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The Ogallala Aquifer in Nebraska: Gray Literature (1891–2010)

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Abstract

The Ogallala Aquifer is a key water resource for several U. S. states. TransCanada, a Canadian company, proposes to construct the Keystone XL pipeline to transport tar sands crude oil from Alberta to refineries in Texas; one proposed route would bury the pipeline in the Aquifer, raising water quality and environmental concerns. A rich inventory of information about the Aquifer predates the current controversy. This article presents a key subset of an extensive, ongoing bibliography: 128 citations to gray literature about the Ogallala Aquifer in Nebraska, which are inaccessible online and/or held in only a few libraries. The authors present several examples to illustrate the relevance of this gray literature to current events, comment on difficulties encountered during the bibliographic harvest and the identification of this subset, and reiterate the need for planned preservation through digitization of historical (print) gray literature.

Keywords: gray literature, grey literature, Keystone XL pipeline, Nebraska, Ogallala Aquifer

Background

TransCanada's proposed construction of the Keystone XL pipeline, to transport tar sands crude oil from Alberta to refineries in Texas, raises multiple environmental concerns. Opponents decry the environmental damage from extraction processes, construction of the pipeline, and potential pipeline leaks. For many citizens in Nebraska, the pipeline's proposed placement in the ecologically unique

Sandhills region and through the Ogallala Aquifer, makes these more global concerns local. The Ogallala Aquifer is a vast water resource underlying Nebraska and seven other states (South Dakota, Wyoming, Colorado, Kansas, Oklahoma, New Mexico, and Texas). It contains over 3 billion-acre feet of water, with 65% of its volume in Nebraska (Kromm & White, 1992).

The Ogallala Aquifer

The Aquifer's formation began 70 to 50 million years ago during the Laramide orogeny, when tectonic plate movement along the western margin of North America created uplift, forming the present day Rocky Mountains. Water from mountain streams and glaciers transferred vast sediments southeastward. These permeable sediments, 500 feet thick in places, overlay impermeable bedrock, causing the water to collect in a vast underground reservoir (Bittinger & Green, 1980). About 10,000 years ago, the last of the glaciers withdrew and contributing rivers diverted southward, leaving the Aquifer with little or no recharge (Opie, 2000). The controversial use of this nonrenewable resource began during the early days of European settlement and the prevailing theory of "rain follows crops," continuing with the recent proposal to build the TransCanada Keystone XL oil pipeline through the Aquifer (United States Department of State, 2011).

European immigrants pushing westward in the United States received encouragement and tangible support to settle and practice farming in the high plains, instead of passing through to land that was more desirable on the west coast. In 1862, the Homestead Act offered settlers 160 acres of free land if they stayed and farmed 5 years. In 1880 the popular slogan, used by land promoters, that "rain follows the plow" became "science" with the endorsement of Joseph Henry of the Smithsonian Institute, F. V. Hayden of the U. S. Geological Surveys of the Territories, and Nebraska scientist Samuel Aughey. In their pamphlet, *Agriculture Beyond the 100th Meridian*, Aughey and C. D. Wilber (1880) stated, "As pioneers take up the government lands, and encroach on the plains the line of abundant rainfall also marches westward" (p. 5). They attempted to validate their theory by citing the heavy rainfall that occurred during the decade of 1878 and 1887 (Opie, 2000). These beliefs and the accompanying agricultural practices led to disastrous results, culminating with the Dust Bowl of the 1930s (Opie, 2000). The farmers who remained turned to irrigation. At first, irrigators tapped surface water and shallow wells; as technology for deep drilling developed after World War II, they then utilized the Ogallala Aquifer.

Drought, low crop prices, and limited technology slowed the use of the Aquifer for irrigation in Nebraska. The 1950s saw an improvement in welldrilling technology, and the number of wells drilled for irrigation increased from 1,500 in 1941 to 8,000 in 1953 (Bleed, 1993). The number of wells drilled averaged about 2,000 a year in the 1950s and 1960s (Schafer, 1993).

The mass production and use of center-pivot irrigation systems in the 1970s dramatically increased irrigation, especially in western Nebraska where the shape of the land prohibited gravity irrigation methods. The number of center-pivot systems increased from 2,725 in 1972 to more than 27,000 in 1988 (Sheffield, 1993). By 1990, center-pivot irrigation watered more than 3 million of the 8 million acres of crops produced in Nebraska (Evert, 1993). Today Nebraska has 118,843 wells for crop irrigation (Nebraska Department of Natural Resources, 2011), and over 85% of all irrigated land in the state uses groundwater (Schafer, 1993). Overall, the Ogallala Aquifer supports 14 million acres of crop production for the eight states it underlies, providing 5 trillion gallons of water annually. This crop production constitutes one-fifth of the total U.S. harvest (Ashworth, 2006).

Gray Literature

In a widely accepted definition, commercial publishers do not produce gray literature, which can include documents in both paper and electronic format produced by governments, academia, business, and industry (GreyNet International, 2011, para. 2). Studies of gray literature over the past decade indicate that it is expanding at a much higher rate than mainstream publishing (Coad, Hardicre, & Devitt, 2006). The publication categories of gray literature vary by discipline, ranging from diaries and letters to conference proceedings, technical reports, unpublished dissertations and theses, newsletters, and digital scientific data sets (Auger, 1994; Ranger, 2005; Carroll, Crowe, & Candlish, 2011). In water science, government documents make up the bulk of the gray literature (Contreras, 2000). While the Internet has made many federal government documents widely available through outlets such as the U.S. Geological Survey (USGS) Publications Warehouse, many local, state, and regional documents remain elusive. Couple these government documents with technical reports and dissertations and theses about the local watershed, and a researcher discovers that the gray literature contains a wealth of information useful in the study of the Ogallala Aquifer.

Completeness is another aspect of gray literature. Drafts, preliminary reports, and ongoing investigations often become widely available once published as a completed document. The question then becomes: Does the preliminary document have value? Yes, according to Charles Auger (1994); once these documents pass from "restricted and temporary" to "open and permanent," they become part of the footprint of the final document. Even after the final document becomes widely distributed through commercial means, the original remains in bibliographic indexes and is frequently cited (Auger, 1994). One can argue that this occurs because the draft or preliminary report contains information that is not available in the final report. For example, the Open File Report (OFR) is a

series of preliminary research results published by the USGS frequently in cooperation with state geological surveys. The OFRs provide timely, "quick and dirty" releases of research data (Bichteler, 1991). A final, more refined report documents the completed research and supersedes earlier reports, but may be years in preparation. Many of the OFR entries contain detailed, large-scale maps that have more information than those in the final report. These preliminary documents may show project development over time and are valuable to historical and legal researchers, as well as to current participants in research groups with transitory membership.

Format is another attribute that classifies some information as gray literature. Social media has a huge influence on public opinion, yet the digital formats of blogs, twitters, emails, and webpages do not easily fit with traditional methods of bibliographic control. Earlier instances of social media communication included pamphlets and correspondence. In the late 1800s the controversy over settlement of the western plains peaked. Explorer, scientist, and Chief of the USGS, Army Major John W. Powell argued that the 160 acres allocated by the Homestead Act was not sustainable in the arid and semi-arid lands of the western plains. He advocated that it would take 2,560 acres to sustain any kind of farming, with most of the acreage in use as pasture and a small amount set aside for irrigated farming (Fite, 1966). Opposition arose from the numerous settlers moving into western Nebraska and the Dakotas as part of the "Great Dakota Land Boom." This drama played out through a series of pamphlets, speeches, and correspondence. Although these formats were major forms of communication, few found their way into the permanent bibliographic record. For example, in order to encourage pioneers to settle and farm the western plains, land promoters distributed the seven-page pamphlet *Agriculture Beyond the 100th Meridian*, printed in 1880 (Aughey & Wilber, 1880). Only four U.S. libraries hold the pamphlet, written as a response to the 1878 *Report on the Lands of the Arid Region of the United States, with a More Detailed Account of the Lands of Utah* by John Wesley Powell. In contrast, more than 600 libraries have copies of Powell's report, reprinted several times since its original printing and distribution by the Federal Government.

Objectives

The harvest of citations to materials about the Ogallala Aquifer in Nebraska began in 2008 as a cooperative project with the Greater Western Library Association and the Western Waters Digital Library. Beyond the selected bibliographies found in books, research journal articles, and various scientific and technical reports, the authors identified only two other significant bibliographies that covered the Ogallala Aquifer. The most comprehensive, first published in 1998 and last updated in 2010, enumerates only federal and state government publications

about the Aquifer. It does not cover any other types of gray literature, although it captures a citation to a state groundwater map dated 1964, and publications specifically about the Aquifer dating from 1980 (University of Nebraska at Kearney, 2011). The second, *Ogallala Aquifer (1970–Aug 83)*, published in 1983, includes citations to publications for sale from the National Technical Information Service (NTIS), a division of the U.S. Department of Commerce (United States Department of Commerce, 1983). This bibliography lists 60 documents, with only 1, *Quantitative Hydrogeology of the Upper Republican Natural Resources District Southwest Nebraska* (Lappala, 1978), pertaining specifically to Nebraska. In order to provide a more comprehensive collection of resources, two of the authors (Adonna Fleming and Elaine Nowick) proposed the creation of an online bibliographic database of free, full-text resources. However, after evaluation of the harvested citations, the authors discovered that many of the documents, regardless of format, were either not widely available or were unavailable free of cost. The project's modified objectives became:

- to create and share a regularly updated, robust bibliography about the Ogallala Aquifer in Nebraska;
- to identify gray literature about the Aquifer, in order to increase awareness of these resources, and to explore the potential of making these more accessible via digitization.

Methods

The authors searched six bibliographic resources: Agricola, GeoRef, Water Resources Abstracts, WorldCat, the USGS Libraries Program (http://library.usgs.gov/), and the "Classic Catalog" of the University of Nebraska-Lincoln Libraries (http://libraries.unl.edu). The choice of resources reflected the authors' primary interest in scientific and technological research involving the Aquifer; environmental policy and water law were not priorities in these searches. The results were exported to RefWorks, a proprietary bibliographic citation management software.

Keywords searched were *Ogallala* (also variant *Ogalala*), *aquifer*, *groundwater* (also variants *ground water*, *ground-water*), *irrigation*, and *water supply* (also variant *water-supply*). *Nebraska* served as an additional limiter to these searches. Some of the initial 1,089 references addressed the Ogallala Aquifer in Nebraska and other states. The authors decided to concentrate on those citations that addressed only Nebraska in building the bibliography. The largest and deepest portion of the Ogallala Aquifer underlies Nebraska, covering 64,400 square miles (Guru & Horne, 2000). The authors sorted the initial 1,089 references, selecting citations addressing only Nebraska, and then de-duplicated that selection, arriving at the current 758 records in the "Ogallala Masterfile" (as of October 2011).

Readers with access to RefWorks may view this bibliography, which is a work in progress, at (http://www.refworks.com/refshare2?site=029901110171600000/RWWEB107743349/Ogallala%20Masterfile).

The subset of particular interest was the group of citations that appeared to be unavailable in a free full-text digital format or were not widely available within the United States. To develop this gray literature bibliography, the authors reviewed the 758 citations contained in the Ogallala Masterfile. As a first step, WorldCat title searches of the citations eliminated incomplete records and those duplicates that escaped the RefWorks de-duplication tool. The authors conducted title and/or author searches for the remaining 351 citations, via Google Scholar (http://scholar.google.com/), Nebraska's digitized state documents collection (http://nebraskaccess.ne.gov/), and the USGS Publications Warehouse. These searches verified that the references were (a) unavailable in full-text at no cost, or (b) not widely available in print or microform (available in five or fewer libraries in the United States), and (c) not out of scope of the bibliography. Those that were out of scope included primarily "how to" publications from the Nebraska Cooperative Extension Service, as well as titles (cataloged separately) from the series Nebraska Water Survey Papers and/or the federal Water Supply Papers. The gray literature discussed in this article is discoverable. Referring back to the definition of gray literature presented earlier, the authors' concern is primarily one of limited accessibility, because of non-digital format and/or limited copy availability. The remaining 128 citations to gray literature, arranged in chronological order, appear in the Appendix.

Results and Discussion

Approximately 17% of the 758 citations contained in the Ogallala Masterfile fell into the category of gray literature, as defined earlier. Graduate works, primarily master's theses from the University of Nebraska system, comprised the majority (61%) of the gray literature collection (see Figure 1). Of the theses or dissertations, none were freely available online and, in most cases, the research was available only as a single print copy. The authors did not investigate whether any of this graduate research appeared subsequently in peer-reviewed journals. However, it is likely that there is a unique level of detail found in the theses and dissertations, given that most scientific theses and dissertations are not publication-format and/or are unpublished in their entirety elsewhere. While doctoral dissertations are available digitally via ProQuest's Dissertations and Theses database, master's theses are not widely indexed in this resource, nor are these available in many institutional repositories (IRs). None of the Nebraska theses listed in the Appendix were available online via the University of Nebraska-Lincoln's (UNL) IR, Digital Commons. In the United States, authors of master's theses retain copyright, so digitization of this mate-

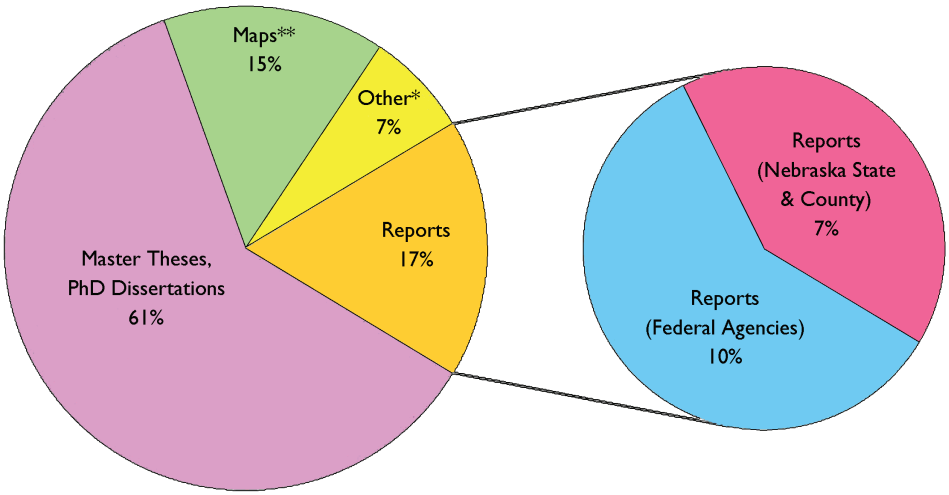

Figure 1. Gray Literature, Ogallala Aquifer in Nebraska, Categorized by Publication Type.
* Contains Reports from Conference Proceedings, Private Papers, and the U.S. Army
** Primarily Published by the Nebraska Conservation and Survey Division

rial requires seeking out and receiving permission for digitization and public access to the work. As others note (Paillassard, Schopfel, & Stock, 2007), universities should encourage or require studentresearchers to make their work available online in IRs or other appropriate digital libraries.

Of the remaining gray literature identified in this study, most are publications from the UNL Survey and Conservation Division and/or the USGS (Figure 1). There is no evidence that any of these publications are available digitally. As state and/or federal government publications, these documents are candidates for digitization and dissemination via the Digital Commons or another suitable repository. Notable exceptions include collections of field notebooks and other documentation (dating from 1891) from UNL's Survey and Conservation Division and a collection of archival records available only from a county office. After evaluation by an archivist, digitization, and provision of open online access, the use of these two archival sources would likely increase.

The distribution of publication types over the years reflects the increase in digital publication of government documents beginning in the late 1990s. Prior to 1996, the gray literature found in the Appendix is a mixture of state and federal documents and dissertations and theses. From 1997 on, the citations are predominantly to graduate research. Digital publication at the state and federal level increases the likelihood of discovery of and access to these items. However, the loss of born-digital government publications, with changes in administrations or appearance of new versions, is a serious concern if one accepts that superseded versions are part of the footprint of a document (Auger, 1994; Eells, 2007).

Some might question the value of, or need to, access older reports, theses, or dissertations. A number of published accounts, written by information specialists and researchers representing a range of disciplines, support this need. Bichteler (1991) observes that geologists frequently consult state Open File Reports (OFRs), dissertations, and theses, because these provide regional information and data that are unique spatially and temporally. Without appropriate cataloging, not all available versions are discoverable; without the retention of earlier versions, accessibility to the state OFRs is limited or impossible. Print-only theses are inaccessible if unavailable digitally or via interlibrary loan. Colten (2005), a geography professor researching interstate pollution in the United States, details a difficult process to obtain a 1949 technical report issued by the U.S. Public Health Service. Unable to visit the library likely to house this document, since national security rules allow access only to federal employees, he discovered that the report was no longer available from the NTIS. Colten finally located a librarian willing to photocopy the report for him. He concludes: "Scholars who rely on historical documents must help librarians and archivists convince administrators of the importance of vital records …" (Colten, 2005, p. 678). Costello (2007) describes efforts to capture the gray literature, including theses and dissertations, of Louisiana's deteriorating and disappearing coastal wetlands. This project involved the identification and selection of gray literature by the author, a librarian. She also discusses a survey of the users of this information, the results of which helped guide selection and prioritization in the project. Approximately 66% of the respondents considered theses and dissertations as "valuable" to their research, and 83% placed "state government reports" in the same category (Costello, 2007). Hurricane Katrina interrupted the development of the citation database and subsequent digitization of selected gray literature, a reminder that unexpected disasters also affect the availability of gray literature. Cordes (2004) reports on the impact of gray literature produced by GESAMP, the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (http://www.gesamp.org/). Through citation analysis using ISI's Web of Science, she demonstrated a high level of use of many of GESAMP's publications. There was a relatively low rate of citation by GESAMP affiliates, indicating discovery and access by those outside the organization. Cordes concludes that "grey literature publications can be long-lived and influential, deserving of much more respect than is often accorded to the genre" (p. 67). The authors themselves experienced the value of access to gray literature. In attempting to confirm the quote attributed to Aughey and Wilber regarding rainfall, one of the authors discovered that Opie (2000) inaccurately reported it in his book, *Ogallala: Water for a Dry Land*. Access to a copy of Aughey and Wilber's 1880 pamphlet led to the discovery of the complete quotation.

The ongoing controversy about the placement of the Keystone XL pipeline, particularly in Nebraska, accentuates concern for the availability of comprehen-

sive information about the Ogallala Aquifer. The authors examined the reference lists provided in the *Keystone XL Pipeline Project: Final Environmental Impact Statement* (*EIS*; United States Department of State, 2011), specifically for inclusion of any of the gray literature identified in this study. Many of the Nebraska-related citations are USGS publications. These include maps, Water Supply Papers, Fact Sheets, Circulars, and Professional Papers; most of these are available online via the USGS Publications Warehouse. Also cited are a number of reports available online from the Nebraska Games and Parks Commission; these do not relate to water resources directly, but address species considered threatened, endangered, or of conservation interest. The authors found no publications from UNL's Conservation and Survey Division in the review, despite the wide availability of many of these. In fact, the only water-related reference from UNL was *Eastern Nebraska Water Resources Assessment* (*ENWRA*; Joeckel, 2009), accessed online in July 2011. The *EIS* reference lists include none of the theses or dissertations listed in the Appendix; in fact, very few dissertations or theses from any institution are present in the reference lists. It is, of course, possible that the gray literature enumerated in this manuscript is irrelevant to the *EIS.* However, the omission from the *EIS* of many widely accessible and seemingly relevant entries from an extensive body of research about the Aquifer in Nebraska—as captured in the Ogallala Masterfile— is disturbing.

Another disturbing aspect of this project was the difficulty that three librarians experienced in determining whether items were available online, and where. The authors knew to look beyond Google Scholar in attempting to find these publications, realizing that repositories like the USGS Publications Warehouse and the Nebraska state documents collection exist. Where will less-experienced searchers look, and how much energy will they expend?

The authors also encountered difficulties during the bibliographic harvest: incomplete citations, items cataloged separately that were actually part of a series, and difficulties in clarifying holdings. The authors noted when searching a title in WorldCat that, in some cases, there would be more than one record for an item, often with a different number of holdings. The authors found they had to look at each listing to find the most complete record. For example, WorldCat lists the Bradley and Johnson 1957 publication, *Geology and Ground-Water Hydrology of the Valleys of the Republican and Frenchman Rivers, Nebraska*, three times, with holdings of 44, 5, and 1, respectively. The one with the most number of holdings is the full catalog record, submitted by an OCLC member institution. The other two are abbreviated versions of cataloging acquired during batch loading from international libraries. After investigating all the entries, the authors did not include this title in the gray literature (Appendix), because it is widely held. However, they noted the frustration this could cause someone who was looking for a title and did not know how to recognize the different levels of cataloging or that the series title, *Contributions to the Hydrology of the United States, 1955*, included the monographic title: *Geology and Ground-Water Hydrology*

of the Valleys of the Republican and Frenchman Rivers, Nebraska. Individual libraries determine whether or not to catalog to the monographic level in a series. The errors would multiply if one of the bibliographic indexes were to pick up the incomplete record and then have that cited in professional papers or used for interlibrary loan requests.

Different formats of an item also caused different results, in terms of availability. For example, the Federal Government distributes documents in both paper and microfiche, and the lending library decides which format to collect. This forces researchers to examine multiple records, for both paper and fiche, in order to accurately determine an item's availability.

Conclusion

This study enumerates citations to gray literature that directly addresses scientific and technological research about the Ogallala Aquifer in Nebraska, a subset of a larger, ongoing bibliography available at this time to readers with access to RefWorks. The work reveals difficulties in harvesting complete citations, in many cases, and in identifying online access points for other documents. Our water resources are critical for human and environmental health, crop and animal production, and U.S. national security. The preservation and increased ease of access to research about the Ogallala Aquifer should be part of knowledge and records management for the governments of at least the eight states that enjoy the Aquifer's bounty, if not part of a national plan. The authors join with other researchers, librarians, archivists, and citizens to add evidence to the need for a preservation plan for key gray literature, as well as a plan to make these publications more accessible through digitization. The increased awareness and ease of access to gray literature will support more fully informed and robust research, public policy, and planning (e.g., oil pipeline placement).

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Appendix. The Ogallala Aquifer in Nebraska: Gray Literature (1891–2010)

Year(s)	Description of material(s)	Author	Title	Publisher information
1891–2001	Archival materials	University of Nebraska-Lincoln (UNL) Conservation and Survey Division *	Conservation and Survey Division records, 1891—2001	UNL Conservation and Survey Division
1937–1947	Archival materials	Bennett, Chester Otis	Papers, 1937–1947	None
1945	Report, maps	Lloyd, Henry; Federal Land Bank of Omaha	Pump irrigation in Nebraska	Federal Land Bank, Omaha, NE
1946–1959	Maps	UNL Conservation and Survey Division	[Nebraska county maps: Water survey and ground water]	UNL Conservation and Survey Division
1952	MS thesis	Marlette, Ralph R.	Field determinations of the transmissibility and storage coefficients of the Platte Valley Aquifer near Ashland, Nebraska	UNL
1954	Open-file report	Keech, Charles Franklin; Case, R. L.; U.S. Geological Survey (USGS), Water Resources Division	Water levels prior to January 1, 1954 in observation wells in Nebraska	USGS, Department of the Interior
1955	Open-file report	Keech, Charles Franklin; USGS, Water Resources Division	Hydrology of Clay County, Nebraska: With special reference to recharge	USGS, Department of the Interior
1955–1957	Open-file report	Keech, Charles Franklin; Case, R. L.; USGS, Water Resources Division; UNL Conservation and Survey Division	Water levels in observation wells in Nebraska during 1954–1956	USGS, Department of the Interior
1961	MS thesis	Nelson, Charles Edward	Deep well irrigation in Hamilton County, Nebraska: Resource, development, impact and future	Oregon State University
1962	Open-file report	Keech, Charles Franklin; USGS	Relation of ground-water withdrawals to the water supplies in Nebraska	USGS, Department of the Interior

(Continued on next page)

Appendix. The Ogallala Aquifer in Nebraska: Gray Literature (1891–2010) *(Continued)*

Year(s)	Description of material(s)	Author	Title	Publisher information
1962	Map	Reed, E. C.; UNL Conservation and Survey Division	Nebraska groundwater storage map	UNL Conservation and Survey Division
1964	Map	Svoboda, G. R.	Configuration of water table and depth to static water level	UNL Conservation and Survey Division
1966	MS thesis	Weakly, Edward Cletus	Geology and ground-water resources of Polk County, Nebraska	UNL
1968	MS thesis	Brugger, Wayne Edwin	Groundwater recharge in a Platte Valley wellfield	UNL
1968	MS thesis	Stoffey, Philip Stephen	Transmissibility of the Little Blue River Basin in southeastern Nebraska	UNL
1969	MS thesis	Jess, John Michael	An analysis of the irrigation use of the ground-water resource in Seward County, Nebraska	UNL
1969	Report, maps	Johnson, Lynn A.; Hall, Charles E.; Bennett, N. B., III; U.S. Department of the Interior, Bureau of Reclamation	Reconnaissance groundwater geology report: Ft. Kearney Unit, Tri-County Division, Missouri River Basin Project, Nebraska	U.S. Department of the Interior, Bureau of Reclamation
1969	MS thesis	Row, Donald Dean	Groundwater quality study: Eastern Nebraska	UNL
1969	Maps	UNL Conservation and Survey Division; USGS	[Nebraska's water supply]	UNL Conservation and Survey Division
1970	MS thesis	Zitterkopf, Ronald Eugene	Basin recharge of a Platte Valley aquifer	UNL
1971	Report, maps	U.S. Department of the Interior, Bureau of Reclamation	Fort Kearney unit, Pick-Sloan Missouri Basin program, Nebraska: Reconnaissance report	U.S. Department of the Interior, Bureau of Reclamation

1971	MS thesis	Waddington, Ralph Emmett	An electric analog model study of ground water in Box Butte County, Nebraska	UNL
1971	Report, maps	United States Army, Corps of Engineers, Omaha District	Feasibility report on the ground water problem at Niobrara, Nebraska and the Niobrara State Park	U.S. Army Engineer District, Omaha
1971–1983	Map	USGS; UNL Conservation and Survey Division	Nebraska state water plan drainage areas	UNL Conservation and Survey Division
1972–1978	Report (6 vols.)	U.S. Department of the Interior, Bureau of Reclamation	Proposed North Loup Division, Pick-Sloan Missouri Basin program, Nebraska: Final environmental statement	U.S. Department of the Interior, Bureau of Reclamation
1973	MS thesis	Atkinson, Jon Charles	Chemical quality of the groundwater system in Hall County, Nebraska	UNL
1973	Report, maps	United States Army, Corps of Engineers, Omaha District	Ground water problem at Niobrara, Nebraska and the Niobrara State Park: Final environmental statement	U.S. Army Engineer District, Omaha
1975	MS thesis	Hosek, Ronald Joseph	Quantitative hydrogeology and evaluation of water-management alternatives, Mira Valley Area in Valley County, Nebraska	UNL
1976	Open-file report	Lappala, E. G.	Changes in the water supply in the Upper Republican Natural Resources District, Southwest Nebraska, from 1952–1975	USGS
1976	MS thesis	Larson, David Roy	The hydrogeology of the landfill at Lincoln, Nebraska	UNL
1976	Report	UNL Conservation and Survey Division	Law, rules, and regulations pertaining to groundwater in Nebraska	UNL Conservation and Survey Division

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Appendix. The Ogallala Aquifer in Nebraska: Gray Literature (1891–2010) *(Continued)*

Year(s)	Description of material(s)	Author	Title	Publisher information
1977	MS thesis	Hammons, R. H.	Atrazine persistence in a Valentine loamy fine sand profile	UNL
1977	Report, maps	State of Nebraska-Little Blue Natural Resources District	Groundwater in the Little Blue: An informational series	State of Nebraska-Little Blue Natural Resources District
1978	MS thesis	Avery, Charles	Groundwater geology of Johnson County, Nebraska	UNL
1978	Open-file report	USGS, Water Resources Division	Nebraska Water Data Programs, 1978	USGS
1978	MS thesis	Goodenkauf, Owen	The groundwater geology of southern Lancaster County, Nebraska	UNL
1978	MS thesis	Grosskopf, Fred W.	The hydraulic connection between the Republican River and aquifer(s) along the reach between McCook, Nebraska and Cambridge, Nebraska	UNL
1978	Open-file report	Lappala, E. G.; Hemphill, P. F.; Booker, R. E.	Ground-water availability in the Hitchcock-Red Willow, Frenchman Valley, and Meeker-Driftwood Irrigation Districts, Southwest Nebraska	USGS, Water Resources Division
1979	Open-file report	Lichtler, William F.; Stannard, David I.; Kouma, Edwin; Old West Regional Commission; University of Nebraska, Water Resources Center; Nebraska Natural Resources Commission; USGS	Artificial-recharge investigation near Aurora, Nebraska: 2-year progress report	USGS, Department of the Interior
1979	Map	Nebraska Geological Survey	Test hole location map	Nebraska Geological Survey
1979	Report	Nebraska Natural Resources Commission; Camp, Dresser & McKee, Inc.	Six state EDA High Plains Ogallala Aquifer study: Plan of study, study elements for Nebraska	Nebraska Natural Resources Commission

1980	Map	Nebraska Department of Environmental Control; UNL Conservation and Survey Division	Concentration of dissolved solids in the principal aquifer, Nebraska	Department of Environmental Control, State of Nebraska
1980	Maps	Nebraska Department of Environmental Control; UNL Conservation and Survey Division	Thickness of principal aquifer, 1979	UNL Conservation and Survey Division
1980	Maps	UNL Conservation and Survey Division; Nebraska Department of Environmental Control	Configuration of base of principal aquifer, 1979	Department of Environmental Control, State of Nebraska; UNL Conservation and Survey Division
1981	MS thesis	Folkman, David N.	Hydrogeology including ground water/surface water relationships in the vicinity of Cook, Nebraska	UNL
1981	Report (7 issues)	Nebraska Natural Resources Commission	Policy issue study on selected water rights issues: State water planning and review process: Report of the Natural Resources Commission	Nebraska Natural Resources Commission
1981	Map	UNL Conservation and Survey Division	Locations of low and high nitrate-nitrogen concentrations in water from sampled wells and areal distribution of soil associations, Pierce County, Nebraska	UNL Conservation and Survey Division
1982	Maps	UNL Conservation and Survey Division; USGS	Groundwater maps, 1981: [Nebraska]	UNL Conservation and Survey Division
1983	Map	Spalding, Roy F.; Loope, C. N.; UNL Conservation and Survey Division	Radium-226 concentrations in groundwater, Central Platte Region, Nebraska, 1982–1983	UNL Conservation and Survey Division

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Appendix. The Ogallala Aquifer in Nebraska: Gray Literature (1891–2010) *(Continued)*

Year(s)	Description of material(s)	Author	Title	Publisher information
1983	PhD dissertation	Veatch, Maurice Deyo	Ground-water occurrence, movement, and hydro-chemistry within a complex stratigraphic framework, Jefferson County, Nebraska	Stanford University
1984	MS thesis	Druliner, Allan Douglas	Groundwater uranium chemistry of the Crawford area, northwestern Nebraska	UNL
1984	Map	Spalding, Roy F.; Loope, C. N.; Central Platte Natural Resources District, State of Nebraska	Uranium concentrations in groundwater: Central Platte Region, Nebraska, 1979–1983	UNL Conservation and Survey Division
1985	MS thesis	Hiergesell, Robert A.	Analysis of the stream-aquifer system near Cook, Nebraska, using a finite-difference digital groundwater model	UNL
1985	MS thesis	Kalinski, Robert	Investigation and computer simulation of stream-aquifer relationship along Elm Creek, Webster County, Nebraska	UNL
1985	Maps	UNL Conservation and Survey Division; USGS	Groundwater maps, 1984: [Nebraska]	UNL Conservation and Survey Division
1985	MS thesis	Wood, Bruce R.	Investigation of a hazardous waste disposal site near Beatrice, Nebraska and its potential effects on the aquifer in the area	UNL
1986	PhD dissertation	Barrash, Warren	Hydrostratigraphy and hydraulic behavior of fractured Brule Formation in Sidney Draw, Cheyenne County, Nebraska	University of Idaho

1986	MCRP thesis	Corey, Toby L.	A study on the practicability of Nebraska's natural resources districts to manage Nebraska's states groundwater resources	UNL
1986	MS thesis	Davis, Ralph K.	Hydrogeologic interrelations of the Platte River Basin and the Upper Big Blue River Basin, in the Polk County area of Nebraska	UNL
1986	MS thesis	Gross, Jonathan A.	The Lincoln sanitary landfill: An evaluation of groundwater quality and movement, methane production, and percolation potential	UNL
1986	Report	Miewald, Robert D.	The judicialization of ground-water management: The case of Nebraska	American Society for Public Administration National Conference, Anaheim, CA
1986	Map	UNL Conservation and Survey Division	Saturated thickness of the principal groundwater reservoir in Nebraska	UNL Conservation and Survey Division
1986	MS thesis	Woldt, Wayne E.	A linearized model for management of a surface-groundwater system in the tri-county area of south central Nebraska	UNL
1987	MS thesis	Alix, Jonathan J.	A hydrogeologic study of the local groundwater flow system at Osmond, Nebraska	UNL
1987	MS thesis	Fulton, John W.	The distribution of explosive residues and nitrate-nitrogen in the groundwater west of Grand Island, Nebraska	UNL
1987	MS thesis	Katz, Gary Joshua	A hydrogeological and thermal infrared investigation of the Blue Creek anomaly	UNL

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Appendix. The Ogallala Aquifer in Nebraska: Gray Literature (1891–2010) *(Continued)*

Year(s)	Description of material(s)	Author	Title	Publisher information
1987	MS thesis	Kitchen, Lisa	Nitrate-N profiles of fine to medium textured sediments of the unsaturated zone of southeast and south-central Nebraska	UNL
1987	MS thesis	O'Connor, Thomas Mark	A preliminary study of the hydrogeology of the Dakota Formation in Douglas, Sarpy, and Washington counties, eastern Nebraska	UNL
1987	MS thesis	Page, Eric J.	A hydrogeologic investigation of the groundwater resources in Richardson County, Nebraska	UNL
1987	MS thesis	Pipes, Jeffrey W.	The hydrogeologic framework of the Paleozoic aquifers of the Papio Natural Resources District, Nebraska	UNL
1987	Map	U.S. Soil Conservation Service; U.S. National Cartographic Center	Irrigated floodplain land and groundwater storage map, Swan Creek watershed, Saline and Jefferson Counties, Nebraska	USDA-SCS-National Cartographic Center, Fort Worth, TX
1988	MS thesis	Bryda, Anthony P.	Nitrate-nitrogen profiles documenting land use practice effects on ground-water in and around Sidney, Nebraska	UNL
1988	MCRP thesis	Burbach, Mark E.	Groundwater quality management alternatives: South Platte NRD and the city of Sidney, Nebraska	UNL
1988	MS thesis	Chu, Tyan-Ming	Investigation of the thermal regime in a river-aquifer system near Ashland, Nebraska	UNL

1988	MPH thesis	Jacobs, Candace Ann	Factors influencing ground-water contamination in rural Nebraska	San Diego State University
1988	Open-file report	Kastner,William M.; USGS	U.S. Geological Survey ground-water studies in Nebraska	USGS
1988	MS thesis	McKenzie, Garold Dale	Economic factors that affect groundwater irrigation development in Nebraska	UNL
1988	Conference program	Nebraska Academy of Sciences, TER-QUA Division	Symposium: Global climate and the future of the High Plains Aquifer: Program & field conference guide	Institute for Tertiary-Quaternary Studies, Lincoln, NE
1988	Map	Nebraska Geological Survey	Test hole location map	Nebraska Geological Survey; UNL Conservation and Survey Division
1988	MS thesis	Parrott, Jack D.	Shallow ground water denitrification associated with an oxidation-reduction zone in Hall County, Nebraska	UNL
1988	MS thesis	Van Noort, Peter John	A preliminary investigation of hydrocarbon contamination: Alliance, Nebraska	UNL
1988	MA thesis	Walker, April Rubens	Agriculture and nonrenewable resources: The case of irrigation on the Ogallala Aquifer	West Virginia University
1989	MS thesis	Fischer, Alex J.	The impact of volatile organic compounds (VOCs) on ground water underlying Hastings, Nebraska	UNL
1989	MS thesis	Gilbert, Julia A.	A water quality study of boiling springs along the Dismal River in the sand hills of Nebraska	UNL

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Appendix. The Ogallala Aquifer in Nebraska: Gray Literature (1891–2010) *(Continued)*

Year(s)	Description of material(s)	Author	Title	Publisher information
1989	MS thesis	Hibbs, Barry Joseph	Investigation of a brine contaminated aquifer in southeastern Hitchcock County, Nebraska: Emphasizing the conjunctive use of geophysical and geochemical methods of pollutant detection	UNL
1989	MS thesis	Link, Martha Louise	Application of a transport model to a contamination site in southeast Nebraska, including parameter estimation effects	UNL
1989	Archival materials	McCormick, Sam A.; Nemaha County (Nebraska) Monitoring Committee	Archival material	Not available. Contact Nemaha County directly
1990	Report, maps	Department of Environmental Control, State of Nebraska	Ground water quality investigation of five solid waste disposal sites in Nebraska: A supplemental report to the assessment and classification of community solid waste disposal sites in Nebraska	Department of Environmental Control, State of Nebraska
1990	MS thesis	Guhman, Ann Irene	The role of ground water sapping in gully formation along the Dismal River, Hooker and Thomas Counties, Nebraska	UNL
1990	MS thesis	Mergia, Girma	Comparison of three-dimensional finite difference and finite element transport models with application to a groundwater remediation site in western Nebraska	UNL

1990	Map	Nebraska Geological Survey	Test hole location map	Nebraska Geological Survey; UNL Conservation and Survey Division
1990	Maps	UNL Conservation and Survey Division; USGS	[Groundwater maps, Nebraska, 1989–1990]	UNL Conservation and Survey Division
1990	MS thesis	Webber, Caroline M.	Ground-water movement through the fractured Brule Formation in the Sidney Draw/Lodgepole Creek Valley near Sidney, Nebraska	UNL
1991	MCRP thesis	Trewhitt, Thomas R.	Preferences of nonpoint source groundwater protection programs by Nebraska's Natural Resources Districts	UNL
1992	MS thesis	Balasubramanian, Nallaperumal	Effects of alternative agricultural management practices on nitrate in groundwater and farm income in southeastern Nebraska	UNL
1992	MS thesis	Erickson, Nanette Eileen Rayapati	Vegetation, soil, and ground-water characteristics of wet-lands in the Nebraska Sandhills	Iowa State University
1992	Report, maps	U.S. Department of the Interior, Bureau of Reclamation	Special report, O'Neill Unit: Ground-water recharge plan, Pick-Sloan Missouri Basin Program, Nebraska	Bureau of Reclamation, Nebraska-Kansas Projects Office

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Appendix. The Ogallala Aquifer in Nebraska: Gray Literature (1891–2010) *(Continued)*

Year(s)	Description of material(s)	Author	Title	Publisher information
1993	MS thesis	Miller, Christopher A.	Modeling of the Kearney well field using a three-dimensional groundwater model	UNL
1993	MS thesis	Smith, David M.	The development of a wellhead protection area program for the Beatrice, Nebraska Municipal Wellfield	UNL
1994	MS thesis	Steele, G. V.	Groundwater-levels in response to precipitation events, central Nebraska, 1987–1992	UNL
1995	MCRP thesis	Pillard, Matthew Edward	Using the sole source aquifer protection program as a model for management strategies for Lincoln's wellfields	UNL
1996	MS thesis	Headrick, Jacqueline	Fluoride in Nebraska groundwater	UNL
1996	MA thesis	Parsley, Joseph Edward	Water quality survey of south central Sarpy County, Nebraska	University of Nebraska at Omaha (UNO)
1996	Maps	UNL Conservation and Survey Division	Groundwater-level changes in Nebraska, predevelopment to spring 1994; Registered irrigation wells in Nebraska–summer 1995	UNL Conservation and Survey Division
1996	MS thesis	Zurbuchen, Brian R.	The dipole probe development and dipole flow test applications in a sand and gravel aquifer (MSEA site, Shelton, Nebraska)	UNL

1997	MS thesis	Bisbee, Mary	Geology, soils, and the potential for further migration into the groundwater of hazardous material from the University of Nebraska Agricultural Field Laboratory in Saunders County, Nebraska	UNL
1997	MS thesis	Ham, Carl	Contaminant flow from landfills located on the edge of semi-perched aquifers, using the Norfolk, Nebraska landfill as a case study	UNL
1997	MS thesis	Waisner, Scott A.	Removal of RDX from a contaminated groundwater aquifer by in-situ bioremediation	University of Missouri-Columbia
1998	Honors thesis	Mahrt, Daniel Brian	Infrastructure assessment for Raymond, Nebraska	UNO
2000	MS thesis	Cornwall, James F.	Development of a groundwater flow model coupled to a slope stability model to predict bank erosion patterns in a meander near Cook, Nebraska	UNL
2002	MS thesis	Christ, Brian J.	A case study of reductive dechlorination of trichloro-ethylene-contaminated ground-water at Offutt AFB by use of an organic composite biowall & lasagna treatment	UNL
2002	PhD dissertation	McGinnis, Shelley Rene	Factors affecting surface-water and ground-water quality within tribal lands of eastern Nebraska	University of Arkansas, Fayetteville

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Appendix. The Ogallala Aquifer in Nebraska: Gray Literature (1891–2010) *(Continued)*

Year(s)	Description of material(s)	Author	Title	Publisher information
2003	MS thesis	Koester, Paul H.	Temporal soil water loss estimation for Box Butte County, Nebraska	UNL
2003	MA thesis	Raymond, Kristie Lynn	Effects of different magnitude precipitation events on the water quality of the Little Papillion Creek, Omaha, Nebraska	UNO
2004	MS thesis	Hyun, Yunsoon	Optimization study of an existing GAC treatment system former Nebraska Ordnance Plant, Mead, NE	UNL
2004	PhD dissertation	Stroup, Duane D.	Development of a decision support system for the hydrologic evaluation of the Platte River cooperative agreement	Colorado School of Mines
2004	MS thesis	Triplett, Jennifer Lake	Advanced oxidation process used at a former ordnance plant	University of Missouri-Rolla
2005	Seminar proceedings	CLE International	Nebraska water law	CLE International, Denver, CO
2005	MS thesis	Eidem, Nathan T.	Directors' perceptions of public participation in groundwater management of Tri-Basin Natural Resources District	Southern Illinois University Carbondale
2005	MCRP thesis	Lukash, William H.	Evaluating and improving the H2O/Q2 Project: Professional planning project	UNL

2005	MS thesis	Shimerdla, Michael	Evaluation of remediation technologies for the treatment of hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) at the former Nebraska Ordnance Plant	UNL
2005	MS thesis	Warren, Kelli J.	Initial characterization of regional water table dynamics and preliminary recharge estimates in the eastern portion of the Nebraska Sand Hills	UNL
2006	MS thesis	Ginige, Gevinda Krishan	Protection of community water supply in an agricultural watershed	UNL
2007	Seminar proceedings	CLE International	Nebraska water law	CLE International, Denver, CO
2007	MS thesis	Olaguera, Francia O.	Investigating factors affecting flow-through regimes of the Sandhills lakes	UNL
2008	MS thesis	Coke, Gordon Richard	Groundwater dynamics within the Saline wetland alluvium of the Little Salt Creek Valley, Lancaster County, Nebraska	UNL
2009	MS thesis	Katt, Jordan D.	Response of walleye to the addition of spawning substrate in a Nebraska irrigation reservoir (Walleye eggs)	University of Nebraska at Kearney
2010	Conference proceedings	Abraham, Jared D.; Cannia, James C.; Peterson, Steven M.; Smith, Bruce D.; Minsley, Burke J.; Bedrosian, Paul A.	Quantitative hydrogeological framework interpretations using heliborne electromagnetic surveys for the North Platte Valley, western Nebraska groundwater model	Petroleum Exploration Society of Australia, West Perth, West. Aust.; Conference Name: 21st international geophysical conference and exhibition, ASEG-PESA 2010

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