread over a footprint of thousands of acres. We work diligently to ensure that impacts to water are contained

within our operational footprint. The kinds of minor changes to our operations that might be covered by discharge permit amendments typically are within the interior of our mines and are rarely noticeable at all to the public, including our closest neighbors. The Department's review ensures that any permit changes comply with the applicable requirements.

If we are unable to receive approval for minor changes through permit amendments, and given the slow pace of action on applications for permit modifications and amendments, we would not be able to make the necessary changes to permits and, consequently, adjustments to our operations that are needed for safe and efficient mining. If that were the case, the inability to obtain timely permit changes could require curtailments in operations. The importance of this issue is so great that it was addressed directly in the Copper Rule, and the Commission adopted a definition of "discharge permit amendment" in that Rule. The mining industry would welcome additional changes to the permit process to make it more efficient and to provide for more timely agency actions. Unfortunately, proposals offered by parties such as AB/GRIP typically add to the already heavy permitting burdens faced by industry and the Department and slow the process even further.

The rule amendments offered by the Department would provide clearer limits on when the Department can authorize a permit change through an amendment, as opposed to a modification. For example, rather than relying on the Department to decide whether a change in the volume of a discharge or the concentration of a contaminant is "significant," the proposed rule language would set a ten percent limit.

I will address briefly some of the permit examples covered in Ms. Martin's testimony that relate to mining operations and, particularly, the Chino and Tyrone Mines. I note that Ms. Martin testified to spending about 20 hours reviewing all of the permit amendments on which

she testified, and given the complexity of our operations and the number of permits involved, it is understandable if Ms. Martin did not have time to evaluate and understand all of the circumstances. Here is my response to Ms. Martin's testimony.

Page 11—DP-213: Ms. Martin claims that an amendment allowing a discharge of wastewater from a septic tank to Reservoir 4A is an example of a permit amendment allowing a change in discharge location. Missing from Ms. Martin's analysis is an understanding of Reservoir 4A, which as her testimony indicates is a component of a copper leaching system that received large volumes of leach solutions, which are low pH and contain a high concentration of dissolved solids and other constituents. Not only is Reservoir 4A an existing discharge location, but the addition of water from a septic system would have a negligible impact on water quality.

Page 12—DP-166: Ms. Martin criticizes a permit amendment allowing an increased rate of makeup sulfuric acid to leach solutions. The leach solutions in question have a very low pH (typically between 2 and 3) as stated in the permit, and sulfuric acid is added to maintain the low pH, which is critical for the operation. The change was needed because the material being leached was neutralizing the acid such that the pH was rising and more acid was necessary to maintain the pH at a level needed for the operation. Without the ability to increase the application of acid in a timely manner, the leaching operations would have been impaired. In situation such as this, the Department is fully capable of assessing whether the permit change will affect the quality of the water authorized for discharge (in this case, leach solutions to a leach stockpile) and whether there could be any adverse impacts to ground water.

Pages 14-16—DP-1236: The permit amendment in this instance related to a system to transport good quality water to be withdrawn from an existing mining area for use in a leaching operation that requires makeup water. Ms. Martin criticizes this amendment for allowing an

increase in discharge quantity as well as a new discharge location. However, the same volume of makeup water is needed by the leaching operation regardless of source, so the new source would not increase the quantity of the discharge. Indeed this water source would obviate the need to supply makeup water from another source, such as pumping fresh water from water supply wells. The SX-EW and leaching operation is already a permitted discharge location for discharges of poorer quality water than would be supplied by the new system.

Pages 17-19: Ms. Martin criticizes permit amendments allowing the use of mine wastewater for dust suppression on haul roads. The mine wastewater simply replaced other water supplies, such as pumped ground water, used for the same purpose and at the same volume. The mine wastewater is of a similar quality to water within the open pit mine where the haul roads are located and precipitation that comes into contact with the haul road, which is constructed of mined materials.

Pages 19-20, DP-376: Ms. Martin criticizes a permit amendment that incorporated into the permit a booster facility that was constructed as a requirement of a corrective action. The booster station was needed to improve the operation and to reduce the likelihood of additional spills. If Chino had been required to complete a permit modification before it could construct the booster station, it would not have been able to take the action needed for corrective action in a timely manner. This facility is within the boundaries of a very large leach stockpile and solution collection and management system.

Page 21, DP-455: This is another example of a facility change within the interior of a mining and copper leaching operation that was required to address a notice of noncompliance from NMED. Had the Department required a permit modification for the corrective action, the

system reconfiguration that was needed to address the unplanned circumstances, as required by the Department, would have been delayed for months.

Pages 25-28, DP-455: Here Ms. Martin discusses several permit amendments relating to copper leaching operations conducted within the Gettysburg open pit in the interior of the mining operation, where leach solutions are contained largely by the hydraulic containment of the open pit and, therefore, will not travel outside of the mine. As discussed above, some of these changes were required by the Department and others were needed for adjustments to the leaching operations. The Departments is fully capable of assessment these operational changes for their technical merits and to ensure that they will not adversely affect ground water quality.

Page 28-31, DP-526: Ms. Martin complains of a permit amendment to allow for relocation of pipelines. Again, these pipelines are located within the active mining area and were being moved to other locations within the active mining area. The whole point of these systems are to ensure that leach solutions are kept within the mine and leaching system. The pipelines had to be moved for mining operations to continue. This is a frequent occurrence at our mining operations, and if we had to wait months or years for permit modifications in order to make these kinds of changes, our mining operations would be seriously disrupted. In most instances, pipeline locations are not specified by our discharge permits due to frequent movement of pipelines. Consequently, these movements are not restricted under the terms of the permit, but for a major project, a "permit amendment" may be done just to make sure that the Department has a record of facility changes. For the same reasons, these types of internal facility changes, particularly moving pipelines, does not require a permit change under the Mining Act Rules. Similarly, the "frog pond" location was changed from one location within the interior of the mine to another. Ms. Martin raises a concern with compliance with dam safety requirements. For

smaller impoundments, the Department has jurisdiction instead of the State Engineer, and the Department is fully capable of ensuring that any impoundment complies with applicable safety criteria.

Pages 31-33, various permits: I will not address each of these comments individually. However, they all are for changes within the interior of the mining operations, and in each instance the Department would have concluded that the changes would not have qualified as a "discharge permit modification" as defined by the Commission. As it relates to our mining operations, each of the changes would have been needed to be approved in a timely manner to avoid disruption of our mining operations, and the permit modification process would not have allowed for timely action to avoid those disruptions. All of these changes are minor, both in the context of the large scale of our mining operations and with respect to having negligible, if any, impact on water quality.

Within Ms. Martin's testimony she proposes alternative language for a definition of "discharge permit amendment." One version is structured as a list of permit changes that can be accomplished by "amendment," and the other is a list of permit change prohibited from being done by a permit "amendment." Both of these lists are so restrictive that they would not allow for the types of changes to our operations as exemplified by the discussion above without a "discharge permit modification" and the resulting delays that would seriously affect our ability to continue to operate our mines efficiently. Indeed, if the Commission were to adopt either of the AB/GRIP proposed definitions, the process for permit changes would be so burdensome to our operations that we would face curtailment of operations, or we would have to propose changes to our permits to remove restrictions and add sufficient flexibility so that we could accomplish these necessary changes without having to amend our permits at all. That could require a

substantial overhaul of our permit conditions. AB/GRIP proposes a corresponding change to the definition of "discharge permit modification" that would have similar effects.

Ms. Martin's testimony also seeks to justify amendments to 20.6.2.3109 NMAC that would impose new and burdensome public notice requirements for "discharge permit amendments" such that they would be treated very similar to "discharge permit modifications." These requirements would add new procedural burdens and delay the process. In my view, the more restrictive limitations on "discharge permit amendments" that would result from the Commission's adoption of the Department's proposal will ensure that "discharge permit amendments" are limited to minor changes that have little or no potential impact on water quality. The Department is fully capable of assessing the technical merits and potential impacts of such changes without the need for public comment, such that public notice and comment is not necessary. The Commission should weigh the lack of need for public input on minor permit changes with the potential for adverse impacts on business operations and conclude that the rule amendments proposed by AB/GRIP should not be adopted.

This concludes my written rebuttal testimony on behalf of the NMMA.

Lynn Lande

Lynn Lande

NMMA Exhibit G

Resume of
Lynn Lande

Lynn Lande

3980 Pitchfork Ranch Road Silver City, NM 88061 Work (575)-912-5235 llande@fmi.com

EXPERIENCE:

Chief Environmental Engineer at New Mexico Operations (NMOs):

- Strong Supervisor and Business Skills –
  - Reclamation Acting Manager – Acting manager for long intervals with successful staff accomplishments
  - Project Manager leading a diverse team of employees and consultants to ensure State and Federal permitting goals and compliance requirements are achieved
  - Tyrone Sitewide Abatement Environmental assessment, investigation, alternatives and reclamation project lead
  - Manage New Mexico Reclamation FA, FAS 143/ARO, reserve and operating budgets
  - Coordinate permitting and environmental issues with multiple state and federal agencies
  - Train staff and consultants to understand short and long term strategic goals
  - Mentor staff to communicate effectively to achieve business objectives
  - Technical mentor and supervise employees in the ground water, waste, and soil for numerous ground water abatement and reclamation projects
  - Support and encourage work safety among staff and consultants
  - History of making sound business decisions
  - Proven record in achieving short and long term business targets and objects by meeting deadlines and reducing costs

- Strong Knowledge of NM State and Federal Regulation -
  - Closure Closeout permit regulatory team lead guiding the strategic plan development in an effort to balance short and long-term business objects from site wide investigations, financial assurance cost estimates to the development of reclamation and water treatment plans.
  - NM Copper Mine Rule technical committee member – worked with State, federal, and NGO representatives to development this rule. NM Reclamation subcommittee representative
  - Interface with legal counsel on various environmental law making and permitting issues
  - NEPA lead and team mentor
  - NPDES permit and SWPPP experience
  - Lead technical permitting and financial negotiation meetings with the state and federal agencies
  - Technical review of permits, reports, project approaches and correspondence

- Community Outreach and Representative –
  - New Mexico Mining Associated Member and Subcommittee Chair for NMED Site Wide Abatement Rule making
  - Company representative meeting and presenting to NGOs, schools, and community groups as well as responding to individual community permit concerns
  - Copper Mine Rule Team Member/Technical Committee Member. Testified before Water Quality Commission as the FCX Geologist technical witness
  - Public Hearing Presentations and Testimony: Tyrone Little Rock Mine and Chino North Lampbright Stockpile Expansion Projects

Chino Sr. Environmental Engineer:

- Project lead for Closure/Closeout Permit, Sitewide Abatement Plans, as well as the Hydrology, Geology, Geotechnical, Geochemical, Reclamation, Soil Cover and Water Treatment Investigations reports and plans
- Coordinated with and supervised reclamation contractors to reduce cost, increase production and ensure regulatory compliance.
- Educated Reclamation Service staff to understand environmental objectives and compliance issues
- Oversee and maintain records of environmental incidents and responses
- Project Manager drafting, reviewing, planning and negotiation of the Closure/Closeout Plan Reclamation and Water Treatment renewal application package.
- Gained regulatory permit approval of reclamation plans and permits

Chino Sr. Geologist:

- Chino Ore Control Department Supervisor (Staff of 9; geologists, engineers and technicians)
- Coordinated with Operations, Engineering and the Mill employees on a daily basis providing information on the tons, grades, and geologic characterization of ore types and reserves.
- Maintained the MineSight Reserve Ore Model
- Spear-headed the grass root installation and training of the MineSight and Acquire upgrade.

Morenci Geologist:

- Supervised up to seven geologic technicians in addition to core drilling crews.
- Logged core and helped develop the geologic ore model using MineSight software.

Barrick Goldstrike Geologist:

- Developed and supervised multimillion-dollar core and RC drill programs consistently staying on budget and met deadlines

Employment History:

YEAR	TITLE and COMPANY
2011-Present	Chief Environmental Engineer Freeport-McMoRan Inc.
2006-2011	Senior Environmental Engineer Freeport-McMoRan Inc./ Phelps Dodge Chino
2005-2006	Senior Geologist Phelps Dodge Chino
2004-2005	Geologist II Phelps Dodge Morenci
2001-2004	Volunteer, Substitute and then Algebra Teacher Morenci Junior High School
1999-2000	Independent Geologic Consultant Aqua Terra Consultants
1995-1997	Independent Geologic Consultant Self Employed
1993-1995	Mine and Senior Geologist Barrick Goldstrike/Kilborn Engineering
1991-1993	Independent Geologic Consultant Barrick Goldstrike
1989-1991	Staff Geologist Cominco American Resources Inc.
1988-1989	Consulting Geologist Westmont Mining
1987-1988	Metallurgical Tech and Geologist Newmont Mining Company

Academic Background:

MS Program: Idaho State University, Pocatello Idaho
BA Geology Degree and Economic Minor Kean University of New Jersey: Junior Student Council Representative, Finance Board Member and Geology Club President

STATE OF NEW MEXICO
BEFORE THE WATER QUALITY CONTROL COMMISSION

IN THE MATTER OF PROPOSED AMENDMENTS TO GROUND AND SURFACE WATER PROTECTION REGULATIONS, 20.6.2 NMAC	)	**No. WQCC 17-03(R)**

NMMA EXHIBIT H

REBUTTAL TESTIMONY OF DANIEL B. STEPHENS & ASSOCIATES ON BEHALF OF THE NEW MEXICO MINING ASSOCIATION

A. Introduction and Qualifications

Daniel B. Stephens & Associates, Inc. (DBS&A) was asked by the New Mexico Mining Association (NMMA) to evaluate the New Mexico Environment Department's (NMED's) proposed amendment to add a new abatement standard for "subsurface water contamination," proposed section 20.6.2.4103.B. Mr. T. Neil Blandford and Dr. Daniel B. Stephens of DBS&A reviewed the proposed amendment and developed this rebuttal testimony. Our qualifications are summarized below and are detailed in the résumés provided with this submittal.

Daniel B. Stephens, PhD, PHg, P.G.: I am DBS&A's founder and principal hydrologist. I have more than 30 years of experience in consulting, research, and academia. I am internationally recognized as an authority on vadose zone and groundwater hydrology, and have served as an expert in more than 28 depositions and trials in the field of hydrology. I also serve on ASTM committees that establish guidelines and set standards for determining hydrologic properties and monitoring the vadose zone. I have provided expertise on technical issues related to litigation and other investigations that have included characterization of the vadose zone and

site hydrogeology, numerical modeling of volatile organic compounds (VOCs), and the distribution and sources of contaminants in the vadose and saturated zones. I have served as a technical expert for dozens of cases involving contamination of soil and groundwater, many of which involved allocation of remediation costs. A copy of my professional résumé is provided as Exhibit I.

T. Neil Blandford, P.G.: I am a senior vice president and principal hydrologist with DBS&A in Albuquerque, New Mexico. I hold a B.A. in environmental science from the University of Virginia (courses of study were hydrology, geology, meteorology, and ecology), and an M.S. in hydrology from New Mexico Tech. I have been a consulting groundwater hydrologist since 1987, and I have lived in New Mexico and worked on water issues here since 1994. My work experience includes numerous groundwater investigations to evaluate groundwater quality and supply, both nationally and internationally. A copy of my professional résumé is provided as Exhibit J.

B. Rebuttal to Mr. McQuillan's Testimony Supporting a New Abatement Standard for "Subsurface Water Contaminants"

As proposed by the NMED, the new abatement standard 20.6.2.4103.B would read as follows:

> B. Subsurface water contaminants shall be abated to concentrations below those which may with reasonable probability injure human health, animal or plant life or property, or unreasonably interfere with the public welfare or the use of property through percolation, capillary suction, sequestration, phytoextraction, plant uptake, volatilization, advection or diffusion into crops, structures, utility infrastructure, or construction excavations.

NMED's stated purpose for the requested change is to "ensure that abatement actions include subsurface water, and protect against the types of injuries specified by the Legislature in the statutory definition of water pollution." We understand NMED's concerns and intent related to the proposed amendment, but the proposed amendment is overly broad and will be problematic and burdensome in practice. The proposed amendment would call into question the appropriateness of standard reclamation and remediation measures already approved and implemented at numerous mine sites and other types of facilities, and would likely lead to significant, unneeded increases in investigation costs and regulatory burden for future site

closures and remediation. In particular, there are few scientific references or criteria that exist to specify the concentrations at which contaminants that might exist in "subsurface water" (that is, in soil water alone as differentiated from contaminants in the bulk soil or rock in the vadose zone) that are injurious to human health and animal or plant life, or that may unreasonably interfere with the public welfare or the use of property. Also, existing testing methods do not differentiate between contaminants in "subsurface water" and those that otherwise may exist in the associated soil or rock; therefore, the proposed amendment seeks to regulate the potential presence of contaminants in a phase that is not ordinarily measurable given current methods and technologies. Consequently, NMMA and its members are concerned that this provision is inadequately defined and, as a result, that this provision could generate expensive and prolonged studies and arguments over whether contaminants exist in "subsurface water," whether there is any need for abatement and, if so, what the appropriate level of abatement would be. The very limited number of examples of problems that have been identified does not justify the adoption of such a broad and ill-defined requirement.

One of NMED's concerns is the need to regulate the vapor intrusion exposure pathway. This is not a significant issue at mine sites, as potential contaminants are generally non-volatile and not subject to vapor intrusion. Of primary concern to NMMA are the requirements to evaluate the effects of "subsurface water contaminants" on animal and plant life that will arise if the proposed amendment is adopted. Subsurface water is water below ground surface but above the water table, an area typically referred to as the vadose zone. To evaluate the effects on animal and plant life, one would need to determine how animals and plants are exposed to moisture in the vadose zone (like plant uptake), and the vadose zone water concentration for each potential contaminant that would lead to a "reasonable probability" that animal or plant life would present an unacceptable risk. In this scenario, "reasonable probability" is not a defined term, and will be subject to individual interpretation, leading to inconsistent application of the regulations. Site-specific ecological risk assessments and studies required to answer these types of questions are very complicated to design, may produce ambiguous results, and are time-consuming and costly.

In our opinion, NMED does not provide adequate justification regarding the need for the proposed amendment relative to the injurious effects of subsurface contaminated water on human health and animal or plant life. The example provided by NMED of Stephens and

Spalding (1984) does not justify the proposed amendment. The crops in that case study were affected by the unknowing irrigation with oil field brine due to unforeseen subsurface contamination in groundwater; the proposed rules would not have prevented the damage to the crops, and the rules already in place (existing 20.6.2.4103.A NMAC) would have required remediation of the impacted groundwater.

The proposed amendment could also bring into question well-accepted, long-standing functioning remedies at mine sites, landfills, and other types of facilities. Many of these sites rely on vegetated covers to protect groundwater, where the approved and implemented remedy has been stabilization of the waste (tailing, waste rock, landfill contents) by grading, drainage controls, and construction of a vegetated soil cover. The vegetation removes soil water that infiltrates into the cover from rainfall, protecting groundwater by minimizing the infiltration of water through the cover. It is possible, even likely in many instances, that some "contaminants" from the covered material (e.g., tailing) could be incorporated into the vegetation.

Other complexities will also be encountered. For example, the cover material at mine sites may be naturally elevated in minerals that could be considered "contaminants" and are taken up by plants and consumed by animals. Background concentrations for the cover material would need to be assessed before evaluation of allowable subsurface water contaminant concentrations could be completed.

If the proposed amendment is approved, addressing these issues would require large, complex ecological risk assessments for site reclamations, as there are few standard criteria on which to rely. Existing soil screening levels for soil contamination have been determined to protect groundwater, in accordance with the existing Water Quality Control Commission (WQCC) groundwater standards. These screening levels for soil are intended to address the potential risk pathway of impacts to groundwater; so, in a sense, the current WQCC groundwater standards already address the hypothetical issue that the amendment is intended to address. To evaluate what concentration of a contaminant in soil water is harmful to each possible receptor (human, animal, plant, property) would require highly skilled personnel to implement and regulate, and would significantly increase NMED's regulatory burden.

In summary, we urge the WQCC to not approve the proposed amendment, as it is vague and overly burdensome to implement, and NMED has demonstrated no pressing need for its implementation.

October 27, 2017

T. Neil Blandford, P.G.

Daniel B. Stephens, PhD, PHg, P.G.

NMMA Exhibit I

Resume of Daniel Stephens

Daniel B. Stephens, Ph.D., P.Hg., P.G.

Founder, Principal Hydrologist

EDUCATION

Ph.D., Hydrology, University of Arizona, 1979

M.S., Hydrology, Stanford University, 1974

B.S., Geological Science (with honors), Pennsylvania State University, 1971

PROFESSIONAL REGISTRATIONS

Certified Professional Hydrogeologist No. 406, American Institute of Hydrology

Certified Hydrogeologist No. HG355, California

Professional Geologist No. 5937, California

Professional Geologist No. 28483, Arizona

Professional Geologist No. 936, Idaho

Professional Geoscientist No. 1767, Texas

Dr. Stephens has expertise in hydrogeology; artificial recharge; groundwater resource evaluations; stream-aquifer interaction; applications of numerical models; fate and transport; allocation; remediation system effectiveness analysis.

Technical Review Boards

Los Alamos National Laboratory, Los Alamos, New Mexico: Blue Ribbon Panel, Review and Hydrogeologic Data Needs for the Environmental Restoration Program at LANL

U.S. Department of Energy, Technology Innovation and Development, Office of Environmental Management, Advance Simulation Capability for Environmental Management, Peer Review Team Chair, 2011

Orange County Water District and the Orange County Sanitation District, Groundwater Replenishment System, Independent Advisory Panel, National Water Research Institute

Yucca Mountain Project, Department of Energy Expert Elicitation on Recharge

Westinghouse Hanford Company, Hanford, Washington: Peer Review Panelist, Site and Grout Performance Assessments

Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho: Executive Committee Chairman, National Roadmap for Vadose Zone Science and Technology

Ernest Orlando Lawrence Berkeley Laboratory, Oakland, California: Earth Sciences Division Annual Review

Advisory Boards

U.S. Environmental Protection Agency Technical Workshop on Case Studies to Assess Potential Impacts of Hydraulic Fracturing on Drinking Water Resources, Research Triangle Park, North Carolina, Invited Technical Expert, July 30, 2013

Board of Directors of the National Ground Water Association—2009 to 2016

Scientists and Engineers Division National Ground Water Association—Chair, 2006-2016

Pennsylvania State University Department of Geosciences Alumni Advisory Board

New Mexico Tech, Advisory Board for the Earth and Environmental Science Department

Geological Society of America, Academic & Applied Geoscience Relations Committee

The University of Arizona, Hydrology and Water Resources Department Advisory Committee, Chairman

The University of Arizona, College of Science Dean's Board of Advisors

New Mexico Tech, Presidential Advisory Committee

Altela, Inc., Technical Advisory Board, Albuquerque, New Mexico

Representative Professional Assignments
NuMex Landfill Permit Application, Public Hearing, New Mexico Environment Department, Southern New Mexico

Copper Flats Mine Permit Review, Consultant to New Mexico Energy & Minerals Division, Truth or Consequences, New Mexico

Mine and Mill Tailings, CERCLA Site Investigation, Cyprus-Amax, Pecos, New Mexico

Landfill Site Investigation for Environmental Restoration, Los Alamos National Laboratory, New Mexico

Groundwater and Surface Water Contamination, LAC Minerals Corporation, Santa Fe, New Mexico

RCRA Facility Investigation, Los Alamos National Laboratory, New Mexico

Umetco Minerals Corporation, Assess Mill Operations on Drinking Water Supply, Uravan, Colorado

Litigation Support, Underground Uranium Mines, Grants, New Mexico

Assessment of Impacts of Abandoned Mines on Soil and Water Resources, Prescott National Forest, Arizona

Litigation Support, Allocation of Clean-up Costs, Historic Barite Mining Area, Confidential Client, Arkansas CERCLA Site, Halliburton Corporation, Coffeyville, Kansas

Landfill Materials Characterization, Casmalia Resources Landfill, Santa Maria, California

Wood Treating Facilities, Insurance Coverage Case, International Paper

Acid and Metals in Groundwater, Phelps Dodge Corporation, Pinal Creek, Cost Recovery Litigation, Miami, Arizona

Technical Support, Toxic Tort and Remediation, Tucson International Airport CERCLA Site, Tucson, Arizona

PCE-Contaminated Site, Public Service Company of New Mexico, New Mexico

Dry Cleaner Site, PCE Release, Insurance Coverage Case, Uvalde, Texas

High Level Nuclear Waste Repository, Hydrogeologic Study, U.S. Nuclear Regulatory Agency, Deaf Smith County, Texas

Evaluation of Remedial Action for TCE Contamination, Tucson Airport Authority, Tucson, Arizona

Volatile Organic Compounds PCE, TCE, 1,1-dichloroethene (1,1-DCE), Perchlorate and 1,4-dioxane Contamination of Aquifer and Impacts to Municipal Well Fields, Chemical Manufacturer, Southern California

Oil Recycling Facility, CERCLA Cost Allocation, Morrison-Knudsen, Salt Lake City, Utah

Contaminant Transport/Uranium and Vanadium Mill, Colorado Department of Health, Cañon City, Colorado

Former Oil Refinery, Property Damage, Kansas

Oil Field Brine Contamination, Cole Ranch, Property Damage Case, Midland, Texas

Oil Field Brine Contamination, Paul Hamilton, Caprock, New Mexico

MTBE Contamination Cost Allocation, Shell Oil Company, Southern California

Gasoline Refinery Contamination, Cost Allocation, Tosco Refinery, Texaco, Inc., Martinez, California

Technical Expert for Contaminant Migration, RCRA Site, Envirosafe Corporation, Boise, Idaho

Due Diligence, Hydrogeologic Evaluation of Potential Sites of Water Sources for a Confidential Client, California, Washington, Oregon, Arizona, Colorado, Connecticut, Florida, Indiana, Maryland, Maine, Michigan, Pennsylvania, Ohio, Tennessee, and Texas

Basin Recharge, United Water Conservation District, Santa Paula, California

Water Budget Analysis, International Boundary and Water Commission, Arizona and California

Nationwide Aquifer Yield Survey, U.S. Air Force, MX Missile Program

Water Availability Study, Pacific Agricultural Holdings, Inc., Cadiz Basin, California

Water Bottling Facility, Source of Groundwater for the Springs, Crystal Geyser, Olancha, California

Nuclear Power Plant Siting, Groundwater Investigations, San Diego Gas & Electric, Colorado River Region, Arizona and California

Groundwater Modeling Investigation, HydroGeoLogic, Inc., CERCLA Sites, Montana

Basin Recharge Quantification, Vidler Water Company, Carson City, Nevada

Water Rights Case, American Water Development Corporation, Great Sand Dunes National Monument, Colorado

Water Rights Application, The Hide Out of Lincoln County LLC, Angus, New Mexico

Collapsing Soil, City of Albuquerque, Albuquerque, New Mexico

Residential Water Source Identification, Property Damage Case, City of Albuquerque, New Mexico

Regional Groundwater Model Development, Roswell Basin, New Mexico

Numerical Modeling for Water Resource Impacts, American Groundwater Consultants, Inc., Albuquerque, New Mexico

Numerical Groundwater Flow Model, American Groundwater Consultants, Inc., Jemez Mountains, New Mexico

Water Supply Analysis for Water Rights Transfer, Lea County, New Mexico

Numerical Modeling for Water Supply Analysis, Andrews Ranch, Prewitt, New Mexico

Water Budget Study Review, New Mexico Environmental Evaluation Group, Waste Isolation Pilot Plant, Southeastern New Mexico

Water Resources Impacts Assessment Due to Coal Mining on Black Mesa, Hopi Tribe, Arizona

Beverage Bottling Plant, Environmental Site Assessment, City of Roswell, New Mexico

Landfill Soil and Liner Characterization, IT Corporation, Imperial Valley, California

Methane Contamination, Natural Gas Operations, Southwestern Colorado

Coal Tar, Insurance Coverage Case, Phelps Dunbar, LLP, Manufactured Gas Plant, Louisiana

Technical Expert for Insurance Coverage Case, Carlsbad, New Mexico

Hydrogen Sulfide Contamination, Underground Gas Storage Facility, El Paso Natural Gas, Southern New Mexico

Chlorinated Solvents, Technical Consultant for Mediator, Puente Valley, San Gabriel Valley, California

Chlorinated Solvents, CERCLA Cost Allocation, Zero Corporation, San Fernando Valley, California

Chlorinated Solvents, Dry Cleaner Site, Insurance Coverage Case, Stockton, California

Chlorinated Solvent Storage Tank Site, Insurance Coverage Case, Phelps Dunbar, LLP, San Jose, California

Chlorinated Solvents in Groundwater, Insurance Coverage Case, Phelps Dunbar, LLP, CERCLA Site, Mountain View, California

Chlorinated Solvents at Rocket Engine Test Sites, Insurance Litigation, Rockwell International, Contaminated Sites Throughout U.S.

Chlorinated Solvents, Eagle-Picher Industries, Inc., Property Damage Case, Security, Colorado

Chlorinated Solvents in Groundwater, Allocation, Cascade Corporation, Portland, Oregon

Chlorinated Solvents, GE South Valley, Technical Expert, Natural Resources Damages, Groundwater Contamination, Albuquerque, New Mexico

PCBs and Chlorinated Solvents at Compressor Stations Site Assessment, ENRON Corporation, New Mexico

Pesticide and Herbicide Migration, Agrochemical Facility, Cost Recovery Action, Santa Fe Rail, Arvin, California

Perchlorate Impacts, Rialto, California

Perchlorate, NDMA; Aerojet Facility, State Water Quality Control Board, Rancho Cordova, California

Tar Sand/Asphalt Refinery Contamination, Cost Recovery Action, Oxnard Refinery, Oxnard, California

Dense Non-Aqueous Phase Liquid (DNAPL) Migration, F&B Manufacturing Corporation, Phoenix, Arizona

Petroleum Hydrocarbons, Former Refinery, Oklahoma

Oil Pipeline Spill, Allocation, Fowler vs. ExxonMobil et al., Oklahoma

Oil Field Brine Contamination, Samson v ExxonMobil et al, Oklahoma East Austin Tank Farm, Identification of Petroleum Hydrocarbon Contamination, Travis County District Attorney, Texas

East Austin Tank Farm, Identification of Petroleum Hydrocarbon Contamination, Travis County District Attorney, Texas

Brine and NORM Contamination, Martha Oilfield, Kentucky

Recharge and Hydrogeologic Analysis, Low-Level Radioactive Waste Disposal Site, El Paso County, Texas

Hexavalent Chromium in Drinking Water, Toxic Tort Claim, Merck and Amsted, Merced, California

Metals and Chlorinated Solvents in Soil and Groundwater, Cost Recovery, Confidential Client, Bronson, Michigan

Litigation Support for Toxic Tort Suit, Analysis of Metals and Other Impacts, Domestic and Municipal Supply Wells, Fresno, California

Columbia Helicopters, Technical Expert, Insurance Coverage Case, Aurora, Oregon

Nitrate Contamination in Groundwater, Apache Nitrogen, Arizona

Professional Affiliations

American Institute of Hydrology

American Society of Agronomy

American Geophysical Union

Arizona Hydrological Society

Crop Science Society of America

Geological Society of America

Groundwater Resources Association of California

International Association of Hydrogeologists

National Ground Water Association

New Mexico Geological Society

Soil Science Society of America

Books and Chapters of Books

Stephens. 2008. Vadose Zone Hydrogeology: Basic Principles, Characterization, and Monitoring, Chapter 12, In Manual of Applied Field Hydrogeology, second edition, Willis Weight, editor. McGraw-Hill, New York.

Stephens, D.B. 1999. Monitoring for Groundwater Management in (Semi-) Arid Regions. Chapter 4, In Vadose Zone Monitoring Strategy to Protect Aquifers from Contamination, UNESCO, Wageningen, The Netherlands.

Stephens, D.B. 1996. Vadose Zone Hydrology. CRC Press, Boca Raton, Florida.

Stephens, D.B. 1993. Hydraulic conductivity assessment of unsaturated soils. In D.E. Daniels and S.J. Trautwein (Eds.), Hydraulic Conductivity and Waste Contaminant Transport in Soils, ASTM STP 1142, American Society for Testing and Materials, Philadelphia, Pennsylvania.

Stephens, D.B. 1992. Application of the borehole permeameter. Chapter 4 In Advances in Measurement of Soil Physical Properties: Bringing Theory into Practice. SSSA Special Publication No. 30, Soil Science Society of America, Madison, Wisconsin.

Stephens, D. B. 2014. Analysis of the Groundwater Monitoring Controversy at the Pavillion, Wyoming Natural Gas Field. Groundwater. doi: 10.1111/gwat.12272.

Stephens, D.B., M. Miller, S.J. Moore, T. Umstot, and D.J. Salvato. 2012. Decentralized Groundwater Recharge Systems Using Roofwater and Stormwater Runoff. Journal of the American Water Resources Association 48(1):134-144. February 2012.

Simco, A., D.B. Stephens, K. Calhoun, and D.A. Stephens. 2009. Historic Irrigation and Drainage at Priestley Farm by Joseph Elkington and William Smith. Vadose Zone Journal 9:4-13.

Stephens, D.B. 2009. J.D. Mather (ed.), Book review: 200 Years of British Hydrogeology, The Geological Society, London, 2004. Hydrogeology Journal 17(7). November 2009.

Stephens, D.B. 2009. An Imminent Human Resource Crisis in Ground Water Hydrology? Ground Water 47(2): 176-183. March—April 2009.

Stephens, D.B. 2009. Also consider the recharge. Technical commentary. Ground Water 47(1):2-3. January—February 2009.

Stephens. 2008. Recent Trends in Hydrogeology and Environmental Consulting and A Perspective on the Maturing of the Hydrogeology Profession. Journal of Hydrologic Engineering 13(1):20-27.

Stephens, D.B. and D.A. Stephens. 2006. British land drainers: their place among pre-Darcy forefathers of applied hydrogeology. Hydrogeology Journal 14:1367-1376.

Stephens, D.B. and M.A. Ankeny. 2004. A missing link in the historical development of hydrogeology. Ground Water 42(2):304-309.

National Vadose Zone Science and Technology Roadmap Executive Committee, Daniel B. Stephens, Chair. 2002. Letter to the editor on a national strategy for vadose zone science and technology. Vadose Zone Journal 1(1):197-198.

Graves, B.J., D. Jordan, D. Cartron, D.B. Stephens, and M.A. Francis. 2000. Allocating responsibility for groundwater remediation costs. Trial Lawyer, 23(2):159-171.

Stephens, D.B., J.A. Kelsey, M.A. Prieksat, M.G. Piepho, C. Shan, and M.D. Ankeny. 1998. DNAPL migration through a fractured perching layer. Ground Water 26(4):605-610.

Stephens, D.B., K.C. Hsu, M.A. Prieksat, M.D. Ankeny, T.N. Blandford, T.L. Roth, J.A. Kelsey, and J.R. Whitworth. 1998. A comparison of estimated and calculated effective porosity. Hydrogeology Journal 6:156-165.

Stephens, D.B. and C. Shan. 1995. An analytical solution for vertical transport of volatile chemicals in the vadose zone. Journal of Contaminant Hydrology 18:259-277.

Shan, C. and D.B. Stephens, 1995. Steady infiltration into a two-layered soil from a circular source. Water Resources Research, 31(8):1945-1952.

Shan, C. and D.B. Stephens. 1994. Recommendation for usage of SURFER to gridding model results. Ground Water 32(3).

Stephens, D.B. 1994. A perspective on diffuse natural recharge mechanisms in areas of low precipitation. Soil Science Society of America Journal 58(1):40-48.

Stephens, D.B. and L.M. Coons. 1994. Landfill performance assessment at a semi-arid site: Modeling and validation. Ground Water Monitoring and Remediation, Winter 1994.

Shan, C. and D.B. Stephens. 1993. A borehole field method to determine unsaturated hydraulic conductivity. Water Resources Research 29(8):2763-2769.

McCord, J.T., D.B. Stephens, and J.L. Wilson. 1991. Toward validating state-dependent macroscopic anisotropy in unsaturated media: Field experiments and modeling considerations. In P.J. Wierenga (Guest Ed.), Validation of flow and transport models for the unsaturated zone. J. Contam. Hydrol. 7:147-177.

McCord, J.T., D.B. Stephens, and J.L Wilson. 1991. Hysteresis and state-dependent anisotropy in modeling unsaturated hillslope hydrologic processes. Water Resources Research 27(7):1501-1518.

McCord, J.T. and D.B. Stephens. 1988. Comment on "Effective relative permeabilities of anisotropic porous media" by Bear, Braester, and Menier. Transport in Porous Media 3:207-210.

Stephens, D.B., J. Havlena, R.G. Knowlton, Jr., E. Mattson, and W. Cox. 1988. Vadose zone characterization of low-permeable sediments using field permeameters. Ground Water Monitoring Review, Spring.

Stephens, D.B. and S.E. Heermann. 1988. Dependence of anisotropy on saturation in a stratified sand. Water Resources Research 24(5):770-778.McCord, J.T. and D.B. Stephens. 1987. Lateral moisture flow beneath a sandy hillslope without an impending layer. Hydrological Processes Journal 1:225-238.

McCord, J.T. and D.B. Stephens. 1987. Short note on "Effect of groundwater recharge on configuration of the water table beneath sand dunes and on seepage in lakes in the sandhills of Nebraska, USA" by T.C. Winter. J. Hydrology 95:365-367.

Stephens, D.B. 1987. The significance of natural ground-water recharge in site selection for mill tailings disposal. AIME Trans. 280:2064-2068.

Stephens, D.B., K. Lambert, and D. Watson. 1987. Regression models for hydraulic conductivity and field test of the borehole permeameter. Water Resources Research 23(12):2207-2214.

Stephens, D.B. and R. Knowlton, Jr. 1986. Soil water movement and recharge through sand at a semi-arid site in New Mexico. Water Resources Research 22(6):881-889.

Stephens, D.B. and K. Rehfeldt. 1985. Evaluation of closed-form analytical models to calculate unsaturated conductivity in a fine sand. Soil Sci. Soc. Am. J. 49(1):12-19.

Stephens, D.B. 1985. A field method to determine un-saturated hydraulic conductivity using flow nets. Water Resources Research 21(1):45-50.

Stephens, D.B. 1985. Comments on "A reexamination of the constant head well permeameter method for measuring saturated hydraulic conductivity" by W.D. Reynolds, E.D. Elrick, and G.C. Topp. Soil Science 139(2):190.

Hawkins, D.C. and D.B. Stephens. 1983. Ground water modeling in a southwestern alluvial basin. Groundwater 21(6):733-740.

Byers, E. and D.B. Stephens. 1983. Statistical and stochastic analysis of hydraulic conductivity and particle size in a fluvial sand. Soil Sci. Soc. Amer. Proc. 47(6):679-688.

Person, M., R. Antle, and D.B. Stephens. 1983. Evaluation of the surface impoundment assessment in New Mexico. Ground Water 21(6):679-688.

Stephens, D.B. 1983. Groundwater flow and implications for groundwater contamination north of Prewitt, New Mexico, USA. J. Hydrology 61:391-408.

Stephens, D.B. and S.P. Neuman. 1982. Vadose zone permeability tests 1: Review. ASCE J. Hydraulics Division 108 (HY5):623-639.

Stephens, D.B. and S.P. Neuman. 1982. Vadose zone permeability tests 2: Steady state. ASCE J. Hydraulics Division 108 (HY5):640-659.

Stephens, D.B. and S.P. Neuman. 1982. Vadose zone permeability tests 3: Transient case. ASCE J. Hydraulics Division 108 (HY5):660-677.

Stephens, D.B. and S.P. Neuman. 1982. Free surface and saturated-unsaturated analysis of borehole infiltration tests above the water table. Advances in Water Resources 5:111-116.

Short Courses

Stephens, D.B. 2009. Artificial Recharge by Surface Infiltration and Vadose Zone Wells. Invited short course with D. Pyne at National Ground Water Association Artificial Recharge of Ground Water. September 24-25, 2009, Baltimore, Maryland.

Stephens, D.B.. 2008. Artificial Recharge by Surface Infiltration and Vadose Zone Wells. Invited short course with D. Pyne at National Ground Water Association 2008 Ground Water Expo. December 2-5, 2008, Las Vegas, Nevada.

Stephens, D.B., J.A. Kelsey, J. Hines, J. Kay, and E. Pease. 2007. Elements of Vadose Zone Hydrology. Invited short course at National Ground Water Association 2007 Ground Water Summit. April 29, 2007, Albuquerque, New Mexico

Stephens, D.B. 1998. Principles of vadose zone hydrology. Invited presentation to the City of Tucson Office of Environmental Management, March 6, Tucson, Arizona.

Stephens, D.B. 1997. Principles of vadose zone hydrology. Invited presentation of a two-day short course presented to the New Mexico Environment Department Underground Storage Tank Bureau, October 15-16, Santa Fe, New Mexico.

Stephens, D.B., T.N. Blandford, A. Lewis. 1997. Hydrogeology short course. Invited presentation to the State of New Mexico, Environment Department, Drinking Water Bureau, April 9, Santa Fe, New Mexico.

Stephens, D.B. 1996. Principles of vadose zone hydrology. Invited presentation of a two-day short course presented to Westinghouse Savannah River Company, March 27-28, Aiken, South Carolina.

Stephens, D.B. 1995. Vadose zone processes, characterization and monitoring. Invited workshop at the National Ground Water Association Outdoor Action Conference, May 2-3, Las Vegas, Nevada.

Stephens, D.B., M.A. Ankeny, J.F. Forbes, and J.A. Havlena. 1995. Vadose zone hydrology: Processes, characterization and monitoring. Short course presented in conjunction with Environmental Education Enterprises, Inc., October 18-20, Albuquerque, New Mexico.

Stephens, D.B. 1994. Basic concepts in vadose zone hydrology. Workshop at the National Ground Water Association Outdoor Action Conference, May 23-24, Minneapolis, Minnesota.

Stephens, D.B. and R.S. Bowman. 1994. Principles of vadose zone hydrology. Short course for the National Ground Water Association, June 20-21, San Antonio, Texas.

Stephens, D.B. 1994. Vadose zone course short course. Ohio University, June 23, Athens, Ohio.

Stephens, D.B. 1994. Principles of vadose zone hydrology. Invited presentation to Bechtel Corporation, November 1-2, San Francisco, California.

Stephens, D.B. 1993. Vadose zone characterization of hydraulic properties. Invited presentation at the DOE workshop on Characterization of Glacial Tills, April 15-16, Cincinnati, Ohio.

Presentations and Articles in Symposia Proceeding

Stephens, D.B. 2017. Challenging Times Ahead. Presented to New Mexico Tech Students. Socorro, New Mexico, March 2, 2017.

Stephens, D.B. 2016. Challenging Times Ahead in Hydrology. Keynote speaker at the NGWA Conference on Hydrology and Water Quality in the Southwest. Albuquerque, New Mexico. February 23-24, 2016.

Stephens, D.B. 2015. Managed aquifer recharge. Presentation at the 2015 NGWA Groundwater Expo and Annual Meeting. Las Vegas, Nevada. December 15, 2015.

Stephens, D.B. and D.A. Stephens. 2015. The Role of William Smith's Agricultural Improvements to Prisley Farm in the Development of the Geologic Map, Session on Celebrating the Genius of William 'Strata' Smith: Bicentennial Anniversary of Smith's Revolutionary Map. Presentation at the Geological Society of America 2015 Annual Meeting, Baltimore, Maryland. November 1, 2015.

Stephens, D.B. 2015. Defining Basins from a Hydrologic Perspective: What are the Boundaries? Overview of the statutory structure including SGMA provisions; how the modeling works; areas of certainty and uncertainty; tips for selecting the most cost-effective approach. Invited speaker at the The Science and Law of Water in California Law Seminars International, Santa Monica, California. September 17, 2015.

Stephens, D.B. 2015. Analysis of Groundwater Monitoring Controversy at the Pavillion, Wyoming Natural Gas Field. Invited speaker at the 2015 Multi-State Salinity Coalition Annual Salinity Summit - Understanding the Opportunities and Challenges of Fracking in an Era of Water Supply Scarcity, Las Vegas, Nevada. February 19, 2015.

Stephens, D.B. 2014. Managed Aquifer Recharge: An Overview with Examples. Invited speaker for National Ground Water Association, Groundwater Expo and Annual Meeting, Las Vegas, Nevada. December 9-12, 2014.

Stephens, D.B. 2014. Analysis of a Groundwater Monitoring Investigation for Impacts of Hydraulic Fracturing, Pavillion, Wyoming. Webinar, National Ground Water Association. November 6, 2014.

Stephens, D.B. 2014. Analysis of Groundwater Monitoring Controversy at the Pavillion, Wyoming Natural Gas Field. Presentation at the 2014 Annual Meeting of the Geological Society of America. Vancouver, British Columbia, Canada. October 19, 2014.

Stephens, D.B. 2014. Analysis of Groundwater Monitoring Controversy at the Pavillion, Wyoming Natural Gas Field. Invited speaker for Society of Petroleum Engineers, Environmental Study Group. Midland, Texas. October 16, 2014.

Stephens, D.B. 2014. Analysis of Groundwater Monitoring Controversy at the Pavillion, Wyoming Natural Gas Field. Invited speaker at the Law Seminars International 2014 Hydraulic Fracturing in California. Beverly Hills, California. August 12, 2014.

Stephens, D.B., J. Cherney, J. Kay, T. Umstot, and B. Casadevall. 2014. High Recharge at a Semi-Arid Site Explains Wide-Spread Perchlorate in Groundwater with a Deep Water Table. Presentation at the National Ground Water Association Ground Water Summit. May 7, 2014. Denver, Colorado.

Stephens, D.B. 2013. Brownfield Remediation Program in the U.S. Invited speaker at the Institute of Soil Science of the Chinese Academy of Science. Nanjing, Peoples Republic of China. December 17, 2013.

Stephens, D.B., J. Cherney, J. Kay, T. Umstot, P. Kaiser, and B. Casadevall. 2013. Unexpectedly rapid migration of perchlorate through a thick vadose zone under low rainfall conditions. Invited speaker at the National Ground Water Association Pillars of Groundwater Innovation Conference. November 7-8, Phoenix, Arizona.

Stephens, D.B. 2013. Impacts of hydraulic fracturing on water resources, water supply and water quality. Invited speaker at the New Mexico Involvement Committee—Rocky Mountain Section of the American Water Works Association and the Rocky Mountain Section of the Water Environment Association. June 20, Albuquerque, New Mexico.

Stephens, D.B. 2012. Impacts of hydraulic fracturing on water resources. Invited speaker at the 19th Annual Conference, Western Water Law. November 15-16, Las Vegas, Nevada.

Stephens, D.B., F.E. Botros, S. Helenschmidt, P. Quinlan, and D.W. Davis. 2012. Rising groundwater: unexpected consequences downgradient of a freeway expansion. Presentation at the National Ground Water Association Ground Water Summit, May 6-10, Garden Grove, California.

Stephens, D.B. and J.A. Kelsey. 2012. Overview of artificial recharge by surface infiltration. Presentation at the National Ground Water Association Ground Water Summit, May 6-10, Garden Grove, California.

Stephens, D.B. 2012. Demystifying flow in the vadose zone. Presentation at the National Ground Water Association Ground Water Summit, May 6-10, Garden Grove, California.

Stephens, D.B., F.E. Botros, S. Helenschmidt, B. Casadevall, P. Quinlan, and D. Davis. 2012. The Importance of Hydrogeologic Characterization and Analysis to Avoid Off-site Impacts in Highway Construction. Presentation given by F.E. Botros at the American Society of Civil Engineers, Geo-Congress 2012, March 25-29, Oakland, California.

Stephens, D.B., M. Miller, S. Moore, T. Umstot, and D.J. Salvato. 2011. Decentralized groundwater recharge systems using roofwater and stormwater runoff. Presentation at the American Water Resources Association Annual Water Resources Conference. November 7-10, Albuquerque, New Mexico.

Wahi, A.K. and D.B. Stephens. 2011. Is TCE from Biodegradation of PCE or a Separate Release? An Application of Compound Specific Isotope Analysis and Other Methods. Presentation given by A.K. Wahi at the Environmental Forensics in an Era of Emerging Diagnostic Methods. Ground Water Resources of California, April 12, 2011, Irvine, California.

Stephens, D.B. and S.J. Moore. 2011. A Role for Dispersed Groundwater Recharge Systems to Balance Effects of Hydro modification. Presentation at the Managed Aquifer Recharge Symposium. National Water Research Institute. January 24-26, Orange County, California.

Stephens, D.B., S.J. Moore, M.Miller, T. Umstot, and D.J. Salvato. 2010. Decentralized Artificial Recharge. Invited presentation at the 55th Annual New Mexico Water Conference: Water Needs in the Next Decade—How will institutions evolve to meet our water needs in the next decade? New Mexico State University, Las Cruces, New Mexico. December 1-3.

Stephens, D.B. and S.J. Moore. 2010. Rainwater Harvesting to Augment Groundwater Supplies. Presentation at the North American Geology in the 21st Century: Today and Tomorrow. AIPG-AGWT-FAPG-ASFE 2010 Conference, September 11-15, 2010, Orlando, Florida.

Stephens, D.B., S.J. Moore, S.J. Cullen, A. Staden, and L. Jong. 2010. Augmenting groundwater supplies using rain water harvesting. Presentation at the National Ground Water Association Ground Water Summit and Ground Water Protection Council Meeting. April 11-15, 2010, Denver, Colorado.

Stephens, D.B., S. Moore, M. Miller, and A Standen. 2009. Is There A Role for Rainwater Harvesting in New Mexico Water Resources Management? Presentation at the 2009 New Mexico Water Research Symposium. August 11, 2009, Socorro, New Mexico.

Stephens, D.B., L. Jong, A. Standen, S. Moore, and S. Cullen. 2009. Roof Water Harvesting for Artificial Recharge in the Americas. Presentation at the National Ground Water Association Groundwater for the Americas. June 8-10, 2009, Panama City, Panama.

Stephens, D.B., A. Simco, K. Calhoun, D. Stephens. 2009. Drainage work at Prisley Bog on the Bedford Estate. Presentation at the National Ground Water Association Ground Water Summit. April 19-23, 2009, Tucson, Arizona.

Stephens, D.B. 2009. Artificial Recharge, Groundwater Storage, and Recovery: An Overview. Invited presentation at the American Bar Association Section of Environment, Energy and Resources 27th Annual Water Law Conference: Change in the Midst of Constants: Adapting Water Law to Meet New Demands, February 18-20, 2009, Coronado, San Diego, California.

Stephens, D.B. 2009. Vadose Zone Monitoring Strategies for Contaminant Detection and Recharge. Invited presentation at the Groundwater Resources Association of California Groundwater Monitoring: Design Analysis, Communications & Integration with Decision Making Conference, February 25-26, 2009, Orange, California.

Stephens, D.B. and T. Umstot. 2008. Recharge Analyses in a Desert Groundwater Basin. Presentation at the American Water Resources Association Annual Water Resources Conference. November 17-20, New Orleans, Louisiana.

Umstot, T. and D.B. Stephens. 2008. Distributed parameter modeling of an arid watershed to assess net infiltration. Presentation at the American Water Resources Association Annual Water Resources Conference. November 17-20, New Orleans, Louisiana.

Stephens, D.B. 2008. A Hydrogeologist's Perspective on Vadose Zone Modeling Challenges. Invited presentation at the Geological Society of America/Soil Science Society of America/Agronomy Society of America/Crop Society of America Joint Meeting. October 5-9, Houston, Texas.

Stephens, D.B. and T. Umstot. 2008. Recharge Analyses in a Desert Groundwater Basin. Invited presentation at the Geological Society of America/Soil Science Society of America/Agronomy Society of America/Crop Society of America Joint Meeting. October 5-9, Houston, Texas.

Stephens, D.B. and T. Umstot. 2008. Challenges in characterizing and simulating flow and transport in stony soils. Presentation at the Geological Society of America/Soil Science Society of America/Agronomy Society of America/Crop Society of America Joint Meeting. October 5-9, Houston, Texas.

Stephens, D.B. 2007. Recharge of Groundwater Aquifers in Arid Regions. Invited speaker at Kuwait-MIT Center for Natural Resources and the Environment's Forum on Arid Zone Hydrology, January 16-17, 2007, Kuwait.

Sweetland, N.T., T.G. Umstot, J. Ayarbe, and D.B. Stephens. 2006. Processes Influencing the Transport of Perchlorate Through the Vadose Zone. Presentation at the Perchlorate 2006: Progress Toward Understanding and Cleanup Symposium, Groundwater Resources Association of California, January 26, 2006, Santa Clara, California.

Stephens, D.B., S. Moore, D. Cartron, and T.N. Blandford. 2006. Quantifying Return Flow to Groundwater: What's in the Tool Box. Presentation at the National Ground Water Association 2006 Ground Water Summit, April 22-27, San Antonio, Texas.

Stephens, D.B. 2005. A Perspective on Science and Research in the Environmental Consulting Industry. Invited presentation at the Annual Fall Meeting of the American Geophysical Union. December 4-9, San Francisco, California.

Stephens, D.B. 2005. Overview of Artificial Recharge Projects: Planning and Implementation Challenges. Invited presentation at the Groundwater Resources Association of California's Artificial Recharge: Nexus of Quantity and Quality in California, March 16-17, Sacramento, California.

Stephens, D.B. and T.Neil Blandford. 2004. Hydrogeologic analysis, transport and modeling for environmental litigation, a case study. Presentation at the National Ground Water Association Ground Water and Environmental Law Conference, May 5-6, 2004, Chicago, Illinois.

Stephens, D.B. 2004. Contaminant Age Dating Using Hydrogeologic Analysis. Invited speaker at the Mealey's Water Contamination Conference, January 26-27, 2004, Pasadena, California.

Sweetland, N.T., T.G. Umstot, and D.B.Stephens. 2004. Distinguishing Operational Releases Versus Spills for Insurance Allocation. Poster presentation at the Investigation and Remediation of Dry Cleaner Release Sites, April 7, 2004, Sacramento, California.

Stephens, D.B. 2003. Impact of Hydrogeologic Variables on Contaminant Plume Migration and Forensic Modeling. Invited speaker at the International Society of Environmental Forensics Environmental Forensics: Using Science to Reconstruct Contamination Events, December 8-9, 2003, Taipei, Taiwan.

Stephens, D.B. 2003. Late eighteenth century hydrogeology: a pre-Darcy perspective. Presentation at the Geological Society of America Annual Conference, November 2-5, 2003, Seattle, Washington.

Stephens, D.B. 2003. Unexpected field observations and DOE's Vadose Zone Roadmap. Invited speaker at the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America Annual Meetings, November 2-6, 2003, Denver, Colorado.

Stephens, D.B. 2003. Application of groundwater contaminant transport modeling in environmental forensic investigations: Tucson Airport Superfund Site. Invited speaker at the Workshop on Environmental Forensics: theory, applications and case studies, International Society of Environmental Forensics. May 19-20, 2003, Stresa, Italy.

Stephens, D.B. 2003. Subsurface considerations of artificial recharge. Invited speaker at Artificial recharge in California—technical and policy challenges, Ground Water Resources Association of California. April 30-May 1, 2003. San Jose, California.

Stephens, D.B. 2002. Principles and Case Studies of Allocation of Responsibility for Petroleum Contaminated Soil and Groundwater. Invited speaker at the Identification and Assessment of Historical Subsurface Contamination: An International Society of Environmental Forensics Workshop, July 1-2, 2002, Milan, Italy.

Stephens, D.B. and W. Cox. 2001. The Importance of the Vadose Zone in Stream-Aquifer Interaction—Field and Model Studies. Presented by Mark Ankeny on behalf of D.B. Stephens at the American Water Resources Association Annual Conference on Water Resources. November 12-15, 2001. Albuquerque, New Mexico.

Stephens, D.B. and T. Neil Blandford. 2001. Hydrogeologic Analysis, Transport and Modeling for Environmental Litigation. A Case Study. Presented by Neil Blandford on behalf of D.B. Stephens at the Arizona Hydrological Society Fourthteenth Annual Symposium. September 12-15, 2001. Tucson, Arizona.

Stephens, D.B. and T. Neil Blandford. 2001. Hydrogeologic Analysis, Transport and Modeling for Environmental Litigation. A Case Study. Presentation at the First International Congress on Petroleum Contaminated Soils, Sediments, and Water Analysis, Assessment and Remediation, August 14-17, 2001, London, United Kingdom.

Stephens, D.B. 2001. Scientific applications of volume, mass and toxicity for cost allocation modeling. Invited speaker at the University of Wisconsin-Madison, Environmental Litigation: Advanced Forensics and Legal Strategies, April 4-5, 2001, San Francisco, CA.

Stephens, D.B. and S. Kowall. 2000. The DOE Complex-Wide Science and Technology Roadmap: Characterization, Modeling and Simulation of Subsurface Contaminant Fate and Transport. Presentation at the 12th Technical Information Exchange Workshop. November 14-16, 2000. August, Georgia.

Stephens, D.B., K. Hsu, M.A. Prieksat, M.D. Ankeny, T.N. Blandford, T.L. Roth, J.A. Kelsey, and J.R. Whitworth. 2000. Review of Porosity Measurements for Water Supply and Water Quality Modeling. Presented by T. Neil Blandford on behalf of D.B. Stephens at the Southwest Focus Ground Water Conference 2000. May 17-18, 2000. Austin, Texas.

Stephens, D.B. and N.T. Nelson. 2000. Observed natural attenuation of TCA in groundwater. In Proceedings Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 22-25, 2000. Battelle Press, Columbus, Ohio.

Stephens, D.B. 2000. The role of the unsaturated zone in groundwater recharge. Invited speaker at the Innovations in Artificial Recharge: Augmenting Local Groundwater Supplies for the New Millennium, May 4-5, 2000, Ontario, California.

Stephens, D.B. 2000. Observed natural attenuation of TCA in groundwater. Tenth Annual West Coast Conference on Contaminated Soils and Water, March 20-23, 2000, San Diego, CA.

Stephens, D.B. 2000. MTBE—gasoline additive in the national spotlight. Invited speaker at the Albuquerque Petroleum Association Meeting, February 28, 2000, Albuquerque, NM.

Stephens, D.B. 1999. Physical considerations in artificial recharge. Invited presentation at the 22nd Biennial Ground Water Conference, Interconnected Water Supply in California, September 20-21, San Diego, CA.

Stephens, D.B. 1999. Scientific applications of volume, mass and toxicity for allocating cleanup responsibility. Invited presentation at IBC's Second Annual Executive Forum on Environmental Forensics, June 24-25, 1999, Washington, D.C.

Stephens, D.B. 1999. Basic theory of flow from surface impounds and dry wells used for artificial recharge. Ninth Biennial Symposium on Artificial Recharge of Groundwater, June 10-12, 1999, Tempe, AZ.

Stephens, D.B. 1999. Invited panel member of the Southwest Ground Water—critical issues and information needs, U.S. Geological Survey, Tuscon, Arizona, March 25.

Stephens, D.B. 1998. MTBE fate and transport review. Invited presentation and panel member of the 1998 New Mexico Underground Storage Tank Conference, November 17, 1998, Albuquerque, NM.

Stephens, D.B., W. Cox. 1998. The importance of vadose zone in stream-aquifer interaction: field and model studies. In Proceedings Groundwater Protection Council 1998 Annual Forum, Sacramento, California, September 19-23.

Stephens, D.B., E. Seay. 1998. Interpretations of mechanical integrity tests and groundwater monitoring data at a salt water disposal well: a case study. In Proceedings Groundwater Protection Council 1998 Annual Forum, Sacramento, California, September 19-23.

Stephens, D.B. 1998. Scientific applications of volume mass and toxicity for allocating responsibility for aquifer clean-up. Invited presentation at the National Environmental Forensic Conference: Chlorinated Solvent and Petroleum Hydrocarbons, University of Wisconsin-Madison, Department of Engineering Professional Development, Tucson, Arizona, August 27-28.

Stephens, D.B., J.R. Forbes, M.E. Miller, and J. Minier. 1998. PCE degradation near petroleum contaminated sites. In Proceedings First International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 18-21, 1998. Battelle Press, Columbus, Ohio.

Stephens, D.B. 1997. Case studies in DNAPL delineation, technical infeasibility and remediation cost allocation. Invited keynote speaker at the International Conference on Remedial Technology and Management of Subsurface Contamination, December 1-3, Taipei, Taiwan.

Stephens, D.B., J.A. Kelsey, M.A. Prieksat, M.G. Piepho, C. Shan, and M.D. Ankeny. 1998. DNAPL migration through a fractured perching layer. Presentation at the Geological Society of America Annual Meeting, October 21, Salt Lake City, Utah.

Stephens, D.B. 1997. Infiltration modeling roles in RBCA. Invited presentation and panel member of the 1997 New Mexico Underground Storage Tank Conference, September 9-10, Ruidoso, New Mexico.

Stephens, D.B. 1996. Borehole permeameter development, applications and limitations. Presentation at American Geophysical Union Fall Meeting, December 15-19, San Francisco, California.

Stephens, D.B. 1996. Hydrogeology and contaminant transport. Invited presentation at The Who, What, Where & How of Toxic Tort Litigation, The Arizona Bar Association Continuing Legal Education, November 22, Phoenix, Arizona.

Stephens, D.B., J.A. Kelsey, M.A. Prieksat, M.G. Piepho, M.D. Ankeny, and C. Shan. 1996. DNAPL migration in a complex multi-aquifer system. Presentation at Geological Society of America Annual Meeting, October 28-31, Denver, Colorado.

Stephens, D.B., J.A. Kelsey, M.A. Prieksat, M.G. Piepho, M.D. Ankeny, and C. Shan. 1996. DNAPL migration in a complex multi-aquifer system. Presentation at HSRC/WERC Joint Conference on the Environment, May 21-23, Albuquerque, New Mexico.

Stephens, D.B. 1996. Estimating cleanup costs for purposes of mediation: Achieving finality in face of uncertainty. Invited presentation at Resolving Environmental Disputes Through Mediation conference, University of Wisconsin, May 16-17, Albuquerque, New Mexico.

Stephens, D.B., J. Minier, and M.E. Miller. 1996. Subsurface migration and transformation of PCE. Presentation at the New Mexico Conference on the Environment, March 12-14, Albuquerque, New Mexico.

Forbes, J.R. and D.B. Stephens. 1996. Natural biodegradation of subsurface hydrocarbons: Case studies from the southwest United States. Presentation at Bioremediation Technology Transfer Conference, EPA Western Region Hazardous Subresearch Center and Albuquerque Technical Vocational Institute, February 16, Albuquerque, New Mexico.

Stephens, D.B. 1995. Site characterization, remediation: Better/cheaper/faster. Invited presentation at Los Alamos Environmental Restoration Technical Session, Los Alamos National Laboratory, April 19, Los Alamos, New Mexico.

Stephens, D.B. 1995. Environmental remediation technology. Invited presentation at New Mexico Water Law Water Rights and Water Quality Issues, August 28-29, Santa Fe, New Mexico.

Stephens, D.B. 1994. The role of consultants in water rights matters. Presented at Cambridge Institute seminar on New Mexico Water Rights: Key Issues and Recent Developments, March 16, Santa Fe, New Mexico.

Stephens, D.B. 1994. The significance of saturated hydraulic conductivity and residual water content in predictions of unsaturated transport. Invited presentation at the Soil Physics Workshop on Subsurface Transport at Battelle, March 31-April 1, Richland, Washington.

Stephens, D.B. and T.N. Blandford. 1994. Hydrogeology short course. Invited presentation to the State of New Mexico, Environment Department, Drinking Water Bureau, December 6-7, Santa Fe, New Mexico.

Stephens, D.B. and J.C. Stageman. 1993. The consultant's role in addressing environmental risks in real estate and lending. Invited presentation at the Cambridge Institute workshop on Tackling Environmental Issues in New Mexico, September 24, Albuquerque, New Mexico.

Stephens, D.B. 1993. Designing a vadose zone monitoring system for municipal and hazardous waste landfills. 16th Annual Rocky Mountain Groundwater Conference, September 13-16, Albuquerque, New Mexico.

Stephens, D.B. 1993. Unsaturated flow and recharge. Invited presentation at the 19th Annual Field Studies in Groundwater Contamination Evaluation in Three Modules, Ohio University, June 25, Athens, Ohio.

Stephens, D.B. 1993. Vadose zone processes, characterization, and monitoring. Invited presentation at the National Ground Water Association Outdoor Action Conference, Outdoor Workshops, May 25-27, Las Vegas, Nevada.

Stephens, D.B. 1992. A comparison of the calculated and measured unsaturated hydraulic conductivity of two uniform soils in New Mexico. In M.Th. van Genuchten, F.J. Leij, and L.J. Lund (eds.), Proc. International Workshop on Indirect Methods for Estimating the Hydraulic Properties of Unsaturated Soils, October 11-13, 1989, Riverside, California. University of California, Riverside, California.

Stephens, D.B. 1992. A hydrogeologist's encounter with geologic problems in New Mexico. Guest lecture at the New Mexico Geological Society Annual Spring Meeting, April 10, Socorro, New Mexico.

Stephens, D.B. 1992. Vadose zone processes, characterization, and monitoring. Invited presentation at the National Ground Water Association Outdoor Action Conference, Indoor Workshops, May 11-13, Las Vegas, Nevada.

Stephens, D.B. 1992. Unsaturated flow and recharge. Invited presentation at the 18th Annual Field Studies in Groundwater Contamination Evaluation in Three Modules, Ohio University, June 15-July 3, Athens, Ohio.

Stephens, D.B. 1992. Encounters with geologic problems in New Mexico. Guest lecture at the AWWA-WPCA (WEA) meeting, July 28, Albuquerque, New Mexico.

Stephens, D.B. 1992. Characterizing the leaching potential of landfills. Invited presentation at the American Geophysical Union Western Pacific Geophysics Meeting, August 17-21, Hong Kong, China.

Stephens, D.B. 1992. Cost-effective remediation at UST sites. Presentation at the Cost-Effective Corrective Action session during the New Mexico Conference on the Environment, September 15, Albuquerque, New Mexico.

Stephens, D.B. 1992. Observation of the effects of heterogeneity on unsaturated flow. Invited presentation at the Remson Symposium, 1992 American Geophysical Union Fall Meeting, December 7-11, San Francisco, California.

Bowman, R.S., D.B. Jaynes, R.C. Rice, and D.B. Stephens. 1991. Field determination of solute transport parameters in "homogeneous" vs. "heterogeneous" soils. Presented at the ASA-CSSA-SSSA 83rd Annual Meeting, October 27-November 1, Denver, Colorado.

Havlena, J. and D.B. Stephens. 1991. Vadose zone characterization using field permeameters and instrumentation. In Proc. Symp. Ground Water and Vadose Zone Investigation, ASTM, January 30-February 1, San Diego, California.

Havlena, J.A. and D.B. Stephens. 1991. Vadose zone characterization using field permeameters and instrumentation. In D.M. Nielsen and M.N. Sara (ed.), Current practice in ground water and vadose zone instrumentation, ASTM STP 118, American Society for Testing Materials, Philadelphia.

Stephens, D.B. 1991. Diffuse, natural recharge calculated from field data and comparisons among semiarid sites. Presented at the ASA-CSSA-SSSA 83rd Annual Meeting, October 27-November 1, Denver, Colorado.

Stephens, D.B. 1991. Characterizing permeability to gas in the vadose zone. Invited presentation at the Symposium on Soil Venting, sponsored by the Robert S. Kerr, Environmental Research Laboratory and the National Center for Ground Water Research, April 29-May 1, Houston, Texas.

Stephens, D.B. 1991. Vadose zone characterization and monitoring. Invited presentation for the Hazardous/Radioactive Waste Management Videoconference Training Series, Program 5: Site Characterization, June 12, University of New Mexico, Albuquerque, New Mexico.

Stephens, D.B. 1991. Unsaturated flow and recharge. Invited presentation at the 17th Annual Field Studies in Water Resource and Contamination Evaluation, Ohio University, June 10-28, Athens, Ohio.

Stephens, D.B., R.S. Bowman, E. Mattson, A. Parsons, K. Flannigan, R. Schmidt-Petersen, D. Grabka, P. Arnet, and A. Stark. 1991. Long-term three-dimensional infiltration, drainage, and transport in a heterogeneous soil. Presented at the 1991 AGU Fall Meeting, December 9-13, San Francisco, California.

Stephens, D.B. 1990. Uncertainties in site characterization data. Invited paper, 12th Annual U.S. DOE Low-Level Waste Management Conference, August 28, Chicago, Illinois.

Beach, J.A., D.B. Stephens, and A.L. Gutjahr. 1989. Incorporation of spatial variability in mill tailings hydraulic properties into numerical models: Implications for uncertainty in seepage prediction and ground water protection. Ninth Annual AGU Front Range Branch Hydrology Days, April 17-21.

Bowman, R.S., D.B. Stephens, D.P. Grabka, K.G. Flanigan, and Department of Geoscience, New Mexico Institute of Mining and Technology. 1989. A multi-tracer field experiment to evaluate solute transport in variably saturated soils. Tracers in Hydrogeology: Principles, Problems, and Practical Applications, National Water Well Association Conference, October 31-November 1, Houston, Texas.

Parsons, A.M., E.D. Mattson, D.B. Stephens, K. Flanigan, and K. Black. 1988. Field simulation of waste impoundment seepage in the vadose zone. In Proc. FOCUS on Southwestern Groundwater Issues Conference, National Water Well Association, March 23-25, Albuquerque, New Mexico.

Cox, W.B. and D.B. Stephens. 1988. Field study of ephemeral stream-aquifer interaction. In Proc. FOCUS on Southwestern Groundwater Issues Conference, National Water Well Association, March 23-25, Albuquerque, New Mexico.

McCord J.T., D.B. Stephens, and J.L. Wilson. 1988a. Field experiments and numerical simulations of unsaturated flow and transport: Role of hysteresis and state-dependent anisotropy. NATO Advanced Study Institute on Recent Advances in Modeling Hydrologic Systems, July 1988, Sintra, Portugal.

McCord J.T., D.B. Stephens, and J.L. Wilson. 1988b. Field-scale unsaturated flow and transport in a sloping, uniform porous media: Field experiments and numerical simulation (Abs). International Conference and Workshop on Validation of Flow and Transport Models for the Unsaturated Zone, Poster Session, May 22-25, Ruidoso, New Mexico.

Stephens, D.B., A.M. Parsons, E.D. Mattson, K. Black, K. Flanigan, R.S. Bowman, and W.B. Cox. 1988. A field experiment of three-dimensional flow and transport in a stratified soil. p. 401-413. In P.J. Wierenga and D. Bachelet (eds.), Proc. International Conference and Workshop on Validation of Flow and Transport Models for the Unsaturated Zone, May 22-25, Ruidoso, New Mexico. New Mexico State University, Las Cruces.

Stephens, D.B., J.T. McCord, R.G. Knowlton, Jr., B. Kickham, E. Hicks, and T. Stein. 1988. Three-dimensional soil-water flow in semi-arid terrain (Abs). International Conference on Advances in Ground-Water Hydrology, November 16-18, Tampa, Florida.

McCord, J.T. and D.B. Stephens. 1987. Infiltration and recharge on a sandy hillslope in an arid climate. International Conference on Infiltration Development and Application, University of Hawaii, January 6-9. Manoa, Hawaii.

Stephens, D.B. 1987. Processes affecting the movement and fate of pesticides in soil and groundwater. New Mexico Environmental Improvement Division, May 27, Santa Fe, New Mexico.

Stephens, D.B. 1986. Saturated-unsaturated flow relationships. 15th Annual Rocky Mountain Groundwater Conference, September 13-16, Phoenix, Arizona.

Larson, M.B. and D.B. Stephens. 1985. A comparison of methods to characterize unsaturated hydraulic properties of mill tailings. In Proceedings Seventh Symposium on Management of Uranium Mill Tailings, Low-level Waste and Hazardous Waste, Colorado State University, February 6-8, Ft. Collins, Colorado.

Lewis, B. and D.B. Stephens. 1985. Analysis of infiltration through mill tailings using a bromide tracer. In Proc. Seventh Symp. on Management of Uranium Mill Tailings, Low-Level Waste and Hazardous Waste, Colorado State University, February 6-8, Ft. Collins, Colorado.

Stephens, D.B., R.G. Knowlton, Jr., M. Stanfill, and E.M. Hirtz. 1985. Field study to quantify seepage from a fluid impoundment. pp. 283-308. In Proc. NWWA Conf. on Characterization and Monitoring of the Vadose (Unsaturated) Zone, November 19-21, Denver, Colorado. NWWA, Dublin, OH.

Stephens, D.B. 1984. Groundwater flow and implications for groundwater contamination in sedimentary formations of the southern San Juan Basin, New Mexico, USA. International Groundwater Symposium on Groundwater Resources Utilization and Contaminant Hydrology, Canada Water Well Association, May 21-23, Montreal, Canada.

Stephens, D.B., K. Lambert, and D. Watson. 1983. Influence of entrapped air on field determinations of hydraulic properties in the vadose zone. In Proc. Conf. on Vadose Zone Characterization and Monitoring, December 8-10, Las Vegas, Nevada. National Water Well Association, Columbus, Ohio.

Stephens, D.B., S. Tyler, K. Lambert, and S. Yates. 1983. Field experiments to determine saturated hydraulic conductivity in the vadose zone. pp. 113-126. In J.W. Mercer et al. (ed.), Role of the unsaturated zone in radioactive and hazardous waste disposal. Ann Arbor Sci, Ann Arbor, Michigan.

Stephens, D.B. and J. Siegel. 1981. Fluid waste movement through the vadose zone. pp. 103-110. In S.G. Wells and W. Lambert (ed.) Environmental Geology and Hydrology in New Mexico. New Mexico Geological Society, Special Pub. 10.

Siegel, J. and D.B. Stephens. 1980. Numerical simulation of seepage beneath lined ponds. pp. 219-232. In Proc. Symposium on Uranium Mill Tailings Management, November 24-25, Ft. Collins, Colorado.

Stephens, D.B. and S.P. Neuman. 1980. Free surface and saturated-unsaturated analyses of borehole infiltration tests above the water table. pp. 2.229-2.238. In Third International Conference on Finite Elements in Water Resources, May 19-23, Oxford, Mississippi, USDA-ARS.

Other Publications

Stephens, D.B., P. Johnson, and J. Havlena. 1996. Estimation of infiltration and recharge for environmental site assessment. American Petroleum Institute publication number 4643.

Bowman, R.S., D.B. Stephens, P. Arnet, D.P. Grabka, R.I. Schmidt-Petersen, and A.M. Stark. 1991. Field study of multidimensional flow and transport in the vadose zone. Report No. 262, New Mexico Water Resources Research Institute, December 1991.

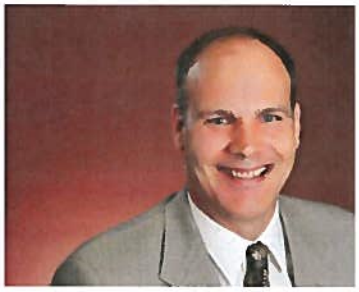
Stephens, D.B. and C. Spaulding. 1984. Oil-field brine contamination: A case study, Lea County, New Mexico. In W.J. Stone, Selected papers on water quality and pollution in New Mexico, Bureau of Mines and Mineral Resources, Hydrologic Report 7.

NMMA Exhibit J

Resume of
Neil Blandford

T. Neil Blandford, P.G.

Senior Vice President, Principal Hydrologist



EDUCATION

M.S., Hydrology,
New Mexico Institute of Mining and Technology, 1987

B.A., Environmental Science,
University of Virginia, 1984

PROFESSIONAL REGISTRATIONS

Professional Geoscientist,
Texas, No. 1034

Mr. Blandford specializes in expert testimony, hydrogeologic evaluations at mine sites, , water supply investigations and water rights analysis, groundwater planning studies, numerical simulation of groundwater flow and contaminant transport, aquifer testing methods, effects of groundwater pumping on surface water, wellhead protection area delineation and source water determination, and remediation well field design.

Expert Testimony Regarding Mine Closure/Closeout Issues, Freeport McMoRan Tyrone, Inc., Tyrone, New Mexico
Provided expert testimony during New Mexico Environment Department and New Mexico Water Quality Control Commission hearings. Areas of testimony included groundwater hydrology of the Tyrone Mine area under current and closure/closeout conditions, locations of reasonably foreseeable future use in the vicinity of the mine, and the potential for mining operations to have adverse impacts on groundwater resources and adjacent users. Testimony was based on modeling and other quantitative analyses of seepage through stockpiles and tailing impoundments, and the influence of multiple open pits on groundwater flow.

Expert Opinion on Mine Application, Mining and Minerals Division of the New Mexico Energy, Minerals and Natural Resources Department, Copper Flat Mine, New Mexico
Conducted detailed review and provided expert opinion on impact analysis modeling and other hydrogeologic analyses conducted for mine permit application.

Tyrone Mine Closure/Closeout and Technical Hydrology Support, Freeport McMoRan Tyrone, Inc., Tyrone, New Mexico
Provided technical oversight, served as project manager, and conducted numerous technical studies and tasks at the Tyrone Mine related to groundwater issues. Examples include aquifer testing of monitor and production wells, development and execution of site investigation and corrective action studies, evaluation of sources of groundwater contamination and the nature and occurrence of groundwater at the mine, and assistance with various legal and regulatory issues related to groundwater.

Development of Stage 1 Abatement Plan for Tyrone Mine, New Mexico, Freeport McMoRan Tyrone, Inc., Tyrone, New Mexico
Principal investigator for development and submission of Stage 1 Abatement Plan for the Tyrone Mine. The plan consists of a comprehensive evaluation of groundwater and hydrogeologic conditions, and delineation of the extent of impacted groundwater. Assisted the client with planning and execution of additional work and negotiations with the regulatory agency.

Site Investigation, Groundwater and Solute Transport Modeling and Post-Closure Monitoring at the Pecos Mine and El Molino Tailing Impoundments, Cyprus Amax Minerals Corporation, Pecos, New Mexico
Project team member for site investigation activities and hydrogeologic analysis at the Pecos Mine and El Molino Mill and Tailing Operable Units (PMOU and EMOU). Principal investigator for development and application of a groundwater flow and solute transport model at EMOU, for quarterly sampling and reporting at both sites, and for the development of Compliance Monitoring Plans at both facilities.

Development of Stage 2 Abatement Plan Proposal for the Tyrone Mine, Freeport McMoRan, Tyrone, Inc., Tyrone, New Mexico
Principal investigator for the development of the Stage 2 Abatement Plan Proposal for Tyrone Mine. The Plan includes a detailed overview of groundwater impacts at the mine, historical and predictive groundwater flow modeling accounting for the effects of open pits, stockpiles and other mine facilities, geochemical transport modeling of 14 constituents of concern, and proposed abatement measures for the mine site, an area of approximately 15 square miles.

Water Rights, Hydrologic, and Environmental Analysis, Pueblo of Acoma, New Mexico
Conducted hydrologic water rights analyses, provided training on hydrologic issues and water resources, developed spring sampling plan, conducted detailed review and analysis of complex regional groundwater flow model, and assisted with development of water quality standards and water code.

Remediation Well Field Design and Contaminant Transport Simulation, AlliedSignal Technical Services, NASA White Sands Test Facility, White Sands, New Mexico
Project manager and principal investigator for design of remediation well field for multi-component contaminant plume that extends several miles from source areas within alluvial sediments and adjoining, structurally complex, fractured rock. Alternative well field designs were tested using three-dimensional groundwater flow, groundwater pathline tracking, and solute transport models. Model was also used to support site risk assessment.

Independent Review of Assessment of Hydrologic Impacts, Village of Galisteo through Commonweal Conservancy, Santa Fe County, New Mexico
Provided an independent review and opinion regarding the effects of a proposed development on the water supply of the Village of Galisteo. Reviewed available data, literature, and reports of other professionals. Village relied on findings to help determine how to proceed with a water rights transfer protest.

Evaluation of District-Wide Hydrogeology and Mine Expansion, Confidential Client, New Mexico
Led project team to evaluate mine site hydrogeology and the source of existing and future groundwater inflows to existing and proposed open mine pits. Analysis was conducted using field investigations, geochemical fingerprinting, and numerical groundwater flow modeling. The project results assisted the client with making key operational and regulatory decisions.

Remediation Well Field Design, New Mexico Environment Department, Hobbs, New Mexico
Developed a three-dimensional groundwater flow model for municipal wells at an underground storage tank (UST) site. Model was applied to determine remediation well locations and pumping rates to maximize contaminant mass removal, provide plume containment, and provide wellhead protection to four municipal water supply wells in the plume vicinity.

Evaluation of Groundwater Resources, Texas General Land Office, Texas
Principal investigator for the evaluation of the groundwater resources associated with over 2,000 General Land Office properties throughout Texas. GIS database was constructed that included aquifer type, groundwater volume, well yield, water quality, aquifer properties, and other attributes that could affect groundwater utilization potential.

Blaine Aquifer System Brackish Groundwater Analysis, Texas Water Development Board, North-Central Texas
Project manager for the assessment and evlaution of the fresh and brackish groundwater resources of the Blaine Aquifer system in north-central Texas. The aquifer system encompasses a region of about 10,000 square miles and is the sole source of supply for numerous communities, agriculture and local industry. Project involved geologic and hydrogeologic mapping of aquifer units and production intervals, determination of groundwater quality, evalaution of the effects of potential well fields, and interaction with stakeholders.

Evaluation of Groundwater Modeling for Santee Basin Groundwater Recharge and Replenishment Project, Padre Dam Municipal Water District, Santee, California
Principal investigator for hydrogeologic evaluation and feasibility modeling of indirect potable reuse (IPR) project. Effort includes development and evaluation of multiple implementation scenarios, simulation of IPR water injection and extraction, interaction of surface water and groundwater, computation of residence time to meet state regulations and identification of critical flaws. Provided recommendations on aquifer testing and well design.

Groundwater Resource Evaluation, Online Water Well Management System, and Water Well Inventory, University Lands, Midland, Texas
Principal-in-charge for evaluation of multiple brackish aquifers underlying University Lands in west Texas. Project included database development, construction of three-dimensional geologic models, and hydrogeologic analysis of multiple aquifers, including production zones, expected well yield and water quality. The water well management system allows oil and gas operators and other University Lands leaseholders to apply for water supply well permits and upload completed water well information, such as well diagrams, geophysical logs, and water quality. GIS development for the groundwater resource evaluation included compiling data related to several thousand oil and gas geophysical logs, water well logs, and cable-tool driller reports obtained from University Lands, Texas Railroad Commission and the Bureau of Economic Geology well log libraries. DBS&A also compiled, and mapped water levels, water quality information, and water well production capacities.

Groundwater Appropriation, Carlsbad Basin, BOPCO L.P., Carlsbad, New Mexico
Principal-in-charge for application to appropriate 2,000 acre-feet per year of groundwater in the Carlsbad Basin, New Mexico. Conducted geologic and hydrogeologic analysis, and developed a three-dimesional groundwater flow model to assess the effects of the appropriation on groundwater and surface water resources, which included Pecos River flows and interstate compact compliance issues.

Groundwater Appropriation Protest, Lea County Basin, Multiple Protestants, Lea County, New Mexico
Provided expert hydrologic and geologic analysis on behalf of multiple protestants opposed to multiple applications for approproiation of groundwater in the Lea County Underground Water Basin.

Region O Water Plan, Llano Estacado Regional Water Planning Group and the High Plains Underground Water Conservation District, Lubbock, Texas
Principal-in-charge for development of a 50-year regional water supply plan to meet drought-of-record demands for Region O. The plan includes evaluation of existing water supplies, identification of potentially feasible water

management strategies, selection and detailed evaluation of selected strategies, and prioritization for selection of funding.

Water Resources Support for Goliad County Groundwater Conservation District, Goliad, Texas
Principal investigator for assessment of the potential effects of in-situ leach uranium mining. Project involved hydrogeologic evaluation of site data, regional, and local groundwater flow and solute transport modeling for the Evangeline Aquifer and other hydrogeologic analysis, and expert testimony in a TCEQ administrative hearing. Provided technical support regarding District's petition to EPA regarding aquifer exemption and comments on rule making. Also assisted the District with evaluation of background water quality and an assessment of surface water -groundwater interaction.

Hood vs. Bounds, Black River Village, New Mexico
Conducted expert geologic and hydrologic analysis to determine sources of groundwater and spring flow and the fate of irrigation water within a local aquifer system in the vicintiy of Black River Village, New Mexico.

Clint Texas Dewatering Case, Snapka Law Firm, Clint, Texas
Conducted expert hydrologic analysis of extent of dewatering conducted to construct a sewer line and pump station in the Town of Clint. Multiple homeowners, businesses and a historic church alleged structural damage due to subsidence.

Municipal Well Field Development and Sustainability Analysis, Colorado River Municipal Water District, Ward County, Texas
Principal investigator for due diligence analysis for a major water right purchase in Ward County, Texas. The water right purchase was followed by a program of test drilling, construction and aquifer testing of 21 high-capacity, raw water supply wells. The well field build-out was required to supplement existing groundwater supplies and was completed on a highly expedited schedule. A groundwater flow model was constructed to assist with well field operations, determination of well-field sustainability, and groundwater resources planning.

Groundwater Analysis and Planning Support, Colorado River Municipal Water District, West Texas
Principal-in-charge or principal investigator for multiple groundwater analysis and planning projects, including evaluation of the Snyder well field, assistance with development and evaluation of desired future conditions for multiple aquifers, evaluation of alternative and additional sources of water supply, and evaluation of potential sources for groundwater contamination within or near existing well fields.

Investigation and Characterization of Deep Saline Water, Hideout of Lincoln County, LLC, Lincoln County, New Mexico,
Project manager for completion and testing of two deep (greater than 2,500 feet) exploratory brackish aquifer water supply wells. Project included well design, permitting, and reporting; drilling oversight; aquifer testing design; implementation and analysis of results; collection of water quality and isotope samples for geochemical fingerprinting for the determination of water sources; and groundwater flow modeling for the assessment of hydrologic effects of utilization of the deep brackish groundwater.

Simulation of Groundwater Flow for Aquifer Storage and Recovery Project Permitting, Cities of Rio Rancho and Albuquerque, Bernalillo County, New Mexico
Conducted numerical simulations of aquifer conditions to obtain State Engineer permits for multiple aquifer storage and recovery projects. Two projects involve injection wells and one project involves surface infiltration. Conducted analysis of effects of aquifer storage and recovery on surface water balance of the Rio Grande.

Analysis of Municipal Water Supply Sources from the Southern Ogallala Aquifer, City of Lubbock, Texas
Project manager and principal investigator for assessment of sustainability of the City's Bailey County well field and pumping groundwater from beneath the City to assist with meeting peak water demands. Ogallala aquifer water quality beneath the City was also considered, as was the contributing zone for proposed water supply wells. Project included the development of historical water level maps and other hydrogeologic analysis, along with development of detailed groundwater flow models for the City of Lubbock area and the Bailey County well field area. Study results were used by the City to make key water planning decisions.

Development of Groundwater Availability Model for Edwards-Trinity (High Plains) Aquifer, Texas Water Development Board, West Texas
Principal investigator for the development of a numerical groundwater flow model of the Edwards-Trinity (High Plains) aquifer in Texas and New Mexico. Project involved extensive data collection and development of the geologic framework of four lower Cretaceous hydrogeologic units based on geophysical and geologic well logs and development of new conceptual models of groundwater flow. Information was employed to develop a three-dimensional groundwater flow model that will be used by groundwater conservation districts and regional water planning groups to evaluate future groundwater availability.

Expert Testimony Regarding Municipal Appropriation of Water in the Middle Rio Grande Basin, City of Rio Rancho, New Mexico
Provided expert analysis and testimony on behalf of the City of Rio Rancho against an adjacent water utility that sought to appropriate 26,000 acre-feet per year of groundwater. Conducted detailed numerical modeling and other hydrologic analysis to illustrate adverse effects on Rio Rancho. The adjacent water utility's application was denied by the State Engineer.

Hydrogeologic Analysis of City of San Angelo Hickory Aquifer Well Field, City of San Angelo, Texas
Provided senior-level review and support for hydrogeologic analysis of the City's Hickory aquifer well field. Project tasks included groundwater sampling, borehole geophysical logging, and hydrogeologic mapping and analysis of key geologic units and water quality constraints.

Update and Recalibration of Rose Valley Groundwater Model for Permit Evaluation, County of Inyo, California
Principal investigator for substantial update and recalibration of an existing groundwater flow model in accordance with Mitigation Monitoring and Reporting Program of Conditional Use Permit 2007 003. Updates included conducting a basin-wide recharge estimate, refinement of the model grid and boundary conditions, improved calibration to historical water levels, and consideration of major historical stresses on the basin (reservoir construction and pumping for irrigation) from 1915 through 2010. The updated model was used to reevaluate future pumping amounts and associated drawdown trigger levels at monitor wells that could occur without exceeding the allowable reduction in groundwater outflow to a terminal lake at the southern end of the valley.

Expert Testimony Regarding Numerical Groundwater Flow Modeling and Evaluation of Salinity Encroachment, City of Alamogordo, Tularosa Basin, New Mexico
Provided expert review and testimony regarding evaluation of multiple groundwater flow models, then applied the model results to predict hydrologic effects of a proposed groundwater appropriation of 10,000 acre-feet per year by the City of Alamogordo. Also conducted an assessment and provided testimony regarding the potential for encroachment of saline groundwater due to pumping the well field, and effects of groundwater pumping on spring flow.

Groundwater Supply Evaluation for the Eastern New Mexico Regional Water System, CH2M Hill, Inc., East Central New Mexico

Applied regional groundwater flow modeling to evaluate the sustainability of future municipal water demand in Curry and Roosevelt Counties, eastern New Mexico. Groundwater from the Ogallala aquifer was one alternative evaluated as part of a long-term regional water supply study.

Assistance with Development of Groundwater Management Strategies, Hemphill County Underground Water Conservation District, Canadian, Texas
Assisted the district with evaluation of existing hydrogeologic data and groundwater management approaches, and provided recommendation regarding alternative approaches and application of the Northern Ogallala GAM. Assisted with defense of desired future conditions selected by Groundwater Management Area 1 to preserve surface water flows.

Water Supply Analysis and Expert Testimony for Water Rights Applications, Mesa Verde Enterprises, Inc., Tularosa Basin, Alamogordo, New Mexico
Principal investigator and expert witness for multiple water rights applications in the Tularosa Basin. Project involved analytical and numerical groundwater flow modeling, evaluation of local and regional hydrogeologic conditions, application of Tularosa Basin administrative guidelines, well field design, and assistance with plan of replacement negotiations in support of application to appropriate water.

Development of Groundwater Availability Model for Southern Ogallala Aquifer, Texas Water Development Board, High Plains of Texas and New Mexico
Principal investigator for development and application of numerical groundwater flow model for the Southern Ogallala aquifer in Texas and New Mexico, an area that exceeds 29,000 square miles. Project involved extensive data collection and incorporation into a numerical groundwater flow model using a geographic information system (GIS), model calibration and verification, presentation at public meetings, and detailed study documentation. The model was used by groundwater conservation districts, municipalities and other stakeholders to assist with water-supply planning efforts.

Evaluation of Current and Historical Underflow Across Newport-Inglewood Uplift, West Basin Water Association, Southern California
Project manager for evaluation of the historical underflow of groundwater between the Central Basin and West Coast Basin (CBWCB) across the Newport-Inglewood Uplift. Project involved review and analysis of numerous historical reports regarding the hydrogeology and history of WBCB areas, groundwater modeling and other types of hydrogeologic analysis.

Application for Appropriation of Groundwater, Aquifer Science, LLC, Sandia Basin, New Mexico
Responsible for hydrogeologic investigations, construction and testing of exploratory production wells, recharge analysis, groundwater model development and application, and expert testimony related to an application to appropriate up to 717 acre-feet per year of groundwater in Sandia Basin. Critical issues involved effect of groundwater pumping on surface water and drawdown at adjacent wells.

Groundwater Flow and Pit Water Quality Analysis for Little Rock Mine, Freeport McMoRan Tyrone, Inc., Tyrone, New Mexico
Principal investigator for development of a groundwater flow model to assess future hydrologic conditions at the Little Rock Mine and computation of open pit water quality post-mining.

Regional Assessment of Section 8 Groundwater Conditions and Conjunctive Use Evaluation, Navajo Nation, City of Gallup and Uranium Resources, Inc., San Juan Basin, New Mexico
Principal investigator for the assessment of hydrogeologic conditions in the vicinity of URI's proposed Section 8 uranium in situ recovery project, and determination of the risk that the proposed mining operation could adversely impact groundwater supplies to be developed as part of the Navajo-Gallup Water Supply Project.

Water Rights Technical Support, Denver Water, Denver, Colorado
Conducted quantitative analysis and expert review of stream depletion computations using numerical and analytical methods.

Assessment of Seawater Intrusion, Confidential Client, Southeast Atlantic Coast
Project manager for the evaluation of seawater intrusion related to an industrial facility near the coastline of the southeastern United States. Considered multiple potential sources of seawater intrusion and directed the simulation of density-dependent groundwater flow and solute transport modeling.

Development of Groundwater Flow and Solute Transport Model to Assess the Effects of Property Development, Basic Remediation Company, Henderson, Nevada
Developed a groundwater flow and solute transport model to assess the effects of proposed development on groundwater levels for property adjacent to the Las Vegas Wash. Model considers multiple water-bearing zones, multiple sources of recharge that vary over time, and heterogeneous aquifer conditions. Transport simulations include multiple plume constituents. Model work plan and simulation results were reviewed and approved by Nevada Department of Environmental Protection prior to application to predict future conditions.

Investigation of Water Rights and Water Supply Issues for Multiple Power Plants, Xcel Energy, Texas and New Mexico
Principal investigator for the review and analysis of various water rights and water supply issues related to multiple power plants in the southwest.

Instructor for Vadose Zone Short Course on Coal Bed Methane, State of Wyoming, Sheridan, Wyoming
Developed and taught modeling portion of coal bed methane vadose zone course developed for Wyoming state regulators.

Municipal Water Supply Investigation, BASCOR Engineering, City of Truth or Consequences, New Mexico
Principal investigator for evaluation of potential sites for water resources development. Provided recommendations regarding sites for potential groundwater development considering impacts to existing water rights, State Engineer policy, and likelihood of obtaining sufficient water supply. Planned and oversaw implementation of aquifer testing and analysis. Provided testimony regarding water supply at public City Commission meeting

Brine Plume Remediation Well Field Design and Expert Testimony, Pioneer Natural Resources, East Poplar Well Field, Montana
Principal investigator for hydrogeologic assessment and development of numerical groundwater flow and solute transport model for remediation well field design. Client used the results of the study to implement remedial action to limit plume migration and ensure that municipal wells would not be impacted. This effort was a significant component of a larger project that received the 2008 Department of the Interior Environmental Achievement Award. Also served as an expert witness in related cost-recovery case regarding hydrogeology, brine transport, and timing of releases to the environment, and assisted with negotiations with U.S. EPA regarding sampling requirements and a proposed Administrative Order on Consent.

Groundwater Model Development for Assessment of Groundwater Capture and Design of System Improvements for Sprague Road Groundwater Plume Superfund Site, U.S. Environmental Protection Agency Region 6, Odessa, Texas
Principal investigator for development and application of a revised groundwater flow and solute transport model to assess groundwater capture system effectiveness. Project involved evaluation of existing model and included significant modifications to the technical approach and input parameters to address initial model limitations. The updated model will be used to modify the pumping strategy to achieve better capture of multiple chromium plumes that exist at the site and to locate additional monitoring wells to ensure capture is complete.

Applied Hydrologic Modeling Course Instructor, New Mexico Institute of Mining and Technology, Socorro, New Mexico
Served as course instructor for several sessions of a graduate-level hydrologic modeling course. Developed and presented course materials on numerical groundwater model development and application.

Little Colorado River Adjudication, The Hopi Tribe, Hopi Indian Reservation, Arizona
Serving as groundwater hydrology expert representing the Hopi Tribe in litigation and related negotiations regarding Navajo and Coconino aquifer water resources and sustainability. Tasks include evaluation of groundwater resources, development of aquifer management plans and concepts, guidance regarding production well placement and expected long-term yield, predictions of groundwater withdrawals on wells of other ownership and surface water flows (stream and springs), and review and comment of work conducted by other experts, and expert tetimony.

Return Flow Analysis and Expert Testimony, Berrendo Cooperative Water Users Association, Roswell, New Mexico
Planned and supervised test drilling and used finite element variably saturated flow modeling and other hydrogeologic analyses to assess the volume and timing of return flow from septic leach fields for a large water cooperative with more than 1,500 service connections. Provided expert testimony regarding timing and volume of return flow for a variety of hydrogeologic conditions that occur within the cooperative service area.

Monitor Well Construction and Hydraulic Testing, Freeport McMoRan Tyrone, Inc., Tyrone, New Mexico
Project manager for the design, permitting, installation, and development of 26 monitor wells completed 200 to 900 feet deep in granite and conglomerate. Conducted hydraulic (aquifer) testing and analysis of aquifer parameters for 10 wells.

Evaluation of New Mexico Office of the State Engineer Administrative Model for Lea County Underground Water Basin, Lea County Water Users Association, Lea County, New Mexico
Assisted with evaluation of the OSE administrative model developed for the High Plains aquifer of the Lea County Basin. Purpose of the evaluation was to determine the suitability of the model for predictive water resources analysis. Project included evaluation and comparison of aquifer base elevation values and assignment of aquifer hydraulic properties.

Design of Groundwater Capture System for State Road 114 Superfund Site, Texas Commission on Environmental Quality, Levelland, Texas
Principal investigator for development and application of a groundwater flow and solute transport model to design a remediation well field for the State Road 114 Superfund Site. An existing regional model for the Southern High Plains (the Southern Ogallala groundwater availability model [GAM]) was modified to improve the historical calibration in Hockley County, and a nested, multi-layer local model was developed to simulate

groundwater flow in the vicinity of the dichloroethane (DCE) plume and used to design a groundwater capture system. Simulation results were used by the EPA to design and cost the groundwater plume extraction system.

Instructor for Groundwater Sampling Short Course, Freeport McMoRan, Inc., Chino and Cobre Mines, New Mexico
Co-developed and taught groundwater sampling short course for environmental staff at the Tyrone, Chino and Cobre copper mines near Silver City, New Mexico. Provided classroom and field instruction.

Expert Testimony Regarding Water Rights Transfer in Indian Basin, Glenn's Water Well Service, , New Mexico
Conducted hydrogeologic analysis and provided expert testimony regarding source of water, hydrologic effects of a proposed transfer, discharge areas of subject water, and effects of groundwater use on a major spring.

Assessment of Water Rights Purchase, Confidential Client, West Texas
Provided recommendation regarding purchase of Ogallala aquifer groundwater rights in West Texas. Reviewed aquifer conditions and hydraulic parameters, assessed effects of nearby pumping, and conducted predictive groundwater flow modeling to evaluate expected drawdown.

Litigation and Negotiation Support Regarding Natural Resource Damage Assessments, New Mexico, Two Confidential Clients
Provided expert advice and testimony regarding Natural Resource Damage Assessments issues for two clients in New Mexico. Both cases involved the assessment of potential impacts of contaminants to groundwater resources.

Evaluation of Proposed Groundwater Appropriations on Remediation Well Field Effectiveness, Lynx Ltd., NASA White Sands Test Facility, New Mexico
Evaluated potential effects of several applications for appropriation of groundwater on remediation system effectiveness in the Jornada Basin in New Mexico. Conducted drawdown, capture zone, and sensitivity analyses for several alternative water development scenarios.

Litigation Support and Modeling, Tucson Airport Authority, Tucson, Arizona
Technical leader and task manager for more than five major modeling tasks for cost allocation and litigation support at a major Superfund site. Modeling tasks included historical calibration of groundwater flow and solute transport models, predictive simulations, and local-scale multiphase (air, water, dense nonaqueous-phase liquids) simulation. Advanced geostatistical techniques (block kriging and indicator kriging) were applied during model development.

Groundwater and Surface Water Impact Analysis and Expert Testimony, Hubbard Enterprises, Inc., Lincoln County, New Mexico
Developed three-dimensional groundwater flow model of upper reaches of Hondo Underground Water Basin for groundwater and surface water (streams and springs) impact analyses. GIS was used as an integral component of model development. Provided expert testimony in State Engineer hearing regarding groundwater and surface water impacts.

Expert Review of Water Supply Studies and Hydrologic Analyses, City of Albuquerque, New Mexico
Provided expert third-party review of modeling and other studies conducted by another consultant on behalf of the City to support its water resources management strategy and associated water rights application for combined surface water and groundwater use.

Evaluation of Return Flow of Treated Effluent, Rancho Encantado, Tesuque, New Mexico
Planned and supervised test drilling and associated laboratory analysis for the assessment of potential return flow at a commercial facility. Assisted with development of innovative techniques (high-pressure injection into clay units) for subsurface disposal of treated effluent.

Groundwater Modeling Assessment of Alumina Refinery, ALCOA, Ludwigshafen, Germany
Principal investigator for groundwater modeling assessment of the potential for impacted seepage from a closed alumina refinery to impact a public water supply well field. A combined semi-analytical capture zone and solute transport model was applied to identify wells that could potentially be impacted and the timing of possible impacts.

Technical Assistance for Water Rights Transfer, Santa Fe Opera, Santa Fe, New Mexico
Analyzed hydrologic impacts of water rights transfer and designed return flow plan critical to proposed project's viability. Also developed subregional groundwater flow and solute transport models. Technical interface with the OSE and the NMED.

Technical Assistance and Expert Testimony for Water Rights Protest, Village of Corrales, New Mexico
Provided technical assistance to the Village of Corrales regarding its protest of a major water rights application made by an adjoining municipality. Analyzed groundwater models developed by applicant and OSE, conducted a well survey within the Village, and provided expert testimony.

Pit Lake Formation Modeling, Freeport McMoRan Tyrone, Inc., Tyrone, New Mexico
Principal investigator for the development of three-dimensional numerical pit lake formation model for multiple open mine pits that intersect regional groundwater. The model was both calibrated and validated to historical changes in pit water levels, accounting for groundwater seepage, surface water inflow, and evaporation. The model has been used to predict pit lake water levels and capture zones under various closure/closeout conditions and has guided high-level decision-making regarding both mine closure and mine expansion alternatives.

Hydrologic and Contaminant Transport Analysis, Confidential Client, Southern California
Project team member for multi-million-dollar cost allocation analysis for Superfund site. Assignments included innovative hydrogeological analysis, development and application of transient groundwater pathline tracking code, evaluation of effects of retardation on historical contaminant migration, and evaluation/critique of previous simulation efforts.

Hydrogeologic Analysis and Groundwater Flow Modeling, Waste Management, Inc., San Juan County, New Mexico
Conducted hydrogeologic studies and sustained yield modeling for permitting of a regional landfill. Analyzed aquifer test and other hydrogeologic data, and conceptualized and simulated groundwater flow within multiple sandstone units.

Sustained Yield Analysis, Texzona Cattle Feeders, West Texas
Conducted groundwater modeling to determine sustainable groundwater resources of cattle feedlot. Planned and managed three-day aquifer test at site. Technical conclusions were used in support of negotiations during real estate transaction.

Capture Zone Modeling, Various Clients and Sites
Applied or reviewed application of various computer models for delineation of extraction well capture zones at several UST sites in New Mexico and Virginia. Modeling approaches ranged from simple analytical models to complex numerical codes.

Three-Dimensional Groundwater Flow Modeling, New Mexico Office of the State Engineer, Roswell, New Mexico
Participated in construction, calibration, and verification of multi-layer numerical model of Roswell Groundwater Basin to assist State Engineer with water rights adjudication and water resources planning. Modeling simulated impacts to Pecos River flows resulting from changes in groundwater pumping.

Water Resources Analysis, County of Santa Fe, New Mexico
Participated in review and analysis of County groundwater resources and assisted with development of recommendations for future groundwater management strategies and policy.

Little Colorado River Sediment Transport, The Hopi Tribe, Northern Arizona
Investigated primary sources and transport mechanisms/characteristics of suspended and bedload sediment in LCR system. Tasks included development of rainfall-runoff relationships and simulation of sediment yield throughout LCR basin.

Borehole Geophysical Analysis, The Hopi Tribe, Kykotsmovi, Arizona
Task manager and lead investigator for application of borehole geophysical techniques to determine potential for interaquifer leakage and groundwater quality degradation for three 1,000-foot-deep water supply wells.

Public Supply Well Wellhead Protection, Southwest Florida Water Management District, Hernando County, Florida
Project manager and principal investigator for delineation of wellhead protection areas (WHPAs) for approximately 60 major public supply wells. Conducted methods comparison study using semi-analytical modeling, flowpath delineation, and three dimensional numerical groundwater flow modeling combined with three-dimensional particle tracking to delineate WHPAs. Presented final recommended WHPAs to Hernando County Board of County Commissioners and Southwest Florida Water Management District in a public hearing and incorporated them into the County's comprehensive Water Resource Protection Plan. District used results of comparative analysis to guide WHPA delineation efforts in other counties.

Model Development and User Support, U.S. EPA Office of Solid Waste, Washington, D.C.
Provided regulatory support and modeling-related tasks for EPA Office of Solid Waste. Developed Monte Carlo simulation module for implementation in EPACMS (EPA Composite Model for Surface Impoundments) groundwater flow and solute transport code. Supervised statistical analysis of nationwide hydraulic conductivity data set for contaminated sites. Developed graphical postprocessor for EPACMS code, analyzed model sensitivity, and implemented code modifications.

Saltwater Intrusion Modeling, St. Johns River Water Management District, Orange County, Florida
Project manager and principal investigator in evaluation of regional groundwater resources using density-dependent groundwater flow and solute transport simulation techniques. Phases included development and calibration of regional, three-dimensional groundwater flow model (MODFLOW), delineation of WHPAs for major municipal supply wells, and cross-sectional and three-dimensional simulations of density-dependent groundwater flow and contaminant transport.

Model Development, Documentation, and Testing, U.S. EPA Office of Ground Water Protection, Washington, D.C.
Project manager for EPA-sponsored development and application of PC based, user-friendly computer code to delineate WHPAs for commonly encountered hydrogeologic settings. Code incorporates state-of-the-art analytical groundwater flow solutions, uses particle tracking to delineate several types of capture zones, and includes module that allows assessment of the effects of uncertain input parameters on the extent of capture zones. EPA distributes the WHPA code developed in this project nationwide for use by state and local technical staff.

Modeling Short Course Development and Presentation, EPA Office of Ground Water Protection, Washington, D.C.
Project manager and principal investigator for development and presentation of nationwide workshops on capture zone modeling and application of EPA WHPA code. Developed and presented modeling portion of two-day courses on delineation of WHPAs in fractured, confined, and karst aquifers.

Regulatory Support and Permit Evaluation, Florida Water Management Districts, Central Florida
Supervised and conducted modeling and review tasks, including critical reviews of modeling studies submitted in support of permit renewal for major municipal well fields and development and assessment of proposed saltwater intrusion criteria for determination of saltwater intrusion impacts. Supervised and reviewed cross-sectional density-dependent groundwater flow and solute transport modeling to determine extent of proposed Water Use Caution Area (WUCA). Conducted quasi three dimensional sharp-interface saltwater intrusion modeling in support of WUCA determination.

Model Development, Documentation and Testing, EPA Office of Ground Water and Drinking Water, Washington, D.C.
Project manager for development, validation, and application of VIRALT and CANVAS groundwater flow and viral transport computer codes developed for EPA Office of Ground Water and Drinking Water (OGWDW). Codes incorporate composite modeling approach: one-dimensional groundwater flow and solute transport modules for unsaturated zone are linked with two-dimensional simulation modules in saturated zone. Codes include menu-driven pre-processor and graphical post-processor. OGWDW staff used models in development of Ground Water Disinfection Rule.

Groundwater Flow Modeling, City El Paso, Texas
Applied USGS MODFLOW code to free surface water table and other complex boundary conditions to analyze impacts of municipal well field on multi layer aquifer system. Major issues were effects of groundwater pumping on surface water and water level declines in the aquifer.

Model Parameter Estimation and Uncertainty Analysis, New Mexico Water Resources Research Institute, Columbus, New Mexico
Conducted parameter estimation and uncertainty propagation analysis for Columbus Basin using finite element modeling, geostatistics, and non-linear optimization techniques. Managed project from data collection through documentation of model results. Calculated uncertainties in predicted model heads using first-order techniques.

Development of Surface Impoundment Transport Model, Washington, D.C., U.S. EPA Office of Solid Waste
Developed and applied Monte Carlo driver coupled with semi-analytical groundwater flow and transport code (EPACMS). Code was used to examine effects of uncertain parameter inputs on magnitude of aquifer contamination caused by leaky surface impoundments.

Contaminant Transport Modeling, Confidential Client, Seattle, Washington
Applied transient, semi-analytical particle tracking code to assess propensity of petroleum-based contaminants released in aquifer to reach major municipal supply well.

Model Development, Testing, and Application, Los Alamos National laboratory, New Mexico
Developed, tested, and applied Monte Carlo uncertainty analysis module for Disposal Unit Source Term (DUST) code for Mixed Waste Disposal Facility. Developed new simulation approach that resulted in reduced simulation run times. Assisted with screening analyses to rank radionuclide mobility and toxicity

Additional Professional Training

Capture Zone Analysis for Pump and Treat Systems, U.S. EPA Region 6 Training Course, 2007

Numerical Model Calibration and Predictive Analysis Using PEST and MODFLOW 2000, 2001

Introduction to ArcView GIS, 1998

Assessing Passive Biodegradation at Leak Sites, 1997

Dissolved Organic Contaminants in Ground Water, 1994

Diagnosis and Remediation of DNAPL Sites, 1993

Digital Geographic Information Systems, 1989

Wellhead Protection Area Delineation, 1989

Selected Publications and Presentations

Blandford, N., 2017. Session moderator for Technical and Regulatory Aspects of Enhanced Aquifer Recharge Using Surface and Near-Surface Facilities. American Ground Water Trust 2017 Annual Texas Groundwater Conference. Austin, Texas, May 4, 2017.

Blandford, N., 2016. Overview of the University Lands Groundwater Resource Evaluation Project. Presentation to Environmental Study Group of the Society of Petroleum Engineers. Midland, Texas. April 28, 2016.

Schnaar, G., Blandford, N., 2015. Not Under My Back Yard: The Looming Battle Over Underground Injection. Presentation at the American Bar Association Fall Conference, Chicago, Illinois. October 28-31, 2015.

Umstot, T., Schnaar, G., Blandford T.N., Cullen, S., Kaiser, P., Ayarbe, J., 2015. Recharge estimates from a soil water-balance model improve groundwater model calibration. Presentation at the MODFLOW and More 2015: Modeling a Complex World conference. May 31 - June 3, 2015. Golden, Colorado.

Blandford, N., 2015. Overcoming Water Rights Challenges. New Mexico Chapter of the Society for Marketing Professional Services. Albuquerque, New Mexico, April 21, 2015.

Blandford, T.N. 2014. Aquifer Replenishment Projects in New Mexico—Technical Considerations, Challenges, and Permitting. Law Seminars International: New Mexico Water Law. Santa Fe, New Mexico, September 11, 2014.

Blandford, T.N. 2014. Effective Tools for Resolving Water Rights and Damages Issues. Law Seminars International: Hydrology and the Law. Santa Fe, New Mexico, July 23, 2014.

Marley, R., N. Blandford, A. Ewing, L. Webb, and K. Yuhas. 2014. Managed Aquifer Recharge as a Solution to Water Scarcity and Drought, European Geosciences Union General Assembly, Vienna, Austria. April 27 - May 2, 2014.

Marley, R. and N. Blandford. 2014. Water Rights Administration for Aquifer Replenishment Projects in New Mexico. NGWA Conference on Hydrology and Water Scarcity in the Rio Grande Basin. Albuquerque, New Mexico.

Blandford, T.N., T. Umstot, R. Marley, C. Wolf and G. L. Bushner. 2012. A Case Study of Exploration and Characterization of Deep Fractured Rock Aquifers for New Groundwater Development, New Mexico, U.S.A. Presentation to the International Conference on Groundwater in Fractured Rocks. Prague, Czech Republic, May 21-24, 2012.

Blandford, T.N. 2009. An Overview of Groundwater Management Approaches and Implications for MAG Permitting. Invited presentation to the Texas Alliance of Groundwater Districts. Arlington, Texas, September 29, 2009.

Blandford, T.N. and M. Kuchanur. 2008. Consideration of administrative management constraints in the development of groundwater supply strategies. Invited presentation to the Joint Meeting of the Geological Society of America, Soil Science Society of America, American Society of Agronomy, and Crop Science Society of America. Houston, Texas, October 5-9, 2008.

Blandford, T.N., M. Kuchanur, and R. Smith. 2008. Groundwater modeling of the Southern High Plains Aquifer: Effects of pre- and post-development recharge on water availability. Invited presentation to the Joint Meeting of the Geological Society of America, Soil Science Society of America, American Society of Agronomy, and Crop Science Society of America. Houston, Texas, October 5-9, 2008.

Earley, D. III, E.A. Salvas, and N. Blandford. 2008. Stockpile Characterization and Hydrogeochemical Seepage Modeling for Mine Closure. 2008 National Ground Water Association / U.S. EPA Remediation of Abandoned Mine Lands Conference, October 2008.

Blandford, T.N. and D.J. Blazer. 2008. Effects of historical pumping distributions and changes in recharge for evaluation of municipal groundwater supply: A case study for the Southern High Plains of West Texas. Presented at MODFLOW and More: Ground Water and Public Policy. Golden, Colorado, May 19-21, 2008.

Blandford, T.N. 2007. Surface water-groundwater interaction, some technical considerations. Presented at Texas Water Conservation Association. San Antonio, Texas, October 11-12, 2007.

Blandford, T.N., D.J. Blazer, and A. Dutton. 2005. The effect of a priori knowledge on conceptual model refinement through numerical model development: A case study for the Southern High Plains of the United States. Invited presentation to ModelCARE 2005, Fifth International Conference on Calibration and Reliability in Groundwater Modeling, From Uncertainty to Decision Making. The Hague, The Netherlands, June 6-9, 2005.

Blandford, N. and N. Sweetland. 2005. Is your remediation system a source of groundwater contamination? Southwest Hydrology 4(3):10-11.

Blandford, T.N. 2005. Evaluation of return flow to groundwater in New Mexico. In Proceedings of New Mexico Water Law Conference. CLE International. Santa Fe, New Mexico, August 15-16, 2005.

Blandford, T.N., M.J. Ronayne, D. Earley III, and T. Shelley. 2004. Lake formation at multiple pits - model development, verification and application for closure. Presented at US EPA Office of Research and Development Pit Lakes, 2004 Conference, Reno, Nevada.

Blandford, T.N., D.J. Blazer, A.R. Dutton, and R. Smith. 2004. Regional groundwater availability modeling of the Southern Ogallala aquifer of West Texas and Eastern New Mexico. In Rainwater, K.A. and T.M. Zobeck

(eds.), 2004 High Plains Groundwater Resources: Challenges and Opportunities, Conference Proceedings. Lubbock, Texas, December 7-9, 2004.

Blandford, T.N. and R. Smith. 2004. Conceptual model evaluation and refinement through numerical model development: A case study for the Southern High Plains of the United States. Presented at Finite Element Models, MODFLOW, and More: Solving Groundwater Problems Conference. Karlovy Vary, Czech Republic, September 13-16, 2004.

Blandford, T.N. and D.J. Blazer. 2004. Hydrologic relationships and numerical simulations of the exchange of water between the Southern Ogallala and Edwards-Trinity aquifers in southwest Texas. In Aquifers of the Edwards Plateau, Mace, R.E., E.S. Angle, and W.F. Mullican, III (eds.), Texas Water Development Board Report 360:115-131. February 2004.

Stephens, D.B. and N. Blandford. 2004. Hydrogeologic analysis, transport and modeling for environmental litigation: A case study. Presented at National Ground Water Association Ground Water and Environmental Law Conference. Chicago, Illinois, May 5-6, 2004.

Blandford, T.N., D.J. Blazer, K.C. Calhoun, A.R. Dutton, T. Naing, R.C. Reedy, and B.R. Scanlon. 2003. Groundwater availability of the Southern Ogallala aquifer in Texas and New Mexico: Numerical simulations through 2050. Prepared for the Texas Water Development Board. 160p.

Blandford, T.N., D.J. Blazer, A.R. Dutton, and T. Naing. 2003. Regional groundwater availability modeling of the Southern High Plains aquifer of west Texas and eastern New Mexico. In Proceedings of MODFLOW and More, 2003—Understanding through Modeling. Sponsored by International Ground Water Modeling Center, Colorado School of Mines, Golden, Colorado, September 16-19, 2003.

Blazer, D.J., K.C. Calhoun, and T.N. Blandford. 2003. Development of the Southern Ogallala groundwater availability model using GIS. In Proceedings of MODFLOW and More, 2003—Understanding through Modeling. Sponsored by International Ground Water Modeling Center, Colorado School of Mines, Golden, Colorado, September 16-19, 2003.

Blandford, T.N. 2003. What is a groundwater flow model and how do you know if you have a good one? In Proceedings of New Mexico Water Law Conference. Sponsored by CLE International, Santa Fe, New Mexico, August 18-19, 2003.

Blandford, T.N. and N.T. Sweetland. 2003. Rethinking traditional approaches to hydraulic capture in preparation for the next series of emerging chemicals of concern in groundwater. Poster presentation at the 1,4 Dioxane and Other Solvent Stabilizer Compounds in the Environment, Groundwater Resources Association of California, December 10, 2003, San Jose, California.

Blandford, T.N., D.J. Blazer, A.R. Dutton and T. Naing. 2003. Regional groundwater availability modeling of the southern High Plains Aquifer of west Texas and eastern New Mexico. In Proceedings of MODFLOW and More, 2003 - Understanding through Modeling. Sponsored by International Ground Water Modeling Center, Colorado School of Mines, September 16-19, 2003, Golden, Colorado.

Blandford, T.N., D.J. Blazer, and A.R. Dutton. 2003. Regional groundwater availability modeling of the Southern Ogallala aquifer of west Texas and eastern New Mexico. Presented at New Mexico Symposium on Hydrologic Modeling. Socorro, New Mexico, August 12, 2003.

Blandford, T.N., D.J. Blazer, A.R. Dutton, and R.M. Smith. 2003. Regional groundwater availability modeling of the Southern Ogallala aquifer in West Texas and Eastern New Mexico. Presented at National Ground Water Association Southwest Focus Conference—Water Supply and Emerging Contaminants. Phoenix, Arizona, February 20-21, 2003.

Blandford, T.N., M.J. Ronayne, and T.L. Shelley. 2003. Lake formation at multiple mine pits: Model development and application. Presented at National Ground Water Association Southwest Focus Conference—Water Supply and Emerging Contaminants. Phoenix, Arizona, February 20-21, 2003.

Blandford, T.N., D.J. Blazer, A.R. Dutton, and R.C. Reedy. 2002. Regional groundwater flow modeling of the Southern High Plains aquifer: Conceptual models applied and insights gained. Presented at Geological Society of America Annual Conference Special Session on Hydrogeology and Water Resources of the High Plains Aquifer: Issues for Public Policy Over the Next 50 Years. Denver, Colorado, October 27-30, 2002.

Blandford, T.N., M.J. Ronayne, and D. Earley, III. 2001. Simulation of lake formation at multiple mine pits in a block faulted porphyry copper deposit. In Proceedings of MODFLOW 2001 and Other Modeling Odysseys, An International Ground Water Modeling Conference and Workshops. Sponsored by International Ground Water Modeling Center, Colorado School of Mines, Golden, Colorado, September 11-14, 2001.

Stephens, D.B. and T. N. Blandford. 2001. Hydrogeologic analysis, transport and modeling for environmental litigation, a case study. Presented at the First International Congress on Petroleum Contaminated Soils, Sediments, and Water Analysis, Assessment and Remediation. London, United Kingdom, August 14-17, 2001.

Ronayne, M.J., T.N. Blandford, D. Earley, and R. Schmidt-Petersen. 1999. Simulation of mine pit lake recovery in a block-faulted porphyry copper deposit. Presented at the Annual Meeting of the Geological Society of America. Denver, Colorado, October 25, 1999.

Hsu, K.-C., D. Jordan, T.N. Blandford, D.W. Reaber, and J.L. Wilson. 1998. Evaluation of local-scale contaminant migration within a heterogeneous alluvial basin in the southwest. Presented at National Ground Water Association 1998 annual convention and exposition. Las Vegas, Nevada, December 13-16, 1998.

Stephens, D.B., K.-C. Hsu, M.A. Prieksat, M.D. Ankeny, T.N. Blandford, T.L. Roth, J.A. Kelsey, and J.R. Whitworth. 1998. A comparison of estimated and calculated effective porosity. In Hydrogeology Journal 6(1):156-165.

Jordan, D.L., T.N. Blandford, and R.J. MacKinnon. 1996. Source term analysis for a RCRA mixed waste disposal facility. In Proceedings of the International Topical Meeting on Nuclear and Hazardous Waste Management Spectrum '96. Seattle, Washington, August 18-23, 1996.

Blandford, T.N., N.-S. Park, and P.S. Huyakorn. 1994. Comment on "Well catchments and time-of-travel zones in aquifers with recharge" by D.N. Lerner. Water Resources Research 30(5):1627-1628. May 1994.

Birdie, T. and T.N. Blandford. 1994. Groundwater flow and solute transport modeling study for Seminole County, Florida, and adjoining regions. St. Johns River Water Management District Special Publication.

Blandford, T.N. and T. Birdie. 1993. Development of wellhead protection areas for the major public supply wells in Hernando County, Florida. Final report completed for the Southwest Florida Water Management District and Hernando County, Florida.

Huyakorn, P.S., J.B. Kool, and T.N. Blandford. 1993. An overview of modeling techniques for solute transport in groundwater. In Metals in groundwater, Allen, H., M. Perdue, and D. Brown (eds.). Lewis Publishers, Chelsea, Michigan.

Park, N., T.N. Blandford, and Y.S. Wu. 1993. CANVAS: A composite analytical-numerical model for viral and solute transport simulation. Code documentation prepared for U.S. EPA Office of Ground Water and Drinking Water.

Park, N., T.N. Blandford, and P.S. Huyakorn. 1992. VIRALT: A modular semi-analytical and numerical model for simulating viral transport in groundwater. Code documentation prepared for U.S. EPA Office of Ground Water and Drinking Water.

Blandford, T.N. and T. Birdie. 1992. Regional groundwater flow modeling for east-central Florida with emphasis on Orange and Seminole Counties. St. Johns River Water Management District Special Publication SJ92-SP17.

Blandford, T.N. 1991. Vertical cross-sectional modeling analysis of groundwater flow and saltwater transport in Orange and Brevard Counties, Florida. Prepared for St. Johns River Water Management District by HydroGeoLogic, Inc., Herndon, Virginia.

Blandford, T.N., T. Birdie, and J.B. Robertson. 1991. Regional groundwater flow modeling for east-central Florida with emphasis on eastern and central Orange County. St. Johns River Water Management District Special Publication SJ91-SP4.

Blandford, T.N. and P.S. Huyakorn. 1990. WHPA: A modular semi-analytical model for the delineation of wellhead protection areas. U.S. EPA Office of Ground Water Protection.

Blandford, T.N. and J.L. Wilson. 1988. Large scale parameter estimation and uncertainty propagation in the Columbus Basin, New Mexico. In EOS, Transactions of the American Geophysical Union 69(16):367.

Blandford, T.N. and J.L. Wilson. 1987. Large scale parameter estimation through the inverse procedure and uncertainty propagation in the Columbus Basin, New Mexico. New Mexico Water Resources Research Institute Report No. 226, Las Cruces, New Mexico.

Blandford, T.N. 1984. The mineralogy of an andesine anorthosite body near Montpelier, VA. In Rocks and Minerals 61(2):57-61.

Huyakorn, P.S. and T.N. Blandford. 1989. A comprehensive model for capture-zone delineation and particle tracking contaminant transport analysis. Presented at the 28th International Geological Congress. Washington, D.C.

Huyakorn, P.S., J.B. Kool, and T.N. Blandford. 1989. An overview of modeling techniques for metal transport in groundwater. Presented at Workshop on Metal Speciation and Transport in Groundwaters. Jekyll Island, Georgia.

Blandford, T.N. and P.S. Huyakorn. 1988. An interactive WHPA delineation model that incorporates a methodology for uncertainty analysis. Presented at Wellhead Protection Conference. New Orleans, Louisiana.

Blandford, T.N. 1986. Variogram estimation for transmissivity in the Columbus Basin, New Mexico. Presented at New Mexico Geological Society Conference. Socorro, New Mexico.