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June 12, 2015

**RECEIVED**  
**JUN 15 2015**  
**WATER RIGHTS**  
**PROGRAM**

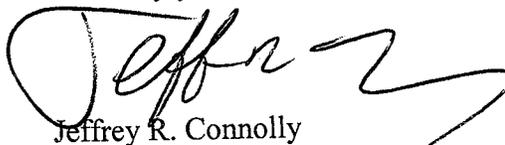
Michael M. Hickey  
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Foye & Simmons LLP  
P.O. Box 2670  
Rapid City, SD 57709-2670

Re: United Order of South Dakota Re: Water Rights  
GPNA File No. 12414.0002

Dear Mike:

Enclosed is Applicant United Order of South Dakota's Answers to Intervener Linda Kilcoin's Interrogatories and Requests for Production of Documents.

Sincerely yours,



Jeffrey R. Connolly

JRC:amb

Enclosure

cc: Jeanne Goodman  
Eric Gronlund  
Ann F. Mines Bailey  
Lois G. Witte  
William R. Hansen  
Rick Fox  
Karl and Suzanne VonRump

Cheryl Schrempp Dupris  
Craig Bobzien  
Mr. and Mrs. David Albrecht  
Toni Martin  
Doug Leshar  
Dean and Delia Johnson  
Rodney Freeman

STATE OF SOUTH DAKOTA  
BEFORE THE WATER MANAGEMENT BOARD

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IN THE MATTER OF THE APPLICATION OF  
THE UNITED ORDER OF SOUTH DAKOTA,  
APPLICATION NO. 2730-2

Applicant United Order  
of South Dakota's Answers to Intervener, Linda  
Kilcoin's Interrogatories and Requests for  
Production of Documents to

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ANSWERS TO INTERROGATORIES

**INTERROGATORY NO. 1:** Prior to answering these interrogatories, have you made due and diligent search of your books, records, and papers, and due and diligent inquiry of all agents of the Applicant, with a view to eliciting all information available in this action?

**ANSWER:** Yes.

**INTERROGATORY NO. 2:** Please state the identify of all the individuals who participated in or were involved in answering these Interrogatories and Requests for Production of Documents and identify which interrogatory or request for production each individual supplied information for.

**ANSWER:** Seth Jeffs, Water Operator, United Order of South Dakota, PO Box 5050, Custer SD 57730.

**INTERROGATORY NO. 3:** As to the Applicant, please state the following:

- a. The legal nature of the Applicant;
- b. The state under which the Applicant is organized;
- c. The date the Applicant was created;
- d. The identity of the individuals who formed the Applicant;
- e. The identity of the current leader, president, principal, trustee and/or beneficiaries of the Applicant; and
- f. Please produce copies of all documents which show the nature of the Applicant, its creation, organizational chart, and its current internal policies, operations or bylaws.

**Answer:**

- A. A Common Law Trust.
- B. South Dakota.
- C. December 23, 2009.
- D. Applicant objects to this requests as it is overbroad, vague, and the information sought does not appear reasonably calculated to lead to the discovery of admissible evidence. In addition, the plaintiffs have not shown they have a substantial need for the requested materials in the preparation of their case.

- E. Applicant objects to this requests as it is overbroad, vague, and the information sought does not appear reasonably calculated to lead to the discovery of admissible evidence. In addition, the plaintiffs have not shown they have a substantial need for the requested materials in the preparation of their case.
- F. Applicant objects to this requests as it is overbroad, vague, and the information sought does not appear reasonably calculated to lead to the discovery of admissible evidence. In addition, the plaintiffs have not shown they have a substantial need for the requested materials in the preparation of their case.

**INTERROGATORY NO. 4:** As of October 14, 2014, the date the Applicant filed Application No. 2730-2, how many persons were being served by the water supply system operated by the Applicant? Please produce copies of any documents reviewed or utilized by you to answer this interrogatory.

**Answer:** Applicant objects to this request as it is overbroad, vague, and the information sought does not appear reasonably calculated to lead to the discovery of admissible evidence. In addition, the plaintiffs have not shown they have a substantial need for the requested materials in the preparation of their case.

Notwithstanding the objection, the operator does not know that exact number, but it is within the number allowed by the current wastewater permits.

**INTERROGATORY NO. 5:** As of the date these Interrogatories and Requests for Production of Documents were served, how many persons are served by the water supply system operated by the Applicant? Please produce copies of any documents reviewed or utilized by you to answer this interrogatory.

**Answer:** See Answer to Interrogatory No. 4.

**INTERROGATORY NO. 6:** Are there current plans by the Applicant to increase the number of persons who may be served by the water supply system operated by the Application? If so, please state the additional number of persons who may be served within the next five (5) and ten (10) years. Please produce copies of any documents reviewed or utilized by you to answer this interrogatory.

**Answer:** To the operator's knowledge, there are no current plans to increase the number of persons served by the water supply system beyond the maximum allowed by current wastewater permits.

**INTERROGATORY NO. 7:** As of October 14, 2014, the date the Applicant filed Application No. 2730-2, how many head and what type of livestock were being watered using

water supplied by the water supply system operated by the Applicant? Please produce copies of any documents reviewed or utilized by you to answer this interrogatory.

**Answer: None.**

**INTERROGATORY NO. 8:** As of the date these Interrogatories and Requests for Production of Documents were served, how many head and what type of livestock are being watered using water supplied by the water supply system operated by the Applicant? Please produce copies of any documents reviewed or utilized by you to answer this interrogatory.

**Answer: None.**

**INTERROGATORY NO. 9:** As of October 14, 2014, the date the Applicant filed Application No. 2730-2, how many acres of noncommercial family gardens, trees, shrubbery, or orchards were being irrigated using water supplied by the water supply system operated by the Applicant? Please produce copies of any documents reviewed or utilized by you to answer this interrogatory.

**Answer: About 5 Acres.**

**INTERROGATORY NO. 10:** As of the date these Interrogatories and Requests for Production of Documents were served, how many acres of noncommercial family gardens, trees, shrubbery, or orchards are being irrigated using water supplied by the water supply system operated by the Applicant? Please produce copies of any documents reviewed or utilized by you to answer this interrogatory.

**Answer: About 5 Acres.**

**INTERROGATORY NO. 11:** As of October 14, 2014, the date the Applicant filed Application No. 2730-2, what was the total water storage capacity available for the water supply system operated by the Applicant? As of that date, how much water was being stored by the Applicant? Please produce copies of any documents reviewed or utilized by you to answer this interrogatory.

**Answer: About 30,000 Gallons.**

**INTERROGATORY NO. 12:** As of the date these Interrogatories and Requests for Production of Documents were served, what is the total water storage capacity available for the water supply system operated by the Applicant? As of that date, how much water is being stored by the Applicant? Please produce copies of any documents reviewed or utilized by you to answer this interrogatory.

**Answer: About 30,000 Gallons.**

**INTERROGATORY NO. 13:** As of October 14, 2014, the date the Applicant filed Application No. 2730-2, what was the total volume of wastewater that was generated as a result

of the water supply system operated by the Applicant? Please produce copies of any documents reviewed or utilized by you to answer this interrogatory.

**Answer:** Applicant does not meter or record the flow into the septic systems, but applicant does not exceed the limits discussed in the Supplemental Report to the Chief Engineer, dated May 14, 2015, UOSD ## 3-4.

**INTERROGATORY NO. 14:** As of the date these Interrogatories and Requests for Production of Documents were served, what is the total volume of wastewater that is being generated as a result of the water supply system operated by the Applicant? Please produce copies of any documents reviewed or utilized by you to answer this interrogatory.

**Answer:** Applicant does not meter or record the flow into the septic systems, but applicant does not exceed the limits discussed in the Supplemental Report to the Chief Engineer, dated May 14, 2015, UOSD ## 3-4.

**INTERROGATORY NO. 15:** As of the date these Interrogatories and Requests for Production of Documents were served, how many gallons of groundwater will the Applicant need to withdraw annually from the Madison aquifer under Application 2730-2 to meet all of the present needs of the Applicant? Please produce copies of any documents reviewed or utilized by you to answer this interrogatory.

**Answer:** Unknown at this time, but within the 60 acre feet limit discussed in the Supplemental Report to the Chief Engineer, dated May 14, 2015 UOSD ## 1-6.

**INTERROGATORY NO. 16:** How has the Applicant beneficially used the groundwater withdrawn pursuant to Water Permit No. 2610-2 for the purpose of suburban housing development? Please produce copies of any documents which establish the beneficial use of groundwater withdrawn or which was reviewed or utilized by you to answer this interrogatory.

**Answer:** Applicant objects to this request as it calls for a legal conclusion.

Notwithstanding the objection, the Applicant has used groundwater in the past for watering gardens, watering orchards, watering landscaping, feeding animals, drinking, washing, sanitary use, and culinary use.

**INTERROGATORY NO. 17:** Has the Applicant ever submitted a Subdivision Review Application to the Custer County Planning Department? If so, for which parcels owned by the Applicant and on what date(s)? Please produce a copy of any such applications or any other documents reviewed or utilized by you to answer this interrogatory.

**Answer:** Applicant objects to this request as it is overbroad, vague, and the information sought does not appear reasonably calculated to lead to

**the discovery of admissible evidence. In addition, the plaintiffs have not shown they have a substantial need for the requested materials in the preparation of their case. Notwithstanding the objection, the Operator is not aware any.**

**INTERROGATORY NO. 18:** Please identify and state the occupation, profession and field of specialization of each person whom you expect to call as an expert witness at the hearing, and as to each such person, please state:

- a. The subject matter on which the expert is expected to testify;
- b. A complete statement of the facts and opinions to which the expert is expected to testify;
- c. The basis and reasons for all of the opinions upon which the expert is expected to testify;
- d. The facts, data or other information provided to or considered by the witness in forming the opinions;
- e. Any exhibits that will be used to summarize or support the opinions;
- f. The title, author, copyright date and publisher's name and address of any book, medical or scientific treatise upon which such expert shall rely or which such expert will utilize in the preparation of and the presentation of his testimony;
- g. The qualifications of the witness, including a listing of all publications authored in the previous ten (10) years;
- h. A list of all other cases in which the witness has testified as an expert at trial or by deposition within the preceding four (4) years; A statement of the compensation to be paid for the study and testimony in this case; and
- i. Please attach a copy of any report prepared by each such expert.

**Answer:** See Expert Disclosure dated June 1, 2015 and attachments.

**INTERROGATORY NO. 19:** Has the Applicant submitted any documents to Dr. Arden Davis? If so, describe each document and produce a copy of each document that was provided and the date on which it was submitted to Dr. Arden Davis.

**Answer:** **Objection, Attorney-client Privilege and Work Product. Notwithstanding the objection, Arden Davis reports that he has received no documents from the Applicant by mail. Arden Davis reports that he has received the following privileged documents from the Applicant's prior attorney, David Ganje by email:**

<b>Date</b>	<b>Description</b>
03/11/2015	Zip files containing current permit and pending permit
03/13/2015	Scan of July 2007 Water Board minutes
03/17/2015	Arden Davis retainer agreement
03/18/2015	Retainer agreement signed by client
03/21/2015	Draft report by Davis with editing comments by Mr. Ganje
03/21/2015	Retainer agreement signed by all three parties
03/21/2015	Second comments by Mr. Ganje – draft report

**Arden Davis reports he has received the following privileged emails from Seth Jeffs:**

Date	Description
03/23/2015 through 4/17/2005	Email chain regarding report and discussing application hearing.

**INTERROGATORY NO. 20:** Has the Applicant or any one acting on its behalf, prepared and/or submitted to the Custer County School District or any other local school board or other governmental entity an Application for Excuse From School Attendance for any child residing on the property for each year between 2007 and the present time? If so, please produce a copy of each such Application and Certificate of Excuse.

**Answer:** Applicant objects to this request as it is overbroad, vague, and the information sought does not appear reasonably calculated to lead to the discovery of admissible evidence. In addition, the plaintiffs have not shown they have a substantial need for the requested materials in the preparation of their case.

**ANSWERS TO REQUESTS FOR PRODUCTION OF DOCUMENTS**

**REQUEST NO. 1:** Any and all documents pertaining to the purposes, formation, composition, and operation of the common law trust known as the United Order of South Dakota.

**Answer:** Applicant objects to this request as it is overbroad, vague, and the information sought does not appear reasonably calculated to lead to the discovery of admissible evidence. In addition, the plaintiffs have not shown they have a substantial need for the requested materials in the preparation of their case.

**REQUEST NO. 2:** Any and all documents associated with the preparation by the United Order of South Dakota of the "2014 Drinking Water Report."

**Answer:** None possessed by Applicant. Applicant submitted water samples to Energy Laboratories, who then reported testing results directly to the Department of Environmental and Natural Resources.

**REQUEST NO. 3:** Any and all documents requested in Interrogatories 1 through 20 above.

**Answer:** See bates nos. Applicant 1-33.

**REQUEST NO. 4:** Any and all documents sent to or received from the South Dakota Department of Environment and Natural Resources between the years 2007 and the present time.

**Answer:** Applicant objects to this request as it is overbroad, vague, and the information sought does not appear reasonably calculated to lead to the discovery of admissible evidence. In addition, the plaintiffs have not shown they have a substantial need for the requested materials in the preparation of their case.

**REQUEST NO. 5:** Any and all documents sent to or received from Custer County between the years 2007 and the present time.

**Answer:** Applicant objects to this request as it is overbroad, vague, and the information sought does not appear reasonably calculated to lead to the discovery of admissible evidence. In addition, the plaintiffs have not shown they have a substantial need for the requested materials in the preparation of their case.

**SIGNATURE PAGES TO FOLLOW**

State of South Dakota     )  
  ) ss.  
County of Pennington     )

Seth Jeffs, being first duly sworn, deposes and states that he is the Water Operator for the United Order of South Dakota and is familiar with the facts and circumstances of the matters referred to hereinabove and states that these Answers to Interrogatories and Requests for Production of Documents and the facts stated therein are true and correct to the best of his knowledge and belief.

**UNITED ORDER OF SOUTH DAKOTA,  
A COMMON LAW TRUST**

  
By Seth S. Jeffs, Water Operator, Acting on  
Authority of the Board of Trustees

Subscribed and sworn to before me the 11th day of June 2015.

  
Notary Public, South Dakota



My Commission Expires: February 20th 2016

AS TO OBJECTIONS:

GUNDERSON, PALMER, NELSON  
& ASHMORE, LLP

By   
Jeffrey R. Connolly  
Attorneys for United Order of South Dakota  
506 Sixth Street  
PO Box 8045  
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[jconnolly@gpnalaw.com](mailto:jconnolly@gpnalaw.com)

CERTIFICATE OF SERVICE

I hereby certify on this 12th day of June, 2015, I mailed by first-class U.S. mail, a true and correct copy of Applicant United Order of South Dakota's Answers to Intervener, Linda Kilcoin's Interrogatories and Requests for Production of Documents to the following:

Jeanne Goodman, Chief Engineer  
Water Rights Program  
Foes Building  
523 East Capitol  
Pierre, SD 57501

Mr. and Mrs. David Albrecht  
High Lonesome Ranch  
26541 Stagecoach Springs Road  
Custer, SD 57730-9109

Eric Gronlund  
Water Rights Program  
Foss Building  
523 East Capitol  
Pierre, SD 57501

Toni Martin  
4141 Villa Ridge Ct. #122  
Rapid City, SD 57701

William Hansen  
Jeff Hughes  
Peter A. Fahmy  
National Park Service  
Water Resources Division  
1201 Oak Ridge Drive, Suite 250  
Fort Collins, CO 80525-5596

Douglas Leshner  
Stone Meadow Ranch  
26699 Remington Road  
Custer, SD 57730

Craig Bobzien  
Forest Supervisor  
Black Hills National Forest  
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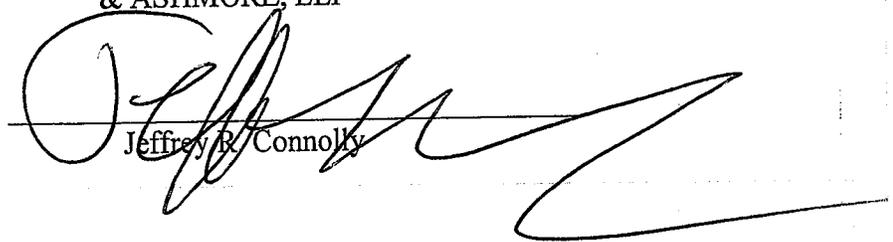
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Assistant Attorney General  
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Rodney Freeman, Prehearing Chair  
Water Management Board  
P.O. Box 176  
Huron, SD 57350

GUNDERSON, PALMER, NELSON  
& ASHMORE, LLP



Jeffrey R. Connolly

SUPPLEMENTAL REPORT TO THE CHIEF ENGINEER  
ON  
WATER PERMIT APPLICATION NO. 2730-2  
UNITED ORDER OF SOUTH DAKOTA C/O SETH JEFFS  
MAY 14, 2015

Water Permit Application No. 2730-2 was received by the Department of Environment and Natural Resources-Water Rights Program (DENR-WR) on October 14, 2014. The application proposed authorization to complete a new well into the Madison aquifer (approximately 1100 feet deep) in the NW¼ SE¼ of Section 10, T6S-R3E, in Custer County. The application proposed to divert water from the new well and from two existing wells, authorized by Water Permit No. 2610-2, at a combined maximum diversion rate of 0.67 cfs (approximately 300 gallons per minute (gpm)). Water Permit No. 2610-2 currently authorizes diversions of up to a maximum rate of 0.21 cfs (approximately 94 gpm) from two wells located in the NW¼ SE¼ of Section 10, T6S-R3E, Custer County. Therefore, Application No. 2730-2 proposed an increased diversion rate from the Madison aquifer of 0.46 cfs (approximately 206 gpm). The water is to be used in the United Order of South Dakota's water system.

Water Permit Application No. 2730-2 was public noticed and several interveners filed petitions in opposition to granting the permit. On February 18, 2015, the Water Rights Program received a request from the applicant to modify Application No. 2730-2 to a reduced diversion rate. Application No. 2730-2, as revised, proposes to appropriate water from the Madison aquifer at an additional maximum diversion rate of 0.236 cfs (approximately 105.9 gpm) and authorize a total maximum diversion rate from a new well and the two existing wells of 0.446 cfs (approximately 200 gpm).

**CURRENT WATER USAGE:**

Water Permit No. 2610-2 was approved August 1, 2007, and included a qualification (No. 4) that requires the applicant to report to the Chief Engineer annually the amount of water withdrawn from the Madison aquifer. A summary of the United Order of South Dakota's reported water use is shown in Table 1.

Table 1. Annual water usage associated with Water Permit No. 2610-2, as reported to the Chief Engineer (Water Rights, 2015).

Water Use Reported by United Order of South Dakota		
Year	Gallons (Reported)	Acre-feet (Converted)
2007	150,500	0.46
2008	2,813,000	8.63
2009	6,207,000	19.05
2010	8,600,900	26.40
2011	13,205,800	40.53
2012	10,635,920	32.64
2013	3,447,480	10.58
2014	8,323,600	25.54

Water Permit No. 2610-2 authorizes the use of water for the purpose of “suburban housing development” and may not exceed the amount of water needed for beneficial use. Suburban housing development use typically includes water for drinking, washing, sanitary and culinary purposes, in addition to incidental irrigation. In a February 18, 2015, letter addressed to the Chief Engineer, The National Park Service Water Resources Division and The Black Hills National Forest, Mr. Seth S. Jeffs, the United Order of South Dakota water operator, indicated the community’s beneficial use of water includes “watering gardens, orchards, landscape, and feeding animals during the spring and summer months”.

**Drinking, washing, sanitary and culinary uses:**

*2014 Drinking Water Survey*

An on-site evaluation at the United Order of South Dakota public water system was conducted by the Department of Environment and Natural Resources-Drinking Water Program on June 11, 2014. The evaluation report identified the system as a “Community Water System” with a total population served of 75. The on-site evaluation reported that well No.1, which was constructed in 2007, was the only well connected to the water system, and it was capable of diverting 80 gpm. The on-site evaluation reported the system was capable of supplying 95 gpm (Holan, 2014).

**Watering Gardens, Orchards, Landscape, and Feeding Animals:**

The areas within the United Order of South Dakota’s development that appear to be cultivated or landscaped were identified by evaluating June 29, 2014, imagery available through Google Earth 7.1.2.2014. The areas, shown as polygons outlined in dark green in Figure 1, digitized using Esri® ArcGIS 10.2, total approximately seven acres. Assuming an application rate of two acre-feet per acre per year, the total annual water use at the development for watering gardens, orchards and landscape is estimated to be less than 14 acre-feet per year. Livestock watering uses cannot be estimated at this time.



Figure 1. Gardens, orchards and landscaping apparent from Google Earth

**FUTURE NEEDS:**

In his February 18, 2015 letter, Mr. Jeffs stated that “the number of gardens and orchards will increase as the community is able to bring more of the land into cultivation”; “the needs for animals in the future will increase the demand for water”; and “the need for fire protection is also a great concern.”

**Drinking, washing, sanitary and culinary uses:**

*Onsite Wastewater System Approvals*

The DENR has approved four onsite wastewater systems for the United Order of South Dakota community. The specifics for these systems are shown in Table 2. The wastewater systems are limited to capacities approved; therefore the total maximum daily flow (MDF) for the four systems is limited to 7,560 gallons per day (gpd). Assuming 7,560 gpd for 365 days equates to total volume of 8.47 acre-feet per year.

Table 2. Onsite wastewater systems approved by DENR for the United Order of South Dakota compound. (Hipple)

ESTABLISHMENT	APPROVAL DATE	REMARKS
United Land Management	09/14/2005	Basic system, 2,160 MDF, 18-bedroom residence
United Land Management	06/28/2007	Basic system, 1,560 MDF, 13-bedroom residence
United Land Management	09/10/2007	Basic drainfield for two duplexes, total of 14 bedrooms, 1,600 MDF
United Order of SD (United Land Management)	03/03/2010	Basic system, 2160 MDF, 18-bedroom residence

MDF=maximum daily flow

The designed wastewater flow rate used in the review of United Land Management's residential septic systems was based on 60 gallons a person per day and a maximum of 2 persons per bedroom (Hipple, 2015). Based on the onsite wastewater systems approved for the community, (i.e. maximum daily flow of 7,560 gpd, and 63 bedrooms), the onsite wastewater system capacity is 126 people.

The total future system residential demand based on a population limited by the community's onsite wastewater system capacity (126) and a per capita demand for residential use of a maximum of 130 gallons per capita per day (Lindeburg, 2012) is estimated to be 18 ac-ft/yr.

**Watering Gardens, Orchards, Landscape, and Animal needs:**

Increased acreage of gardens, orchards and landscape areas is difficult to predict. However, two areas, totaling approximately 14 acres, (identified in yellow in Figure 2.) were considered potentially irrigable lands based on topography and groundcover. The addition of 14 acres of gardens, orchards and landscaping, would result in a tripling of the acreage currently estimated for that use. Assuming 21 acres of gardens, orchards and landscaping, irrigated at a rate of two acre-feet per acre per year results in an estimated "irrigation" use of 42 acre-feet per year. Future animal needs cannot be estimated with the information currently available.



Figure 2. Gardens, orchards and landscaping apparent from Google Earth (shown in dark green polygons) and potentially irrigable acreage (shown in yellow polygons).

**Fire Protection**

“Based on United Order of South Dakota’s Water Right Application stating that they will be constructing at least a 250,000 gal storage tank and the Insurance Service Office (ISO) minimum requirements for fire suppression of 1000gpm at 20psi for 2hours; the 250,000 gal storage will supply adequate domestic and fire suppression storage. The ISO required fire suppression storage should not affect annual drawdown” (Dreis, 2015).

**Projected Total Future Water Use:**

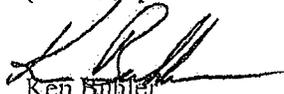
Future water use at the United Order of South Dakota community is estimated on an average per capita water use of 130 gallons per person per day for the maximum population capacity of the onsite wastewater systems (126), plus the irrigation of 21 acres at a maximum rate of two acre-feet per acre. This total demand is estimated to be less than 60 ac-ft/yr.

**ESTIMATED IMPACTS:**

In the report to the Chief Engineer titled “Water Permit Application No. 2730-2, United Order of South Dakota, November 12, 2014” (Buhler, 2014), the Theis Equation was used to compare the theoretical impact of an increase in the total pumping rate at the community of 0.67 cfs compared to 0.46 cfs. Drawdown 1000 feet from a pumped well would have increased with the increased diversion rate on the order of nine feet. The assumption of continuous pumping at the

maximum diversion rate, for one year, with no recharge, is an unrealistic assumption. As stated in the report, "The Theis equation requires a number of simplifying assumptions, some of which may not apply in this case; however, the solution is still useful to show that drawdown should not be significant."

The instantaneous diversion rate proposed by this application has been revised and the drawdown that would result would be less. The impact of this application's proposed withdrawals was evaluated considering well withdrawals more likely for this community. Drawdown was evaluated at a distance of 1000 feet from a production well after one year, assuming: A. a transmissivity of 10,943.2 GPD/F; B. a Storativity of 0.0002; and C. a difference between 40.53 acre-feet per year (maximum reported pumping) and 60 acre-feet per year (projected pumping). With the assumptions above and again, assuming no recharge, drawdown can be expected to be in the vicinity of 1.1 feet ("Theis Equation Calculator").



Ken Buhler  
SD DENR-Water Rights Program

#### REFERENCES:

- Buhler, K.A., 2014, "Water Permit Application No. 2730-2 United Order of South Dakota November 12, 2014": DENR-Water Rights Program, Joe Foss Building, Pierre, SD 57501
- Dreis, E., "Pringle" Email to Ken Buhler. 18 May 2015
- Hipple, S., "Pringle" Email to Ken Buhler. 18 May 2015
- Hipple, S., "Wastewater flow" Email to Ken Buhler. 18 May 2015
- Holan, J., 2014, South Dakota Department of Environment and Natural Resources Drinking Water Program Public Water System On-Site Evaluation Report: DENR-Drinking Water Program, Joe Foss Building, Pierre, SD
- Lindeburg, M.R., 2012, Civil Engineering Reference Manual for the PE Exam, Thirteenth Edition, Belmont, CA:Professional Publications
- McIntire, M., "Book1.xlsx" Email to Ken Buhler. 18 May 2015
- "Theis Equation Calculator." i:calcul<sup>8</sup> 27May 2015 <<http://www.icalcul8.com/theis.php>>
- Water Rights, 2015, Non-irrigation Yearly Reports, DENR-Water Rights Program, Joe Foss Building, Pierre, SD 57501

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PROGRAM

STATE OF SOUTH DAKOTA  
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

BEFORE THE WATER MANAGEMENT BOARD

IN THE MATTER OF WATER PERMIT )  
APPLICATION #2730-2, ) **United Order of South Dakota's**  
UNITED ORDER OF SOUTH DAKOTA ) **Disclosure of Expert Witness**  
)

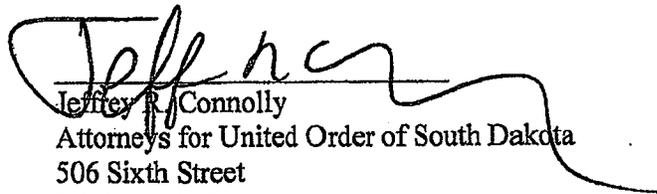
Pursuant to the Court's May 18, 2015 Scheduling Order, United Order of South Dakota hereby discloses the name of any expert that it intends to call as an expert witness as follows:

1. Arden D. Davis, Ph.D., P.E., 1014 Milwaukee Street, Rapid City, South Dakota

57701. A copy of Mr. Davis' March 27, 2015 expert report and his curriculum vitae is attached.

Dated this 1<sup>st</sup> day of June, 2015.

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CERTIFICATE OF SERVICE

I hereby certify on this 16 day of June, 2015, I mailed by first-class U.S. mail, a true and correct copy of a United Order of South Dakota's Designation of Expert Witness to the following:

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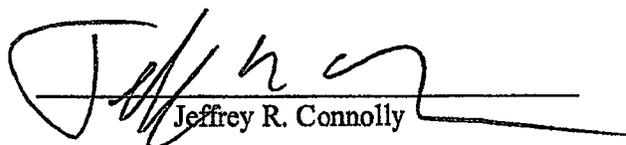
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## Groundwater in the Madison Aquifer

### With Regard to Water Permit Application No. 2730-2

Arden D. Davis, Ph.D., P.E.

1014 Milwaukee Street

Rapid City, South Dakota 57701

March 27, 2015

#### Introduction

This report was prepared in regard to Water Permit Application No. 2730-2, which under the Applicant's revised application requests 0.23 cubic feet per second (cfs) of water from the Madison aquifer. The request for 0.46 cfs was modified to 0.23 cfs by the applicant in a letter of February 18, 2015. A new Madison well would be constructed to augment production from two existing wells that were authorized in a previous permit (Water Permit 2610-2). The wells are in the NW  $\frac{1}{4}$  SE  $\frac{1}{4}$  of Section 10, T. 6 S., R. 3 E., in Custer County, South Dakota. The new well would be about 900 feet from the existing wells at the site.

The Madison aquifer underlies much of the southern Black Hills area and contains abundant groundwater supplies. The Madison aquifer, at the site of Water Permit Application No. 2730-2, is understood by current scientific literature to be fully saturated (Carter et al., 2002), as shown on Figure 1. Groundwater in the Madison aquifer is an under-utilized and almost undeveloped resource in the vicinity of the requested withdrawals. In the S.D. DENR review of Water Permit Application No. 2730-2, Mr. Buhler

(2014) noted no other existing water rights/permits for the Madison aquifer within ten miles or more of the applicant site. Additional evidence of the under-utilized nature of the Madison aquifer, in the area of the requested permit, is available in reports of the U.S. Geological Survey. A potentiometric map of the Madison aquifer in the Black Hills (Strobel et al., 2000) showed no Madison wells for water-level contours in the entire 36 square mile area of T. 6 S., R. 3 E. (Figure 2). Therefore there are no other water permit demands for the aquifer within the 36 square miles.

### **Concerns Raised by the National Park Service**

The National Park Service filed a petition in 2014 to intervene in the matter of Application No. 2730-2. In its petition letter, the National Park Service cited a concern about water levels in the Madison aquifer within Wind Cave National Park. The letter showed calculated values of predicted drawdown at a distance of 13 miles from the site of the requested Water Permit Application No. 2730-2. Assumptions underlying the use of the equations appear to be faulty. The petitioner's assumed values of the aquifer properties used in the calculations are quite variable. For example, the calculations used a storage coefficient value of 0.0002 in trying to predict drawdown at a distance of thirteen miles, from the site of the requested water permit to Wind Cave, even though the outcrop of the Madison Limestone (i.e., part of its recharge area) is exposed between Wind Cave and the site of Water Permit Application No. 2730-2. The aquifer would receive recharge at its outcrop area, but the Theis equation assumes that no recharge occurs during drawdown calculations. Recharge to the aquifer would reduce any drawdown from pumping.

At the outcrop area and eastward toward Wind Cave, the aquifer would be under water-table (unconfined) conditions. It is not appropriate to use a small storage coefficient value such as 0.0002 (which is typical of a confined aquifer) in such an area. The groundwater in Wind Cave and its lakes is under atmospheric pressure and is not confined by the overlying weight of rocks, because the cave is open to the atmosphere. Therefore, the Madison aquifer is not a confined (artesian) aquifer at the cave, and the water is not under pressure by an overlying confining layer. A very small storage coefficient of 0.0002 implies confined conditions (Freeze and Cherry, 1979) and is not suitable for predicting drawdowns at the Wind Cave lakes. A storage coefficient value of 0.0002 would give inappropriately large calculated values of drawdown at Wind Cave, compared to values of drawdown calculated with a storage coefficient value that would be typical of an unconfined (water-table) aquifer at the cave. For areas where an aquifer is unconfined, a storage value much larger than 0.0002 normally should be used. Accordingly, calculated drawdowns from pumping would be less.

The deep lakes at Wind Cave are mainly at the eastern and southeastern side of the cave, approximately 13 miles or more from the site of Water Permit Application No. 2730-2. This is a long distance (more than 68,000 feet) for extrapolating drawdowns; it is noted that in his review of the application, Mr. Buhler (2014) extended his extrapolated drawdowns to a distance of 2000 feet away, which is much more reasonable than a longer distance, because of variability of aquifer properties and uncertainty about hydrologic conditions.

The transmissivity and storage coefficient values of the Madison aquifer are not known with certainty in the Black Hills and can be quite

variable. It is at best speculative to assert that drawdowns of 6 to 9 feet or more would occur at Wind Cave because of pumping occurring about 13 miles away at the site from Water Permit Application No. 2730-2.

It is also important to report that the site of requested applicant withdrawals does not appear to be upgradient from Wind Cave and therefore would be less likely to result in an adverse effect at the cave.

### **Concerns Raised by the Black Hills National Forest**

The United States Department of Agriculture, Black Hills National Forest, in January of 2015 filed a petition to intervene in the matter of Application No. 2730-2. In its letter, the National Forest expressed concern that withdrawals could over time affect the warm water spring ecosystem at Cascade Springs. However, Cascade Springs are approximately 17 miles from the site of requested applicant withdrawals from the Madison aquifer, which is a very long distance for extrapolating effects of pumping. In addition, water at the site of Water Permit Application No. 2730-2 is approximately 54° F, which is much cooler than the warm spring water at Cascade Springs (about 68° F). There is no close hydraulic connection between the applicant's site and Cascade Springs.

The Forest Service letter petition states that there are no known structural features between the area of the well and Cascade Springs that would be expected to isolate the effects of well pumping from the springs. However, U.S. Geological Survey maps by Driscoll et al. (2002) and Strobel et al. (2000) show a long, synclinal fold between the well site and Cascade Springs, which limits any hydraulic connection across this distance (see Figure 3). The axis of a synclinal fold normally is an area of compression in which fractures tend to remain closed, which would limit permeability and

thus limit hydraulic connection between the applicant's well site and Cascade Springs.

Evans Plunge is a warm-springs swimming pool (approximately 87° F) that is fed by springs along the Fall River in Hot Springs (see Figure 3). The springs at Evans Plunge are more than 15 miles from the area of the applicant's site. The source of the springs is believed to be the Madison aquifer (Carter and others, 2002). According to research by Back et al. (1983) the calculated age of water at Evans Plunge was 1,900 years before present. Back et al. (1983) did not calculate an age for the water at Cascade Springs, because of problems with possible mixing of water from the Minnelusa or other aquifers, and Cascade Springs is farther south than Evans Plunge. We can conclude that a very long travel time would be involved for water that emerges at Cascade Springs, indicating that it is extremely unlikely that pumping at the applicant's site would affect the springs.

### **Conclusions**

Groundwater in the Madison aquifer is an under-utilized and almost undeveloped resource in the vicinity of the requested withdrawal for Water Permit Application No. 2730-2. The Madison aquifer is generally understood to be fully saturated at the site. No existing water rights for Madison aquifer wells appear to be within approximately ten miles of the applicant's site. The requested additional diversion of 0.23 cubic feet per second is not expected to have any adverse effect on other Madison wells, or the water at Wind Cave, or Cascade Springs, because of the distances (12 miles or more) that are involved. The requested withdrawals from the Madison aquifer are reasonable for their intended use.

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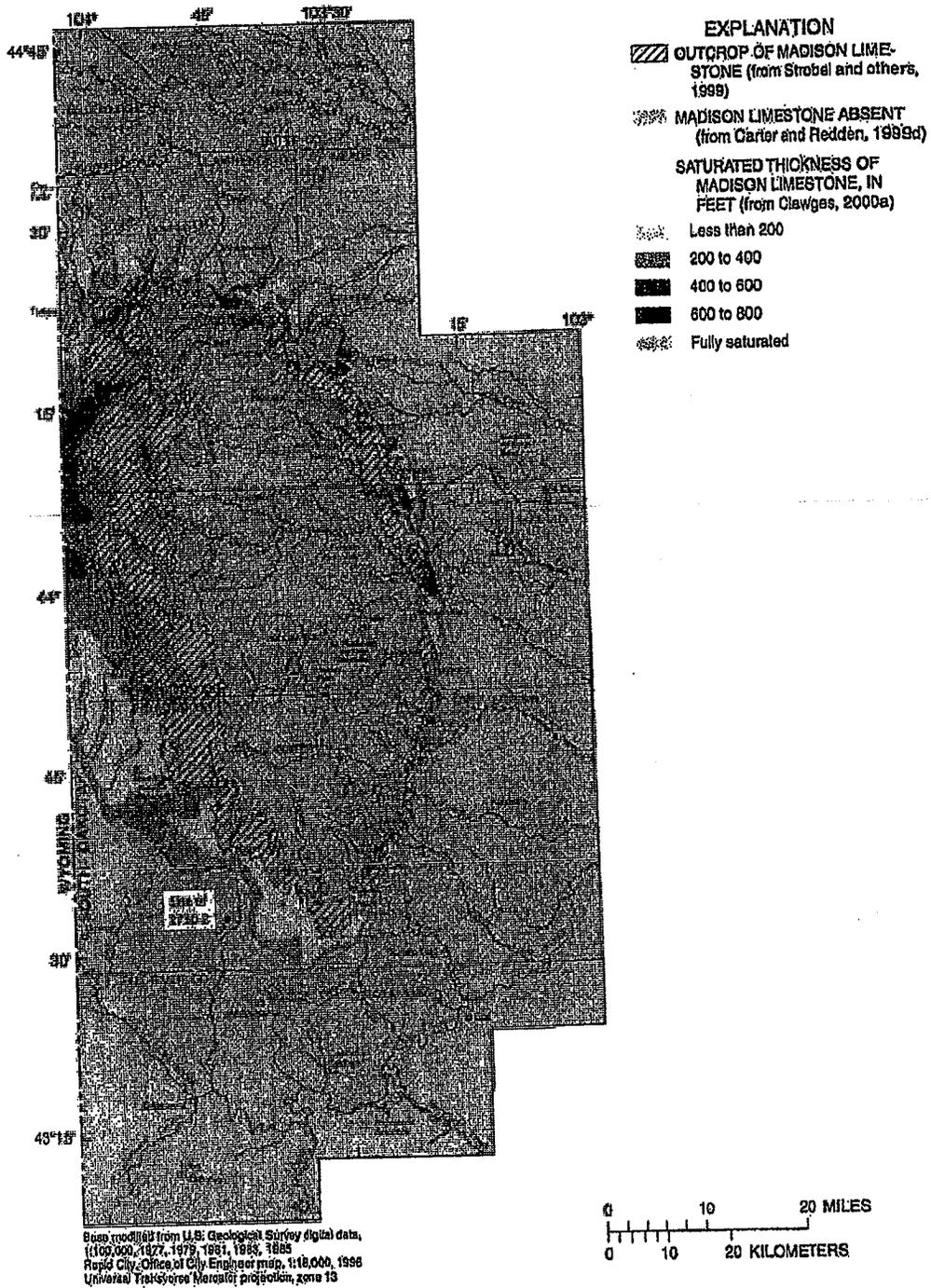


Figure 1. Saturated thickness of the Madison aquifer in the Black Hills (from Driscoll et al., 2002).

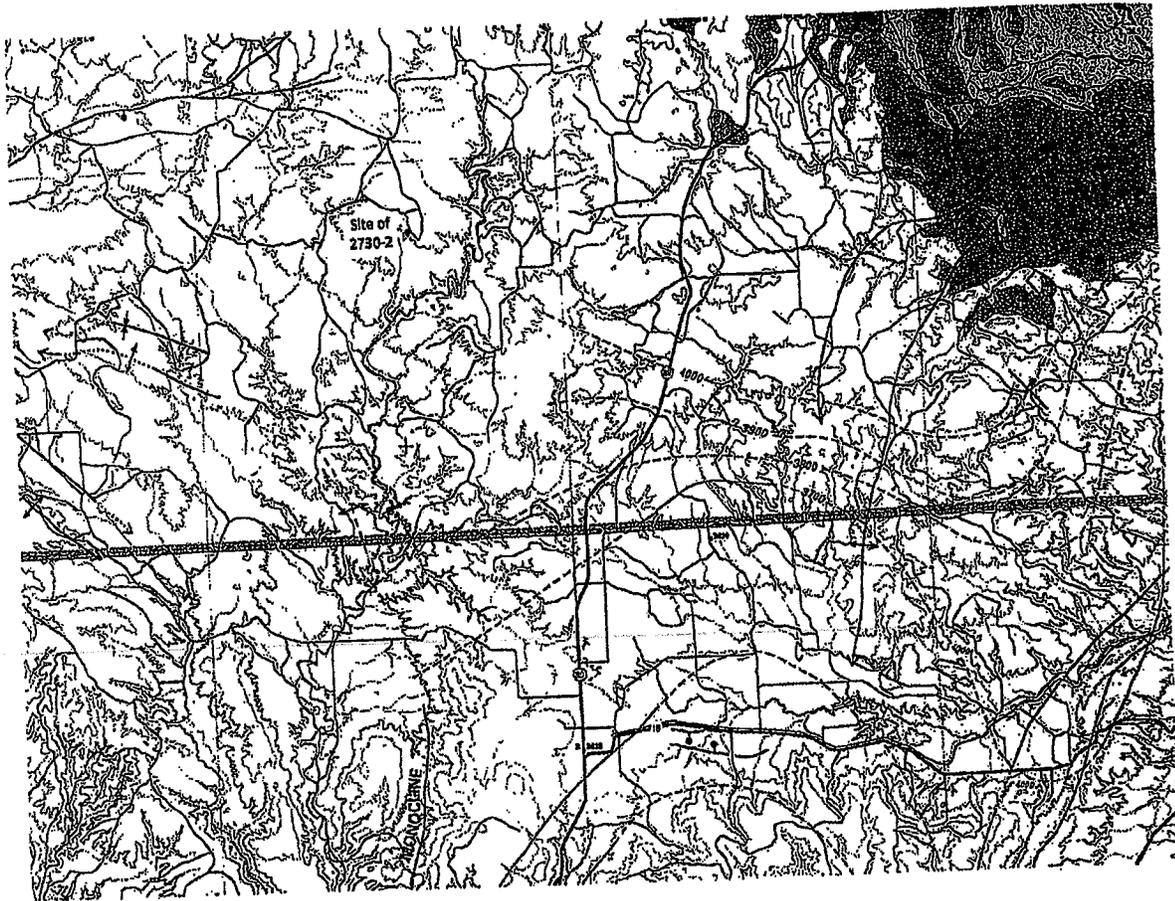


Figure 2. Potentiometric map of the Madison aquifer (from Strobel et al., 2000) showing few or no Madison wells near the site of Water Permit Application 2730-2.

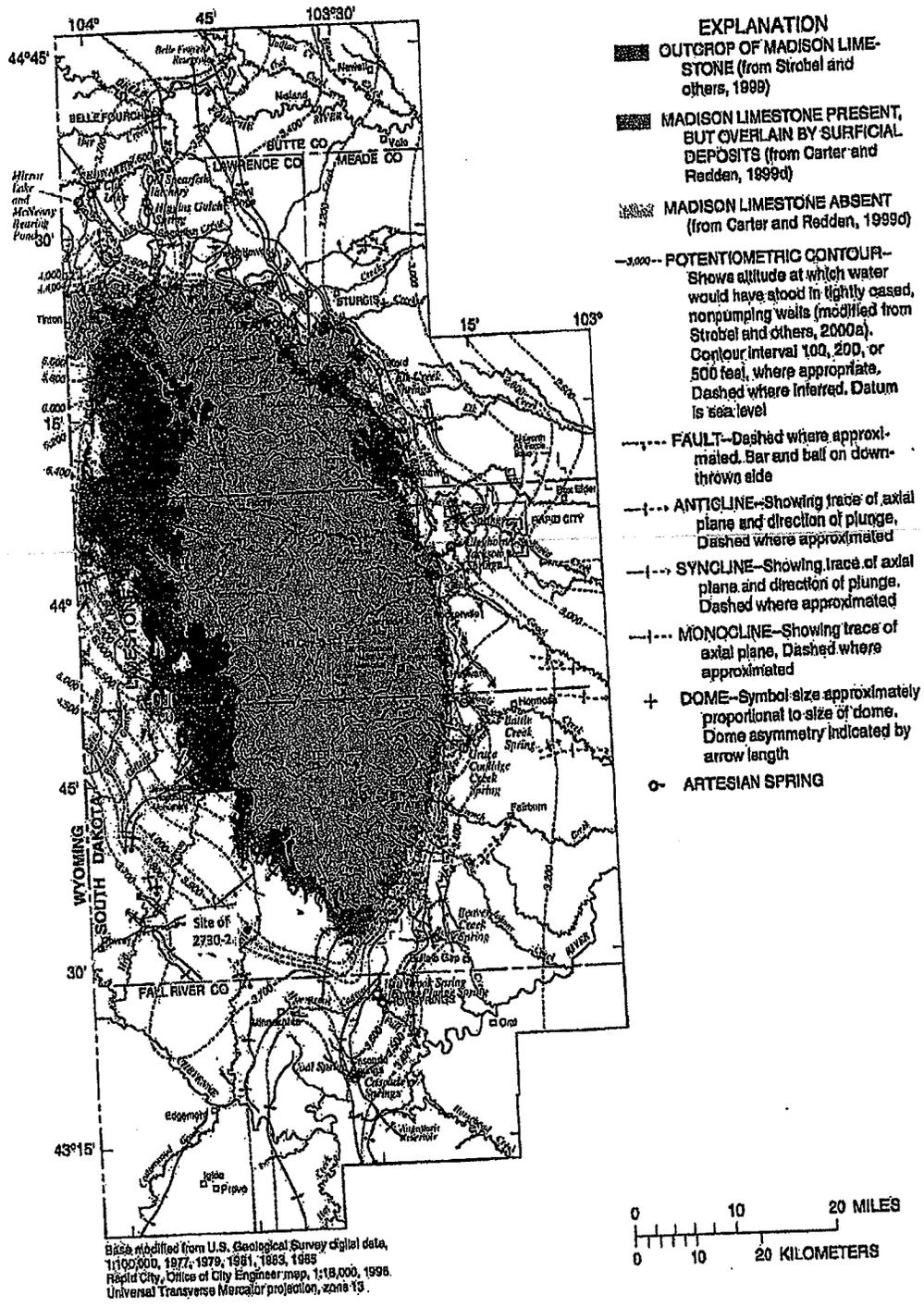


Figure 3. Madison aquifer in the Black Hills area (from Driscoll et al., 2002).

## Arden D. Davis

Arden Davis received a B.A. degree in geology from the University of Minnesota and M.S. and Ph.D. degrees in geological engineering from South Dakota School of Mines and Technology.

Dr. Davis currently is Professor in the Department of Geology and Geological Engineering at South Dakota School of Mines and Technology. Since 1982 he has served as Instructor, Assistant Professor, Associate Professor, Professor, and Chairman of the Department of Geology and Geological Engineering. During that time he has worked on digital modeling of ground-water flow as well as transport and dispersion of subsurface contaminants. He teaches courses in ground water, digital modeling of ground-water flow and contaminant transport, ground-water geochemistry, analytical methods in ground water, and geological engineering design.

Dr. Davis is a Registered Professional Engineer in South Dakota. He also is a member of the Society for Mining, Metallurgy, and Exploration (SME). He has served as associate editor and reviewer for the journal of Ground Water, and as a book reviewer for the Bulletin of the Association of Engineering Geologists. He has served as chairman of the Council of Education and the Accreditation and Curricular Issues Committee of the Society for Mining, Metallurgy, and Exploration. From 2002 to 2007, Dr. Davis served on the Engineering Accreditation Commission of ABET. In 2007, he was appointed to the ABET Board of Directors and served a three-year term. In 2010, he was re-appointed to the ABET Board of Directors.

During his career at South Dakota School of Mines and Technology, Dr. Davis has worked extensively on ground-water projects and geological engineering site evaluations. He has been an investigator in more than fifty funded research projects. As a consultant he has provided expert witness testimony in cases involving environmental contamination and disposal of waste. He also has given technical assistance to the South Dakota Department of Environment and Natural Resources in the review of mining plans and ground-water contamination problems, including Superfund sites. He and his co-researchers hold a U.S. patent for removal of arsenic from water, and they have applied for a second patent for removal of metals from water.

In his service to South Dakota School of Mines and Technology, Dr. Davis has acted as Geological Engineering Program Coordinator and ABET Coordinator for geological engineering accreditation. This included revision of the geological engineering curriculum, origination and teaching of new engineering design courses, and preparation of ABET reports. He also is active in ground-water protection efforts, and in 1998 received the Virginia Simpson Award for community service in the Rapid City area. In 2007, he received the Emmenga Award for Excellence in Teaching. In 2014 he received the Ivan Rahn Education Award from SME, and in 2015 he was presented with the Distinguished Service Award of the Environmental Division of SME.

**Arden D. Davis**

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M.S. - 1979 South Dakota School of Mines and Technology  
(Geological Engineering)  
Ph.D.- 1983 South Dakota School of Mines and Technology  
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Registered Professional Engineer (South Dakota; No. 4663)

Experience: 2006 - present Professor  
S.D. School of Mines and Technology  
2002 - 2006 Chairman  
Dept. of Geology and Geological Engineering  
S.D. School of Mines and Technology  
1995 - 2002 Professor  
S.D. School of Mines and Technology  
1989 - 1994 Associate Professor  
S.D. School of Mines and Technology  
1984 - 1989 Assistant Professor  
S.D. School of Mines and Technology  
1982 Instructor  
1976-1982 Teaching and Research Assistant  
1978 Shell Development (Shell Oil Company)

Teaching: Digital Modeling of Ground-Water Flow Systems, Ground Water,  
Ground-Water Geochemistry, Geochemistry, Analytical Methods in  
Ground Water, Advanced Ground Water, Engineering Field  
Geology, Geological Engineering Design Project I

Consulting: Ground-water hydrologist and geological engineering consultant for  
numerous projects over past thirty years involving ground-water  
contamination, aquifer evaluation, low-level radioactive waste site  
evaluation, spring-flow measurements, and mine site development.

Funded research: Projects involving ground-water contamination, ground-water  
resource evaluation, aquifer vulnerability, water quality, and mine  
waste.

Community service: Ground-water protection efforts (see following pages).

Theses: Forty eight M.S. theses and twelve Ph.D. dissertations supervised.

Consulting:

- 2015 Siting of pipeline; water rights application
- 2014 Spring discharges
- 2013 Spring discharges
- 2012 Expert witness testimony – proposed pipeline
- 2011 Spring discharges
- 2010 Madison aquifer well for municipal water supply.
- 2009 Expert witness testimony: springs and potential effects of nearby wells.
- 2008 Ground-water model for permit application.
- 2007 Siting of new Madison wells for public water supplies in the Black Hills.
- 2006 Modeling of ground-water flow and biodegradation of benzene.
- 2005 Modeling of ground-water flow and gasoline contamination.
- 2004 Ethylene dibromide contamination; expert witness.
- 2003 Alliance of Architects and Engineers; expert witness.
- 2002 Alliance of Architects and Engineers; expert witness.
- 2001 Consolidated Engineers & Materials Testing; GeoTek; expert witness.
- 2000 Hillcrest Spring Water; Rapid City Landfill; expert witness.
- 1999 Boyd County LLW Monitoring Committee; Gill Landfill modeling.
- 1998 Boyd County LLW Monitoring Committee; Rapid City Landfill.
- 1997 Boyd County LLW Monitoring Committee; Terra, Inc., modeling.
- 1996 Terra, Inc., modeling; Boyd County LLW Monitoring Committee.
- 1995 Terra, Inc.; modeling for City of Ida Grove, Iowa; Vogel Paint and Wax.
- 1994 Keystone Gold Project, Keystone, South Dakota.  
Dunbar Resort: proposed railroad grade, Deadwood, South Dakota.  
Vogel Paint and Wax Superfund Site, Maurice, Iowa.
- 1993 Keystone Gold Project, Keystone, South Dakota.  
Vogel Paint and Wax Superfund Site, Maurice, Iowa.  
Low-level radioactive waste site evaluation and modeling.
- 1992 City of Rapid City: criteria for private wastewater disposal facilities.  
Nitrate contamination from mine waste.
- 1991 Corrosion problems during geothermal heating.
- 1990 Low-level radioactive waste site evaluation.  
South Dakota Department of Environment and Natural Resources:  
cyanide contamination.
- 1989 Wastewater facility site evaluation.  
South Dakota Department of Environment and Natural Resources: review  
of mine plan, northern Black Hills.
- 1988 Expert witness: gasoline contamination of ground water.
- 1987 South Dakota Department of Environment and Natural Resources:  
modeling of gasoline contamination.  
Utility Engineering Company: aquifer test evaluation.  
Gasoline contamination of ground water.
- 1986 South Dakota Department of Environment and Natural Resources.
- 1985 South Dakota Department of Environment and Natural Resources:  
ground-water contamination.

- 1983 Rosebud Sioux Tribe: aquifer evaluation.
- 1981 Save Wyoming Water: drawdown calculations.  
South Dakota Public Utilities Commission: aquifer evaluation.
- 1981 Evans Plunge, Hot Springs, South Dakota: spring discharges.
- 1979 U.S. Environmental Protection Agency; Engineering Science, Inc.

Community Service:

Assisted City of Rapid City and Pennington County in determining aquifer vulnerability in the Rapid City area. Assisted U.S. Environmental Protection Agency and South Dakota Department of Environment and Natural Resources as member of Technical Advisory Team, Gilt Edge Superfund Site.

Selected Publications:

- Davis, A.D., 1986, Deterministic modeling of dispersion in heterogeneous permeable media: *Ground Water*, v. 24, no. 5, p. 609-615.
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#### U.S. Patent:

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#### Related research:

Grainger Prize for Sustainability: HydroTech Engineering and Rohm & Haas (collaboration): Limestone-based arsenic-removal method; selected for Round II of competition.

Recent Research Funding:

National Science Foundation: SGER: Characterization of the Precambrian Aquifer at the Homestake DUSEL: Dr. Larry D. Stetler, Dr. Arden D. Davis, and Dr. Rohit Salve (Lawrence Berkeley Laboratory), \$75,000.

U.S. Geological Survey 104b Grant Program / South Dakota Water Resources Institute: Acidic Leaching Tests to Determine Arsenic Mobility from Concrete-Encapsulated Limestone Waste: Dr. Arden D. Davis, Dr. M.R. Hansen, and Dr. David J. Dixon, \$12,131.

U.S. Geological Survey 104b Grant Program / South Dakota Water Resources Institute: Investigation of Arsenic Removal from Water by Microbiologically Induced Calcite Precipitation: Dr. Arden D. Davis, Dr. Sookie S. Bang, and Dr. David J. Dixon, \$13,983.

U.S. Bureau of Land Management: Belle Eldridge Mine Sampling and Monitoring, Phase III, \$4,500 (additional); Arden D. Davis, Principal Investigator.

U.S. Geological Survey 104b Grant Program / South Dakota Water Resources Institute: Development of an agglomeration process to increase the efficiency of limestone-based material to remove metals from drinking water: Dr. Arden D. Davis and Dr. David J. Dixon, \$10,897.

U.S. Geological Survey 104b Grant Program / South Dakota Water Resources Institute: Fixed-bed adsorption column studies and engineering scale-up design of a limestone-based metals removal technology for small water supply systems: Dr. Arden D. Davis and Dr. David J. Dixon, \$12,918.

U.S. Geological Survey 104b Grant Program / South Dakota Water Resources Institute: Leaching tests for encapsulation of waste after arsenic removal from drinking water: Dr. Arden D. Davis, Dr. David J. Dixon, and Dr. M.R. Hansen; \$11,873.

U.S. Department of the Interior, National Park Service; Jewel Cave Pumping Test; Dr. Arden D. Davis, Principal Investigator; \$8,800.

U.S. Bureau of Land Management: Belle Eldridge Mine Sampling and Monitoring, Phase III, \$4,500 (additional); Arden D. Davis, Principal Investigator.

West Dakota Water Development District: Determination of historic ground water pollution problems, Part II: Pactola Dam, Rapid City West, and the North One-Half of Rockerville quadrangles; \$9,162; Dr. Alvis L. Lisenbee, Principal Investigator; Dr. Arden D. Davis, Co-Principal Investigator.

West Dakota Water Development District: Aquifer susceptibility study of the Pactola Dam quadrangle, South Dakota: Part II - Precambrian: \$9,112; Dr. Alvis L. Lisenbee, Principal Investigator; Dr. Arden D. Davis, Co-Principal Investigator.

West Dakota Water Development District: Aquifer mapping (1:24,000) of the Hermosa NW quadrangle; \$13,538; Dr. Alvis L. Lisenbee, Principal Investigator; Dr. Arden D. Davis and Dr. Larry Dr. Stetler, Co-Principal Investigators.

West Dakota Water Development District: Preliminary aquifer vulnerability and susceptibility study of the Blackhawk quadrangle; \$15,988; Dr. Alvis Lisenbee, Principal Investigator; Dr. Arden D. Davis, Co-Principal Investigator.

West Dakota Water Development District: Geologic mapping of the Mt. Rushmore quadrangle, South Dakota; \$14,970; Dr. Alvis Lisenbee, Principal Investigator; Dr. Arden D. Davis, Co-Principal Investigator.

West Dakota Water Development District: Aquifer vulnerability study of the Rockerville quadrangle, South Dakota; \$14,763; Dr. Alvis Lisenbee, Principal Investigator; Dr. Arden D. Davis, Co-Principal Investigator.

Phase I Small Business Innovation Research Grant, U.S. Environmental Protection Agency, Limestone-Based Material for Arsenic Removal from Drinking Water: Dr. Cathleen J. Webb, Dr. Arden D. Davis, Dr. David J. Dixon, and Dr. Terrence L. Williamson; \$100,000.

Phase II Small Business Innovation Research Grant, U.S. Environmental Protection Agency, Limestone-Based Material for Arsenic Removal from Drinking Water: Dr. Cathleen J. Webb, Dr. Arden D. Davis, Dr. David J. Dixon, and Dr. Terrence L. Williamson; \$225,000.

National Science Foundation, Statewide Partnership to Support Technology Innovation and Entrepreneurship in South Dakota (PFI), University of South Dakota: Arsenic Removal from Drinking Water; John C. Lofberg, Dr. Arden D. Davis, and Dr. David J. Dixon; \$35,826.

West Dakota Water Development District: Crystalline Aquifers of the Central Black Hills, South Dakota: Phase IV: Dr. Alvis L. Lisenbee, Dr. Arden D. Davis, and Dr. Maribeth Price; \$44,000.

West Dakota Water Development District: Crystalline Aquifers of the Central Black Hills, South Dakota: Phase III: Dr. Alvis L. Lisenbee, Dr. Arden D. Davis, and Dr. Maribeth Price; \$41,000.

U.S. Geological Survey 104b Grant Program / South Dakota Water Resources Institute: Investigation of the Contribution of Coliform Contamination in Runoff from Scoured Bed Sediments: Dr. Jennifer L. Benning, Dr. Scott J. Kenner, and Dr. Arden Davis, \$14,913.

West Dakota Water Development District: Crystalline Aquifers of the Central Black Hills, South Dakota: Phase II; Dr. Laurie Anderson, Principal Investigator; Dr. Alvis L. Lisenbee, Dr. Arden D. Davis, and Dr. Maribeth H. Price, Co-Principal Investigators; \$33,020.

Pete Lien and Sons, Inc: Optimization and characterization of iron-loaded limestone as a medium for the removal of arsenic from drinking water; Dr. Arden D. Davis, Principal Investigator; Dr. David J. Dixon, Co-Principal Investigator; \$8,800.

City of Custer, South Dakota: Water Sampling of Crystalline and Alluvial Aquifers at Custer, South Dakota: Dr. Arden D. Davis, Principal Investigator; Dr. J. Foster Sawyer, Dr. Alvis L. Lisenbee, and Dr. Maribeth H. Price, Co-Principal Investigators; \$25,000.

U.S. Department of the Interior, Bureau of Land Management: Environmental Monitoring of the Belle Eldridge Mine: Dr. Arden D. Davis, Principal Investigator; \$5,000.