Kansas Water Resources Research Institute
Annual Technical Report
FY 2013
Introduction

The Kansas Water Resources Institute (KWRI) is part of a national network of water resources research institutes in every state and territory of the U.S. established by law in the Water Resources Research Act of 1964. The network is funded by a combination of federal funds through the U.S. Department of the Interior/Geological Survey (USGS) and non-federal funds from state and other sources.

KWRI is administered by the Kansas Center for Agricultural Resources and the Environment (KCARE) at Kansas State University. An Administrative Council comprised of representatives from participating higher education or research institutions, state agencies, and federal agencies assists in policy making.

The mission of KWRI is to: 1) develop and support research on high priority water resource problems and objectives, as identified through the state water planning process; 2) facilitate effective communications among water resource professionals; and 3) foster the dissemination and application of research results.

We work towards this mission by: 1) providing and facilitating a communications network among professionals working on water resources research and education, through electronic means, newsletters, and conferences; and 2) supporting research and dissemination of results on high priority topics, as identified by the Kansas State Water Plan, through a competitive grants program.
Research Program Introduction

Our mission is partially accomplished through our competitive research program. We encourage the following through the research that we support: interdisciplinary approaches; interagency collaboration; scientific innovation; support of students and new young scientists; cost-effectiveness; relevance to present and future water resource issues/problems as identified by the State Water Plan; and dissemination and interpretation of results to appropriate audiences.

In implementing our research program, KWRI desires to: 1) be proactive rather than reactive in addressing water resource problems of the state; 2) involve the many water resources stakeholders in identifying and prioritizing the water resource research needs of the state; 3) foster collaboration among state agencies, federal agencies, and institutions of higher education in the state on water resource issues; 4) leverage additional financial support from state, private, and other federal sources; and 5) be recognized in Kansas as a major institution to go to for water resources research.
Sediment Baseline Assessment

Basic Information

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<td>Principal Investigators</td>
<td>Dan Devlin, Will Boyer, Brock Emmert, Bruce McEnroe, DeAnn Presley, C. Bryan Young</td>
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Publications

There are no publications.
Effects of long-term management on near surface soil properties of upland soils in northeast Kansas

DeAnn Presley and Ian Kenney, Kansas State University Department of Agronomy

EXECUTIVE SUMMARY

Sedimentation of lakes and reservoirs in Kansas is due to a combination of historic land use as well as from the erosion of streambeds and streambanks. This paper contributes to the present-day understanding of post-settlement land use and management effects on soils. The most stable upland landscape was selected for comparison between cropland and pasture. Transects were not randomly selected, but rather, were targeted in order to keep as many factors constant, with land use as the variable. In general, croplands were more eroded and lower in soil organic carbon (SOC), and had lower infiltration rates than pastures. Pastures generally had lower Mehlich III soil test phosphorus (P) levels than croplands. While many producers in northeast Kansas have switched to no-till practices on cropland, the usage of additional practices that increase SOC would likely lead to infiltration and thus less risk of erosion and runoff.

INTRODUCTION AND LITERATURE REVIEW

Mollisols are defined by the presence of a mollic epipedon, the criteria for which are explained in Soil Taxonomy (Soil Survey Staff, 1999). In lay terms, mollisols are the thick, dark, organic matter-rich soils common to those formed under prairie vegetation, and now commonly cropped or managed as pastured. The thickness of the mollic epipedon can be (and often is) altered by erosion and by organic matter decomposition, both of which are exacerbated by tillage. Since the 1930’s erosion phases have been mapped in soil surveys (Olson et al., 2005a), which means that the mappers fully realized that the soils they were observing had been altered by erosion, and thought that this was an important thing to document. According to Olson et al. (2005a), as of 1991, there were 20 million acres of eroded Mollisols mapped in the USA, and mostly in the Midwest and Great Plains states.

The effects of management practices (tillage, fertilization, residue removal, crop rotation, etc.) are well understood and were recently summarized by Hatfield and Sauer, 2011. However, the effects on a given soil are a function of its inherent soil properties and thus, the results and degree to which they are expressed is a product of the inherent properties and management practices. Land use is dynamic. For example, for a given field in northeastern Kansas, it was grassland for thousands of years until the area was settled in the 1840’s to 1860’s. The best agricultural land was either plowed for crops, or pasture for livestock. Starting in the 1950’s, programs for reducing agricultural production and conserving soil resources would place many acres back into grassland, or for cropland, the use of terraces and other structures. Conventional tillage was predominant until reduced and conservation tillage began in the 1970’s, increasing to ≈70% no-till practices today in northeast Kansas (Presley, 2011). Today, the landscape of northeastern Kansas represents a patchwork quilt of land uses, and thus, presents an excellent opportunity to sample soil series under multiple land uses and
compare today’s soil descriptions with historical descriptions contained in soil surveys completed between ≈1950 and ≈1970.

Veenstra (2010) examined 82 representative pedons from 21 counties in Iowa that were originally sampled and described between 1943 and 1963 by the USDA. She found that after 50 years of agricultural land use many (60%) were different from their original descriptions, and that changes in the thickness of the mollic epipedons caused about half of the changes in classifications observed in the U.S. system of taxonomy. Veenstra studied soils across the landscape, and while some soils lost mollic epipedon thickness, other soils (footslopes especially) gained. Kimble et al. (1999) studied soils on eroding landscape positions only, thus observed higher levels of soil loss and greater reductions of mollic epipedon thickness. Thirty-two percent of the sites were no longer Mollisols and 27-71% of the mollic epipedon had been lost. Amundson et al. (2003) observed that much of the central U.S. has a very high proportion of endangered soil series, due to the impact of erosion on mollic epipedons.

The goal of this project is to examine the effects of land use and management on Mollisols of northeast Kansas, with a focus on upland soils in watersheds above the Atchison, Banner Creek, and Centralia lakes. The objective is to characterize the influence of land use (cropland versus grassland) on the morphology, mollic epipedon thickness, organic C content, and infiltration rate.

SITE LOCATIONS AND METHODS

The study sites are located on narrow upland summits of the Pawnee clay loam soil series (fine, smectitic, mesic Oxyaquic Vertic Argiudolls) (Soil Survey Staff). The mapunit that was selected was the Pawnee clay loam, 1-3% slopes. This soil type is frequently cropped, but there are many pastures interspersed in the study watersheds. Our goal was to perform transect perpendicular to the slope and between a cropped field and a pasture. Each transect was composed of multiple stops in order to gain an understanding of the average soil properties for each field. Two complete cropland/pasture transects were completed for Atchison, and four transects were completed in each of the Banner and Centralia watersheds (Figure 1). All sites were on privately owned land and permission was secured from the landowners prior to sampling.

Soil pedons were investigated using a hydraulic, truck-mounted soil probe. Pedons were sampled to the depth of refusal, usually by large rocks common in the glacial till parent material. All pedons were described using the Field Book for Describing and Sampling Soils (Schoenebecker et al., 2002). Samples were split by genetic horizon, air-dried, sieved to 4 mm, removed of visible organic materials, ground with mortar and pestle, and sieved to 0.25 mm for measurement of total C by dry combustion with a LECO TruSpecCN analyzer (LECO Corp., St. Joseph, MI) (Nelson and Sommers, 1996). Bulk density was determined for each horizon (from a
second soil profile) by the core method (Blake and Hartge, 1986). The percentage of C was multiplied against bulk density to compute total soil C pool in Mg ha\(^{-1}\). Soil samples were submitted to the Kansas State University Agronomy Soil Testing Lab for the measurement of Mehlich-3 phosphorus.

A network of automated mini-disk infiltrometers (Madsen and Chandler, 2007) provided 24 in-situ measurements per site of near-saturated (K\(_{2cm}\)) infiltration (Figure 2). The networks were deployed around two pedons per pair (one for each land use).

RESULTS AND DISCUSSION

Data from the soil profile descriptions are presented in Table 1. A calculation was performed to determine how different the mollic epipedon thickness was relative to the pasture. This is referred to as the percent (%) eroded, although any loss of C in the soil is recognized to result from both erosion and accelerated soil organic matter decomposition from tillage. The cropland sites of the Atchison and Centralia watersheds were on average 63 and 38% eroded, respectively. The Banner watershed sites were different in that for two of the transects (2 and 3) the cropland sites had a thicker mollic epipedon than the pasture. This could be explained in one of two ways: It is possible that the pasture site had been significantly degraded prior to being replanted to permanent vegetation, or that it is currently experiencing erosion from a process such as overgrazing. The alternative is that the cropland sites within these transects are less eroded than expected, or that the landowners have been exceptionally good stewards and employing soil management practices that sequester soil organic matter. When averaged across all four transects, the Banner watershed site is 18% eroded, but if you ignore the two sites that were 0% eroded, this value would be 35%, which is more similar to the values observed in the Centralia watershed.

Surface hydraulic conductivity rates (K) measured with tension (-2 cm) infiltrometers (Table 2) ranged between 3 and 11 \(\mu\)m sec\(^{-1}\), which is within the typical range (1 to 10 \(\mu\)m sec\(^{-1}\)) expected for low bulk density soils (Figure 3). The USDA-NRCS hydraulic conductivity value reported for the Pawnee clay loam, 1-3% slopes (mapunit 7500) is 3 um sec\(^{-1}\) (Soil Survey Staff\(^{5}\)). The values for the pastures in Atchison County and Banner Creek watersheds are more rapid than the cropland K. This allows for greater water movement into the soil profile after a precipitation event, and thus, can lead to less runoff. For the Centralia site the values were similar, and were overall the lowest of the study.

The mass of SOC for the mollic epipedons are reported in Table 2. The Atchison site, despite being the most eroded of the three (Table 1) contained the most SOC because of high SOC concentrations (values not shown), which is puzzling. Due to the small number of transects sampled in this watershed (two), we will avoid drawing conclusions from this data. The SOC of
both the Banner and Centralia watersheds were greater for the pasture, particularly so for the Centralia site. Interestingly, despite the greater SOC mass for Centralia pastures, this did not lead to greater K values in the Centralia watershed.

The Mehlich III Extractable P values were greater for the cropland transects in both Banner and Centralia by a large margin, while in the Atchison watershed is was similar (≈ 7 ppm). The Atchison values are within the “very low” range for Kansas (Figure 4, from Leikam et al. 2003). The pasture values for Banner and Centralia are also in the “very low” range. The Centralia cropland sites are very near the 20 ppm value, below which the Kansas State University Soil Testing Laboratory recommends that producers add P fertilizer to attain maximum yields. The Banner cropland values are in the high range.

CONCLUSIONS

This study would benefit from some expansion in the number of transects sampled, yet some trends are apparent. First, it is interesting to note that the watersheds have some different characteristics. Atchison was in some ways had the most unexpected results; the cropland was the most eroded in this watershed, yet the SOC values were much higher than the other sites, and the cropland P values were very low. Since there were only two transects sampled we will view the results for this site with caution. The Banner Creek site was predictable in that the infiltration rate and SOC was higher for pastures, while the P values were higher for cropland. The confounding issue with this site is that two of the transects had just as much if not more topsoil thickness than the pastures. The Centralia site results were a bit more straightforward as the cropland was overall 38% eroded relative to the pasture and the infiltration rate and SOC were lower for the cropland and the P value was higher for cropland.

Overall, these results are an indication that soils are dynamic and that management has impacts on the properties of the surface soil that are a culmination of many years of management. Since soil data is often used as a basic input layer into geographic information system models, etc., it is important that we continually update the soil resource database so that modelers and other types of predictive tools have the best, most up-to-date data for their efforts.

REFERENCES


**Recommendation for Future Research Needs**

1. Survey more cropland fields under different soil management regimes, e.g. tillage, crop rotations, and/or cover crops.
Table 1. Summary of mollic epipedon thickness (cm) by watershed. The mollic epipedon is roughly equivalent to what is referred to as topsoil, in that it has high organic matter and dark colors. The % eroded means how eroded the cropland is compared to the pasture condition.

<table>
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<tr>
<th>Watershed</th>
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<td>61</td>
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<tr>
<td></td>
<td>2</td>
<td>14.5</td>
<td>41.5</td>
<td>65</td>
<td>63</td>
</tr>
<tr>
<td>Banner</td>
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<td>42.8</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>33.3</td>
<td>29</td>
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<tr>
<td></td>
<td>4</td>
<td>16.5</td>
<td>24.3</td>
<td>32</td>
<td>18*</td>
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<tr>
<td>Centralia</td>
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<td>26</td>
<td>41.3</td>
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<td>4</td>
<td>19.7</td>
<td>33.6</td>
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*If the two Banner watershed transects with zero % eroded values are ignored, the average % erosion for Banner is 35%.
Table 2. Surface hydraulic conductivity rates (K) measured with tension infiltrometers (-2 cm). The values reported are averages. The USDA-NRCS hydraulic conductivity value reported for the Pawnee clay loam, 1-3% slopes (mapunit 7500) is 3 μm sec⁻¹. Therefore, these results do not differ greatly from the measured values, however, the values for the pastures in Atchison County and Banner Creek watersheds are more rapid than predicted. This allows for greater water movement into the soil profile after a precipitation event, and thus, can lead to less runoff.

<table>
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<tr>
<th>Location</th>
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Figure 1. Transect sampling method. The smaller figure shows the locations of the four transects completed for the Centralia Lake watershed, and the smaller figure illustrates the layout of a typical transect between a cropland field and adjacent pasture. The entire transect occurs on one soil type and attempts to minimize difference in slope.
Figure 2. Soil sampling was completed by coring with a hydraulic truck-mounted soil probe, and infiltration measurements were collected using an automated mini disk infiltration network.
Figure 3. Typical ranges in saturated hydraulic conductivity (Ksat) for soils. The values recorded in this study are within the expected ranges. Source for the diagram:
Figure 4. Phosphorus management recommendations for Kansas (Leikam et al., 2003).
Riparian Forest Functioning Condition Analysis and Centralia Sedimentation FY 11

REPORT PERIOD:  March 1, 2013 – February 28, 2014

Report prepared by: William Beck, Kansas Forest Service
Report prepared for: Dan Devlin, Kansas Water Resources Institute

Objective

The Kansas Forest Service (KFS) in cooperation with the Kansas Water Resources Institute (KWRI) will perform riparian forest health inventory and functioning condition classification analysis in the watershed above Centralia Lake using the Sediment Baseline Work Plan (2/2/2009) as a guide to implementation.

Activities/Deliverables

1. The KFS will conduct forest inventory and assessment on 6 sites within a 100 foot stream zone where The Watershed Institute (TWI) has already established data collection locations for geomorphologic information to determine extent, composition, and condition of riparian forests. All sites will be georeferenced.

   Deliverables completed prior to report period.

2. ArcPad 7.1 software will be used to collect the following forest stand data: stocking/density, species composition (including invasives), volume, basal area, trees/acre, canopy class, and regeneration. Additionally, active channel width and forest buffer width will be collected to help determine functioning condition based on SVAP and PFC guidelines (BLM).

   Deliverables completed prior to report period.

3. Data will be incorporated and results summarized into a report including forest inventory information from Atchison County Lake watershed and Banner Creek Lake watershed for comparative purposes. The report will be shared with the Baseline Sediment Working Group and other partners.

Billy Beck and Charlie Barden worked to assemble the final report on riparian forest functioning condition for the Sediment Baseline Study. The final report was submitted to the SBWG in winter, 2014.
Aquifer Storage and Recovery in Near-Surface Aquifers: Development of a New Recharge Approach Using Small-Diameter, Low-Cost Wells

Basic Information

| Title: | Aquifer Storage and Recovery in Near-Surface Aquifers: Development of a New Recharge Approach Using Small-Diameter, Low-Cost Wells |
| Project Number: | 2011KS113G |
| Start Date: | 9/1/2011 |
| End Date: | 8/31/2013 |
| Funding Source: | 104G |
| Congressional District: | KS-003 |
| Research Category: | Climate and Hydrologic Processes |
| Focus Category: | Water Supply, Hydrology, Methods |
| Descriptors: | Aquifer Storage and Recovery, Artificial Recharge, Direct-Push Technology, Integrated Hydrological Modeling, Recharge Wells, Infiltration Basin and Trench |
| Principal Investigators: | Gaisheng Liu, Andrea Elizabeth Brookfield, James J. Butler, Marios Sophocleous, Donald Whittemore, Andrew Ziegler |

Publications

Aquifer Storage and Recovery in Near-Surface Aquifers: Development of a New Recharge Approach Using Small-Diameter, Low-Cost Wells

I: Technical Report

**Problem Statement**

Aquifer storage and recovery (ASR) is the artificial recharge and temporary storage of water in an aquifer during times when water is abundant, and recovery of all or a portion of the water during times when it is needed (Pyne, 2005). In recent years, interest in ASR has increased due to various concerns such as declining groundwater resources, vulnerability of surface water supplies to contamination and reservoir sedimentation, and unfavorable projections of future climate change. Most climate change scenarios indicate that due to a likely increase in future global temperature, there will be more severe and prolonged droughts, with precipitation events becoming more intense but less frequent (IPCC, 2007). By capturing and storing excess water in the underground when precipitation is plentiful, ASR offers one of the most practical approaches for resources managers to combat future water-supply challenges. Compared to a traditional surface-water reservoir, aquifer storage eliminates evaporative losses and the need to convert large land areas into reservoirs, provides a much larger storage capacity (which is critical in the case of multi-year drought), and is much less vulnerable to surface-water contamination activities. Because of these advantages, the number of ASR projects that are either fully operational or in various phases of development is quickly growing across the United States.

A successful implementation of ASR typically involves four key components, 1) an aquifer that is suitable for temporarily storing a large volume of water, 2) source water that is of good quality and quantity, 3) a means to transfer the source water into the aquifer, and 4) a means to recover the water from the aquifer. Currently, many limiting factors still hinder the effectiveness of ASR as a new tool for water resources management (Pyne, 2005; Maliva and Missimer, 2010). One of the major technical challenges has been how to design artificial recharge systems that can efficiently transfer source water into the aquifer. Typically aquifer recharge is achieved through various surface infiltration methods (such as basins and trenches) and/or large-diameter injection wells. Surface infiltration methods only work when the storage aquifer is shallow, and no low-permeability layers exist between the ground surface and the aquifer that would constrain downward movement of recharge water. Moreover, surface methods require adequate land area available at reasonable cost. Due to their dependency on natural soil conditions, surface infiltration methods have a limited infiltration capacity. This can greatly undermine the performance of ASR during times when precipitation is intense and a significant amount of water must be stored within a short duration. Surface infiltration methods are often supplemented with injection wells that typically have a diameter of 40 cm or larger. These large-diameter injection wells are equipped with high-power pumps so that water can be forcefully injected into the aquifer at a high rate. When surface infiltration methods are not applicable, e.g., the storage zone is deep or there is a near-surface zone of low permeability, injection wells are the only aquifer recharge
option. In general, large-diameter injection wells are more expensive than surface infiltration methods, as they require a much higher amount of logistical and infrastructure support for pump operation and maintenance. Well clogging remains a problem at many ASR projects (Brown et al., 2005), although it can be somewhat alleviated by operating the wells in a dual-purpose mode for both water recharge and recovery (Pyne, 2005).

In this research we investigate a new recharge method for near-surface aquifers using small-diameter, low-cost wells installed with direct-push (DP) technology. Unlike the large-diameter injection wells, the DP wells are typically small in diameter (less than 10 cm), low in construction and maintenance costs, and limited to depths less than 30 m. Water is allowed to move through the wells by gravity, so the required logistical and infrastructure support are modest. Given the various constraints of surface infiltration methods, the DP wells, if proven practically useful as a supplemental or alternative recharge option to the surface methods, could greatly increase the effectiveness of ASR in near-surface aquifers.

**Objectives and Methods**

The main objective of this research is to increase the effectiveness of ASR in near-surface aquifers by developing a new aquifer recharge method through small-diameter, low-cost wells installed with DP technology. Unlike the common large-diameter injection wells that typically have a diameter of 40 cm or larger and require expensive logistical and infrastructure support, the DP wells are small in diameter (less than 10 cm), low in construction and maintenance costs, and limited to depths less than 30 m. Water is allowed to move through the wells by gravity so the required logistical and infrastructure support are modest. DP wells can be employed either as a supplemental or alternative recharge option to surface infiltration methods as long as the aquifer for water storage is relatively shallow.

In this research, we combine numerical model simulations with field tests to systematically investigate the utility of DP wells in artificially recharging near-surface aquifers. We use a site in the Lower Republican River (LRR) basin in Kansas to perform the proposed field investigations (Figure 1a). Figure 1b shows a cross-section of lithology at the site. The sand and gravel portion of the Belleville formation on the south part of the ancestral Republican River valley, which is overlain by a thin layer of silt and clay (also part of the Belleville formation), is used as the intended aquifer for water storage. In addition to the site characteristics suitable for this project, various Kansas state agencies have become increasingly interested in considering ASR implementation in this area as a potential water-resources management method for utilizing high flows of the Republican River in the LRR basin.

(a) Location of proposed study area in the Lower Republican River basin
This research involves two major activities, 1) a series of numerical simulations to evaluate the recharge process of DP wells as compared to surface infiltration basins, and 2) field water recharge tests under different conditions to directly assess the practical usefulness of DP wells as an artificial recharge option alternative or supplement to the surface methods. The insights developed from the numerical simulations will provide important guidelines for designing and conducting the recharge tests in the field. The DP wells for the field tests at the LRR site will be installed using a Kansas Geological Survey (KGS) DP unit (Geoprobe).

**Project Activities and Results**
a) During the reporting period (3/1/2013 - 2/28/2014), we continued our numerical simulation analysis on the recharge process of DP wells and surface infiltration basins. The simulation results have been presented at 1) the National Groundwater Association Annual Summit in San Antonio, April 29 – May 1, 2013, 2) the NovCare (Novel Methods for Subsurface Characterization and Monitoring: From Theory to Practice) 2013 International Conference in Leipzig, Germany, May 13 – 16, 2013, and 3) the AGU (American Geophysical Union) annual meeting in San Francisco, CA, December 9 – 13, 2013. A paper has been published at the Journal of Hydrology.

b) We have performed a field recharge test for an infiltration basin at the LRR site (see Appendix A). We performed a series of DP profiles to investigate the hydrogeological conditions underneath the site (Figure A1). A 6 by 10 m infiltration basin was constructed with active heating and fiber-optic distributed temperature sensing (DTS) cables for monitoring water movement during the recharge test (Figure A2). A total of fourteen shallow and deep monitoring wells were installed with the KGS DP equipment (Figure A3). An evaporation pan was constructed to measure the precipitation and evaporation near the basin (A4). Both the wells and basin were instrumented with electronic pressure sensors to measure water level changes. A water storage and distribution system was set up prior to the test (Figure A5). The surface basin recharge test lasted for 30 hours (Figure A6). A total amount of 39,660 gallons of water was infiltrated (Figure A7). The project results have been presented at 22nd Annual Kansas Hydrology Seminar, Topeka, KS. The recharge test for DP wells has been planned for the summer of 2014.

II. Presentations and Publications


III. Information Transfer Program
Throughout this project, we dissimilate project results through 1) reports and presentations to regulatory agencies; 2) presentations at local, regional, and national scientific meetings; 3) public information circulars and open-access web publications; and 4) articles in peer-reviewed literature. Our dissimilation efforts have been demonstrated by a number of presentations and publications listed in section II.

As part of our information transfer program, we also convened a special session on aquifer storage and recovery (H11F. Managed Aquifer Recharge: Challenges, Approaches, and Applications) at the 2013 AGU annual meeting. We discussed the latest research on many different topics in ASR during this special session.

Figure A1. DP profiles of injection pressure (psi) from the hydraulic profiling tool (HPT – green curves) and electrical conductivity (EC, mS/m) from the EC probe (black curves). The locations of HPT/EC profiles are marked as HPT1 ~ HPT4. The EC probe had a Wenner sensor array for HPT1 and HPT2; a sensor was broken at depth 52 feet on HPT2, and the probe was reconfigured into a dipole array.
Figure A2. A 6 by 10 m infiltration basin constructed with active heating and fiber-optic distributed temperature sensing (DTS) cables for monitoring water movement during the recharge test.
Figure A3. Fourteen shallow and deep monitoring wells installed with the KGS DP equipment.
Figure A4. An evaporation pan constructed to measure the precipitation and evaporation near the basin.
Figure A5. A water storage and distribution system set up prior to the surface basin recharge test at the LRR site.
Figure A6. Water filling the surface basin during the recharge test at the LRR site. Water levels were measured by electronic pressure sensors in fourteen observation wells, and by an electronic pressure sensor and two metal gauges in the basin.
Figure A7. The water levels in the basin (red curve – electronic sensor after barometric pressure correction, green curve – metal gauges), flow rates into the basin measured by an ultrasonic flowmeter (blue curve), and the actual infiltration rates into the subsurface after correcting for evaporation loss and basin storage (black curve). A total amount of 39,660 gallons of water was infiltrated during the entire recharge test.

Total water injected: 39,660 gallons.
Impacts of In-channel Dredging on the Morphology of the Kansas River

Basic Information

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<td><strong>Principal Investigators:</strong></td>
<td>Melinda Dawn Daniels</td>
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Publication

Impacts of In-Channel Dredging on the Morphology of the Kansas River

Dr. Melinda D. Daniels, PhD
Graduate Program Director, Associate Professor
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Kansas State University
118 Seaton Hall
Manhattan, KS 66506-2904
Tel: 785-532-0765
mddaniel@k-state.edu

In year one of the project we have surveyed two active dredge holes in the Kansas River, one in Topeka and one in Lawrence. A third (also near Lawrence and the Mudd Creek confluence) has been targeted for survey, but low water has prevented access to the site even with small boats (kayaks). The Topeka and Lawrence dredge holes were surveyed using an ADCP (Acoustic Doppler Current Profiler) on two occasions, once in Fall of 2012 and once in Spring of 2013. During this time period, no significant transport active flow occurred on the Kansas River. Our repeat surveys show substantial deepening and enlargement of each dredge hole due to continued excavation and no/insufficient transport-related replacement or infilling by the river. We remain ready to re-sample with the ADCP when flow rises on the Kansas.

While we wait for flow to rise on the Kansas, the GRA has been assembling a HEC-RAS model of the Kansas River main stem and major tributary network architecture.
Evaluation of the Kansas P Index using APEX

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Publications

Evaluation of the Kansas P Index using APEX

2013/2014 Report of Progress

Activities

We made substantial progress in calibrating and validating the Agricultural Policy Environmental Extender (APEX) model for use in predicting phosphorus (P) loss from agricultural fields. We identified sensitive input parameters involved with simulation of P loss from 11 field-scale watersheds, which included seven different cropping and management systems. The results showed that the APEX model can accurately predict water loss with little or minimal calibration, however, the APEX model required calibration for accurate prediction of sediment and total P loss. We are conducting sensitivity analysis of the calibrated parameters and comparing our results to similar research conducted in Missouri and Iowa to determine if we can identify a set of optimum parameter values for use in the Heartland region.

We also started a second study to determine the appropriate P sorption parameters for modeling P leaching in small packed soil columns. We have completed preliminary research to identify the appropriate flow rates and column packing procedures. We developed a simulation model in MatLab to predict P leaching based on the convective dispersive equation with retardation factors based on linear, Freundlich, and Langmuir equations. The model will be expanded to include kinetic rate coefficients and three P pools. The model results will be compared to results from column leaching studies.

Funds have been used to train Ammar Bhandari, a Ph.D. student in Agronomy with a research emphasis in water quality, nutrient management, and fate and transport of P in the environment.
Investigation of Recharge to the High Plains Aquifer, Northwestern Kansas

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Publications

There are no publications.
Introduction

The High Plains region of the United States hosts some of the most productive irrigated agricultural land in the world owing to the vast HPA that it overlies. This extensively utilized aquifer provides irrigation and, to a much lesser extent, drinking and industrial water supplies that account for about 23% of all groundwater withdrawals in the United States (Maupin and Barber 2005). The HPA, which is a critically important resource for Kansas agriculture, extends over much of the western half of the state (Figure 1). A large area of the Kansas HPA is on a fundamentally unsustainable path; large pumping-induced declines in groundwater levels have called into question the viability of the aquifer as a continuing source of water for irrigated agriculture (Dennehy et al. 2002, Waksom et al. 2006, Sophocleous 2010). The future is further clouded by the prospect of climate change; sizable portions of the High Plains region are characterized by relatively steep lateral gradients in climatic variables, indicating the potential vulnerability of the region to the impacts of a changing climate (Rosenberg et al. 1999, 2003; Brunsell et al. 2010; Logan et al. 2010).

In areas of groundwater mining, year-over-year increases in water levels are not expected to occur because water extracted from the aquifer is not replaced by recharge (e.g., Butler et al.
In one area of the Kansas High Plains Aquifer (HPA) with assumed groundwater mining conditions (water level declines exceed 20 m, saturated thicknesses reduced in excess of 35% of pre-development values), unexpected year-over-year increases in water-levels were recently recorded by enhanced monitoring as part of the Kansas Geological Survey (KGS) Index Well Program (Stotler et al. 2011). Hydrograph analysis indicates post-irrigation season recovery is not tied to precipitation, amount of water pumped, length of pumping, or pumping rate. Rather, recovery is constant from year to year – indicating an unknown source of inflow (recharge) to the system (Butler et al. 2013a). This study directly addresses the issue of water availability in a high priority area of the HPA by identifying recharge sources, quantifying recharge amounts, and providing important information on the behavior of low permeability units that have become perched as a result of declining water levels.

**Study Site Background**

As part of the Kansas Water Plan, eight aquifer subunits were delineated by Northwest Kansas Groundwater Management District #4 (GMD4) for potential enhanced management. To obtain water-level information on spatial and temporal scales reasonable for enhanced groundwater management in aquifer subunits, a monitoring well was installed by the KGS at the base of the HPA in Thomas County as part of the Index Well Program. Average annual water use for 2007-10 over the 32.5 km² area centered on the monitoring well was 3.01x10⁶ m³. The HPA hydrostratigraphy in the vicinity of the site consists of an interbedded mix of coarse gravels through clays on top of primarily shale (Pierre Formation) bedrock. Well responses to pumping and changes in barometric pressure indicate that the saturated unconsolidated interval at the site acts as an unconfined aquifer (Buddemeier et al. 2010, Stotler et al. 2011).

Hourly water level and barometric pressure data have been collected at this monitoring well since 2007 (Figure 2). Over six years of monitoring, water levels were more or less stable, until the drought in the last two years, with maximum recorded water levels registering a 1 ft decline from 2008 to 2009, a 1.5 ft increase from 2009 to 2010, 1.5 ft decrease from 2010 to 2011, and a 1.5 ft decrease from 2011 to 2012. However, in all years, water levels were still increasing at the onset of pumping for the next irrigation season. By applying pumping-test interpretation methods to these long-term water-level records, boundaries limiting regional flow were identified (Butler et al. 2013a). The strikingly consistent hydrograph response during the recovery period (Figure 3) indicated a previously unidentified inflow to the area, rather than amount, duration, or length of pumping, is the primary control on recovery. The response was observed in all five of the monitored recovery seasons (2007-08, 08-09, 09-10, 10-11, 11-12) at both the Thomas well and another monitoring well in Scott County, indicating a process that likely affects large portions of the HPA in Kansas (Stotler et al. 2011). A recent, more-detailed, evaluation of these water-level data indicated that this inflow appears to be a relatively steady, vertical inflow throughout the year to the unconfined aquifer (Butler et al., 2013). Hourly water-level data have also been collected from five nearby active and retired irrigation wells since 2010, indicating similar water-level responses occur across the aquifer subunit (Stotler et al. 2011). Analysis of annual water-
level program data indicates the inflow trend could extend across Thomas County and much of northwest Kansas (Butler et al., 2013). Identification of the source of that inflow is critical for determining the long-term prospects of the High Plains aquifer in this portion of northwest Kansas.

Several possible mechanisms could explain the inflow. The first is downward flow originating as irrigation return flow or irrigation enhanced recharge. Although not consistent with previous recharge studies (e.g. Sophocleous 2005), it is possible recharge associated with irrigation is just starting to complete its traverse of the thick (60+ m) vadose zone. Drainage of overlying low-
permeability units induced by a falling water table is a second possible mechanism contributing to the inflow.

Figure 3: Water-level change since start of recovery versus time of recovery for the 2008-09 and 2009-10 recovery periods (recovery for 2008-09 starts at point A, for 2009-10 at point B on Figure 2; the time and water-level elevation at the start of recovery were set to zero for each period).

Methods

The two possible recharge sources are being evaluated by obtaining high resolution stratigraphic and physical information, and chemical and isotopic profiles in core sampled through the 64m thick unsaturated zone. The site chosen for coring was located approximately one mile south-southeast of the Thomas county index well. Core was obtained using a wire-line split-spoon sampler advanced ahead of a hollow-stem auger. Drilling was conducted approximately 15 m within the irrigated circle. This location makes it possible to investigate the effects of return flow on groundwater recharge. The samples are currently undergoing magnetic sensibility logging for stratigraphic correlation.

Pore fluid was extracted from core subsamples by creating a 1:1 saturated paste. Samples were first oven dried at 60°C and sieved. Deionized water was then slowly added and mixed to create a paste-like consistency. After sitting covered for approximately four hours, each sample was
slowly filtered through a Buchner Funnel and collected in a sealed glass tube. Samples were analyzed on an ion chromatograph for Cl, Br, F, SO$_4$, and NO$_3$ concentrations. Intact samples were run on a hanging column and pressure-plate extractor to determine depth functions of soil hydraulic parameters (e.g., water retention curve parameters and hydraulic conductivity), and sieved to determine grain size.

Figure 4: Core retrieval operations at the drill site by the Kansas Geological Survey. A total depth of 65 m was sampled.

2013-14 Results, Information Transfer, and Student Support

Objectives for the second year were difficult to achieve due to a reduced budget resulting from Federal budget sequestration. Depth profiles of anions and grain size have been completed (Figure 5). The additional time required to complete these profiles due to budget sequestration resulted in a delay in completion of isotopic analysis. Currently, transport modeling is underway to determine recharge rates.
Figure 5: (a) Chloride, (b) nitrate, (c) percent sand, silt, and clay, and (d) SO$_4$/Cl$^-$ depth diagrams from the core material.
One Master’s student was trained on core sampling, pore fluid extraction, and data interpretation for this project through other funding, as funds for student support were cut from this budget. Publications have not yet been submitted; however, results have been shown to international, national, and state audiences at four different conferences (Katz et al. 2013a,b; Stotler et al. 2013a,b), with an additional presentation scheduled at the annual Goldschmidt conference in June in Sacramento.
References


Rosenberg, N.J., R.A. Brown, R.C. Izaurralde, and A.M. Thomson. 2003. Integrated assessment of Hadley Centre (HadCM2) climate change projections on agricultural productivity and irrigation water supply in the conterminous United States I. Climate change scenarios and
impacts on irrigation water supply simulated with the HUMUS model. *Agricultural and Forest Meteorology* **117**: 73-96.


Getting the information modelers need: Extracting hydrostatigraphic information from drillers

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Publications

Report of Second Year Activities for
WRRA 104(b) Project

Getting the information modelers need: Extracting hydrostratigraphic information from drillers' logs
(HyDRA: Hydrostratigraphic Drilling Record Assessment)

Reporting Period: March 1, 2013 – February 28, 2014

Principal Investigator: Geoffrey C. Bohling, Associate Scientist, Geohydrology Section, Kansas Geological Survey, University of Kansas, 1930 Constant Avenue, Lawrence, KS 66047, (785) 864-2093, geoff@kgs.ku.edu

Other participants (all KGS Geohydrology Section): James J. Butler, Jr., Senior Scientist; Dustin Fross, High Plains Data Manager; Ed Reboulet, Field Hydrogeologist; Don Whittemore, Senior Scientific Fellow; Brownie Wilson, GIS/Support Services Manager

Introduction

Understanding aquifer characteristics is important for effective ground-water management practices. A largely overlooked source of geologic information is drillers' logs, which contain vast amounts of qualitative information regarding subsurface structure. The purpose of this project, dubbed HyDRA (Hydrostratigraphic Drilling Record Assessment), is to develop and test procedures for employing this lithologic information in the development of quantitative three-dimensional depictions of subsurface properties for estimation of aquifer yield and use in flow and transport models. The objectives of this project are to:

1) Develop software and protocols to increase efficiency and accuracy of transcription of drillers’ log forms into a standardized and accessible database.

2) Develop protocols for three-dimensional (3D) interpolation of lithological data from drillers’ logs, properly accounting for the categorical nature of these data, and related crossvalidation procedure for assessing quality of logs.

3) Apply procedures developed under objectives 1 and 2 to develop 3D depictions of subsurface for use in simulations of water-level variations in vicinity of continuously-monitored wells in Thomas County, Kansas.

4) Provide educational opportunities through student participation in data processing, database and software design and development, and model development and interpretation.

5) Disseminate developed procedures and project outcomes in peer-reviewed publications, professional meetings, technical reports, and communication with state and local agencies.
During the second year of this project we have made progress on all of these objectives, as documented in the following sections.

**Data Transcription and Database Development**

The first step in extracting information from the drillers' lithologic logs is to transcribe the material descriptions for each depth interval more or less verbatim into a table in the Kansas Geological Survey's water well database (WWC5). Figure 1, from last year’s report, shows the transcription progress as of May 13, 2013, with logs identified by transcriber or source. Those shown in light blue were transcribed by Dustin Fross or Carolyn Helm, both participants in the HyDRA project. Logs from approximately 15,500 wells had been transcribed at that time, including transcriptions imported from the Access database developed as part of the earlier PST+ project. About 10,600 logs remained to be imported from the PST+ database. Since then, Fross has completed the import from the PST+ database and has also transcribed many additional logs in the High Plains region, primarily in Groundwater Management District 4 in northwestern Kansas. Dana Adkins-Heljeson, the KGS webmaster, has also continued to transcribe logs, bringing the total number of transcribed logs in the WWC5 database to 42,613, as of today, May 21, 2014. Figure 2 shows a map of the transcription progress to date.
Figure 1: Log transcription progress as of May 13, 2013. Light blue: WWC5 logs transcribed by HyDRA project team members (Fross and Helm, 2824 wells); dark blue: WWC5 logs transcribed by other KGS staff members (7239 wells); brown: logs imported to WWC5 from PST+ database (5445 wells); green: logs remaining to be imported from PST+ (10,643 wells). Larger orange circles are three KGS index wells, blue outline is extent of High Plains aquifer, gold outlines are Groundwater Management District boundaries, and red outline highlights 250 wells in vicinity of Thomas County index well.
Figure 2: Log transcriptions as of May 21, 2014. Logs from 42,613 logs have been transcribed to date, including logs imported from the Access database developed as part of the earlier PST+ project (the majority of the logs in GMD 3 in southwest Kansas).
During project year 2, Fross also examined 913 logs from Scott County, KS, and assessed their overall quality, ranking them Excellent, Good, Fair, or Poor based on both the level of vertical detail and the detail and care exhibited in the descriptions of each interval. Because it would be extremely labor intensive to manually assess the quality of 10’s of thousands of logs, it would be useful to determine an automatically computable measure of log quality. Figure 3 shows the distribution of the average vertical interval thickness in each log versus the overall quality ranking for that log. Applying an average interval thickness threshold of 20 feet (accepting logs with average interval thicknesses < 20 feet, rejecting logs with average interval thicknesses > 20 feet) seems to do a reasonably good job of separating higher quality logs from lower quality logs. This criterion was used to select logs to use in the development of a 3D property model for Groundwater Management District 1, in west central Kansas, as described below.

Figure 3. Distributions of average vertical interval thickness for different quality categories for 913 logs in Scott County, KS.
The next step in the process of converting the logs into quantifiable information is to standardize the sediment descriptions in some fashion. We are employing the standardization approach developed as part of the PST+ project and implemented in the Access database associated with that project. This involves identifying every unique description encountered in the collection of transcribed logs and manually assigning each description to a set of one or more codes representing standardized lithologies. For example, the description “fine sand and clay” would be assigned two codes, “fsnd” for fine sand and “c” for clay. The codes are from a list of 71 standardized lithology codes. The PST+ project developed a table of over 60,000 unique descriptions found in ~225,000 individual interval descriptions from ~17,400 logs, mostly in GMD3. When new logs were entered into the PST+ database, any descriptions that did not match existing entries in the table of unique descriptions are placed at the top of that table, awaiting manual mapping to standardized codes. Thus, as the table is built up over time, more and more of the newly imported descriptions will match existing descriptions and will not need to be mapped (again) into standardized lithologies. This table (referred to as the “filters” table) is applied to the logs in order to cast them into standardized form.

During the second year of the HyDRA project, Bohling extracted the pre-existing filters table from the PST+ database and re-implemented the process for adding new descriptions in a Python script, making the process more convenient for repeated use on a project-specific basis.

**Development of 3D Interpolation Procedures**

In project year 1, Bohling worked on development of the geostatistical procedures used to develop a 3D hydrogeologic property model from the drillers’ lithologic logs, as described in last year’s report. In year 1, the procedures were applied to the development of a 3D property model for the area surrounding the Kansas Geological Survey’s continuously monitored index well in Thomas County, KS, the area for which Helm is developing a 3D groundwater flow model. In year 2, Bohling continued to refine the procedures and applied them to 2216 logs in Groundwater Management District 1 (west central Kansas) in order to develop a 3D property model for use in a groundwater flow model being developed for GMD 1 as part of a separate project. Figure 4 shows the locations of the 2216 logs, which were selected from a total of 2757 logs using the 20-foot average interval thickness criterion described above.

The first step in the property modeling procedure is to map the set of 71 standardized lithologies into a smaller number of categories associated with expected hydrogeologic property ranges. The example shown here uses five categories associated with different ranges of permeability or hydraulic conductivity (K), with category 1 representing the lowest-permeability materials (such as shale and clay) and category 5 representing the highest permeability materials (such as sand and gravel). To build a 3D property model from the categorized logs, the categorical information must be represented in terms of
quantitative values that can be interpolated. This is accomplished by segmenting each well (log) into a sequence of regularly spaced depth intervals (specifically, 10-foot intervals) and computing the proportion of each K category within each interval. These proportions are then interpolated to the 3D grid. Figure 5 shows slices through a 3D model for GMD 1, showing the proportion-weighted average K category in each grid cell.

Figure 4. Locations of 2216 logs used in development of the GMD 1 property model. The area shown is 111 miles east-west by 58 miles north-south. The blue outline represents the extent of the High Plains / Ogallala aquifer and the red outline is the GMD 1 boundary.
Figure 5. Slices of 3D property model for GMD 1, showing the proportion weighted hydraulic conductivity (K) category in each model cell. The lateral dimensions of the model volume are the same as the map in Figure 4 (111 x 58 miles) and the model is 1430 feet in vertical extent.
Flow Model Development

In project year 2, Helm continued to develop the 3D groundwater flow model for the Thomas County index well area. Simulated water levels produced by this model, based on the hydraulic property model developed from the drillers’ logs, are being compared to the actual water levels observed in the index well and other nearby continuously monitored wells in order to assess the utility of the information provided by the drillers’ logs. Development of the flow model has taken longer than anticipated and will continue during the one-year no-cost extension of this project.

The property model for GMD 1 (Figure 5) is being employed in a flow model being developed for a project funded by the Kansas Water Office and GMD 1. At the moment, the flow modeling is 2D, using hydraulic properties derived from vertical integration of the 3D property model shown in Figure 5. During project year 2, Bohling developed code for performing this vertical integration, producing output property files that can be fed directly into the MODFLOW flow model. It is possible that the information will be employed in a more fully 3D fashion in a future version of the model.

Educational and Training Opportunities

During project year 2, this project continued to support a Graduate Research Assistant, Carolyn Helm, providing a basis for her master’s thesis in the Department of Geology at the University of Kansas. The work has provided her with training in the interpretation of drillers’ logs and in groundwater modeling procedures as well as providing familiarity with the geostatistical procedures used in the development of the 3D property model. In addition, Dustin Fross, a young staff member at the KGS, has continued to gain experience in geological and hydrogeological concepts, drillers’ log interpretation, and database development in his work on this project.

Dissemination of Results

Helm presented a poster on this project at the Geological Society of America Annual Meeting in Denver in October 2013 (details on first page). This was her first presentation at a major scientific conference. Her travel to the meeting was supported by the Kansas Geological Survey’s Frank C. Foley Award. Bohling presented a poster on this project at the Governor’s Conference on the Future of Water in Kansas in October 2013. Bohling also presented a poster on the project at the American Geophysical Union Fall Meeting in San Francisco in December 2013.
Water Research for the Fort Riley Net Zero Initiative

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Publications

There are no publications.
Summary of work to date:

Kansas State University is working with Fort Riley personnel, EPA ORD, and EPA Region 7 to develop strategies for meeting the Department of Defense Net Zero Water goals. Specific project objectives for the Fort Riley demonstrations are:

1. Investigation of methods for safe reuse of waste water through the decentralized treatment of water from sewer lines (Titled: Decentralized Waste Water Treatment Technology Demonstration);
2. Containment, control and disposal of large volumes of wastewater following an event involving biological agents (Titled: Wastewater Security Investigation);
3. Use of engagement, education, motivation, and empowerment to reduce water demand at Ft. Riley, with a measurement of the effectiveness of each (Titled: Demand Side Outreach and Intervention Study).

Research was initiated in January 2014 and work is ongoing. K-State researchers are currently working with EPA-ORD to complete the quality assurance project plan (QAPP) for each objective such that field work can begin.
Information Transfer Program Introduction

The KWRI is committed to transferring knowledge generated by its researchers to clientele. The KWRI uses a variety of methods. These include:

1. The second statewide Kansas "Governor's Conference on the Future of Water in Kansas Conference" was held on October 24-25, 2013 in Manhattan, Kansas. The conference was highly successful with 584 people attending both days of the conference. Attending the conference was the Governor of Kansas, Sam Brownback, and several state and national senators and representatives. The Governor fully supports this conference and has expressed his concern about the issue of preserving and protecting the future viability of water in Kansas. Thirty-eight volunteer scientific and 9 invited presentations were presented in plenary and concurrent sessions. Thirty-eight scientific posters were presented in the poster session. An undergraduate/graduate student poster award program was conducted to encourage student participation. Twenty-four students participated. The program agenda is included with this report. The conference website is located at: http://www.kwo.org/Ogallala/Governors_Conference/Governors_Conference.htm The conference will be held again on November 12-13, 2014.

2. The KWRI website, http://www.kcare.ksu.edu/p.aspx?tabid=921, is used to transfer project results and inform the public on issues and scientists on grant opportunities.
Governor

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Publications

Governor’s Conference on the Future of Water in Kansas

AGENDAS

Hilton Garden Inn & Conference Center
Manhattan, KS – October 24-25, 2013
AGENDA - Day 1
Thursday, October 24, 2013

7:30 - Registration/Tour Exhibits (Foyer)

8:00 - Overview on the State of Water in Kansas (Continental Breakfast)
   Tracy Streeter, Director, Kansas Water Office

8:40 - Questions & Discussion

9:00 - Introduction/Overview
   Gary Harshberger, Chairman, Kansas Water Authority

9:10 - Welcome
   Dr. John Floros - Kansas State University

9:15 - Governor Sam Brownback

9:45 - The Mosaic of Water Security in an Era of Uncertainty
   Pat Mulroy, Southern Nevada Water Authority

10:20 - Questions & Discussion

10:35 - Long Term Planning for Kansas’ Water Needs
   Bob Wheeler, Governor’s Economic Council

10:50 - Meeting Kansas Public Water Supply Needs
   Joe Pajor, City of Wichita
   Mike Armstrong, Water District No. 1 of Johnson County

11:20 - Questions & Discussion

11:35 - Break & Tour Exhibits

12:20 - Lunch
1:15 - The Big Thirst: The Values of Water in Kansas, the Nation & the Globe
   Charles Fishman, Author of “The Big Thirst” & “The Wal-Mart Effect”

1:50 - Questions & Discussion

2:05 - Water’s Role in Developing Kansas’ Agriculture Economy
   Dale Rodman, Secretary, Kansas Department of Agriculture

2:25 - Questions & Discussion

3:00 - Legislative Leadership Panel

   Panel: Senator Carolyn McGinn
   Senator Larry Powell
   Representative Kyle Hoffman
   Representative Sharon Schwartz

3:45 - Questions & Discussion

4:00 - Final Comments

4:15 - Adjourn

5:00 - Evening Social at Flint Hills Discovery Center - (5:00 pm - 6:30 pm)
AGENDA - Day 2
Friday, October 25, 2013

7:45 - Registration/View Posters (Continental Breakfast)

8:30 - Concurrent Session 1

A. Ogallala I (Flint Hills, Kings & Konza Rooms)

  Facilitator: Mark Rude, Groundwater Management District #3

  - Tapping Unsustainable Groundwater Stores for Ag Production in the High Plains Aquifer of Kansas: Projections to 2110
    David Steward, Kansas State University
  - A New Approach for Assessing the Impact of Climatic & Pumping Stresses on the High Plains Aquifer in Kansas
    Don Whittemore, Kansas Geological Survey

B. Irrigation & Crop Water Management (Kaw Nation Room)

  Facilitator: Danny Rogers, Kansas State University

  - SDI for Crop Production - Approaching 25 years of KSU R&E’s Efforts
    Freddie Lamm, Kansas State University
  - Applied Technologies Available for Water & Energy Efficiency
    Greg Towsley, Grundfos

C. Reservoir Sedimentation I (Big Basin Room)

  Facilitator: DeAnn Presley, Kansas State University

  - Atlas of Kansas Lakes: A Resource for Communities, Policy Makers & Planners
    Ed Martinko, Kansas Biological Survey
  - Reservoir Sedimentation: Understanding the Past & Recognizing the Future to Act Wisely Now
    Jerry deNoyelles, Kansas Biological Survey

D. Municipal Landscape Water (Alcove)

  Facilitator: Joe Harner, Kansas State University

  - Lessons Learned from Rain-Gardens, Bio-Retention & Green Roof Design, Implementation, Monitoring & Maintenance Efforts in the Flint Hills Eco-Region
    Lee Skabelund, Kansas State University
  - Rethinking Landscape Irrigation Practices that Promote Water Conservation
    Cathie Lavis, Kansas State University

9:15 - Break / View Posters

9:40 - Concurrent Session 2

A. Facilitating Groundwater Conservation (Flint Hills, Kings & Konza Rooms)

  Facilitator: Lane Letourneau, Kansas Department of Agriculture, DWR

  - A Tool for Local Groundwater Management
    Dave Barfield, Kansas Department of Agriculture, DWR
  - Crop Insurance Irrigation Coverage
    Rebecca Davis, USDA-RMA

B. Hydraulic Fracturing: Trends, Legislation & Risks (Kaw Nation Room)

  Facilitator: Rex Buchanan, Kansas Geological Survey

  Panel: Dave Newell, Kansas Geological Survey
  Ryan Hoffman, Kansas Corporation Commission
  Kyle Murray, Oklahoma Geological Survey
C. Municipal Water Management *(Big Basin Room)*
   **Facilitator:** Marci Schulmeister, Emporia State University
   - Municipal Utility Water Supply & Energy Efficiency-It’s Time to Make the Connection
     *Katie Miller, Wichita State University*
   - Water/Wastewater Capital Projects: Decisions, Dollars and Dilemmas
     *Dave Corliss, City of Lawrence*

D. Reservoir Sedimentation II *(Alcove)*
   **Facilitator:** Andy Ziegler, U.S. Geological Survey
   - Release of a USGS Suspended-Sediment Data Portal for the United States
     *Casey Lee, U.S. Geological Survey*
   - Quantifying Suspended Sediment Loads into Cheney Reservoir, Kansas: Temporal Patterns & Management Implications
     *Mandy Stone, U.S. Geological Survey*

10:25 - Break / View Posters

10:55 - Concurrent Session 3

A. Climate *(Flint Hills, Kings & Konza Rooms)*
   **Facilitator:** Jim Butler, Kansas Geological Survey
   - Changing Climate & What it Means to Kansas Agriculture: What is our Response
     *Charles Rice, Kansas State University*
   - Water Resources & Kansas Climate
     *Dennis Hedke, Hedke-Saenger Geoscience, Ltd.*

B. Sedimentation I *(Alcove)*
   **Facilitator:** Jeff Gross, NRCS
   - Streambank Stabilization Effectiveness on the Little & Big Blue Rivers
     *Chris Gnau, Kansas Water Office*
   - Cropland Lost to Streambank Erosion & its Impact on Regional Economy
     *Josh Roe, Kansas State University*

C. Municipal Water & Infrastructure *(Ft. Riley & Big Blue Rooms)*
   **Facilitator:** Dan Clement, Burns & McDonnell
   - Pursuing a Reservoir: A Long or Short Term Solution
     *Karl Stickley, Guernsey*
   - Magnetic Nanoparticles-Based Water Treatment System for Arsenic Removal
     *Meer Husain, Academy of Healthy Water, Ecosystem & Environment*

D. WRAPS *(Discovery Center, 2nd Floor)*
   **Facilitator:** Tom Stiles, Kansas Department of Health & Environment
   - Are We Making a Difference? Evaluating WRAPS Contribution to Improving Water Quality in KS
     *Robert Wilson, Kansas State University*
   - Poultry Litter 101 Education Program & Storage Site Selection Tool: Providing Kansas Producers with the Tools to Protect Water Quality
     *Peter Tomlinson, Kansas State University*

11:40 - Break / View Posters

12:00 - Concurrent Session 4

A. Ogallala II *(Flint Hills, Kings & Konza Rooms)*
   **Facilitator:** Susan Stover, Kansas Water Office
   - Building a District Wide LEMA
     *Jan King, West Central Kansas Groundwater Management District #1*
   - Can New Water Policy Allow a Shift in Water Use for the Ogallala?
     *Danny Rogers, Kansas State University*
B. Sedimentation II (Alcove)
Facilitator: Bryan Young, Kansas University
- Legacy Sediment - A Problem From the Past
  Don Huggins, Kansas Biological Survey
- Effects of Long-Term Management on Surface Soil Properties of Upland Soils in NE Kansas
  DeAnn Presley, Kansas State University

C. Drought (Ft. Riley & Big Blue Rooms)
Facilitator: Earl Lewis, Kansas Water Office
- How Does the Drought of 2012 Compare to Earlier Droughts in Kansas?
  Aavudai Anandhi, Kansas State University
- Drought Busters: Changing Return Rates for High Intensity Precipitation
  Mary Knapp, Kansas State University

D. Habitat and Water Quality (Discovery Center, 2nd Floor)
Facilitator: Doug Nygren, Kansas Department of Wildlife, Parks & Tourism
- Mapping & Assessing Crucial Aquatic Habitats in Kansas
  Michael Houts, Kansas Biological Survey
- Scientific Data Available for Developing Water Budgets on a Dairy
  Joe Harner, Kansas State University

12:45 - Lunch (Kaw Nation & Big Basin Rooms) Emcee – Dr. Dan Devlin, Director, KCARE, KSU
Speaker - Dr. Jim Stack, KSU – “Feeding a Growing Population in a Resource Stressed World”
Graduate/Undergraduate Student Poster Governor’s Awards

1:45 - Concurrent Session 5
A. Ogallala III (Flint Hills, Kings & Konza Rooms)
Facilitator: Tim Boese, Groundwater Management District #2
- Economic Analysis of Irrigated Agriculture in Western Kansas
  Michael Lindbloom, Kansas State University
- Kansas Irrigation Trends & Impacts
  Danny Rogers, Kansas State University

B. Water Management (Alcove)
Facilitator: Stacy Hutchinson, Kansas State University
- Evaluating Future Water Management Strategies in the Lower Republican River Basin: A Progress Report
  Andrea Brookfield, Kansas Geological Survey
- Net Zero Water - Ft. Riley’s Innovative Approach to Reduce Water Use
  Chris Otto, Fort Riley

C. Algal Blooms (Ft. Riley & Big Blue Rooms)
Facilitator: Ed Martinko, Kansas Biological Survey
- Technologies to Eliminate Cyanobacteria from Kansas Lakes & Ponds
  Phil Barnes, Kansas State University
  Jennifer Graham, U.S. Geological Survey

D. Water Quality (Discovery Center, 2nd Floor)
Facilitator: Steven Graham, Kansas State University
- Rivers Stability Analysis Using Physical Hydraulic Models
  Don Baker, Water Resources Solutions, LLC
- Providing Cattle a Limited Access to Ponds
  Herschel George, Kansas State University

2:30 - Adjourn
Conference Sponsors

Black & Veatch - Reception
Burns & McDonnell - Reception
Great Lakes Dredge & Dock - Reception

Kansas Rural Water Association - Platinum
Select Energy - Platinum
Syngenta - Platinum
Westar Energy - Platinum

Grundfos - Gold
Kansas Biological Survey - Gold
KS Dept. of Wildlife, Parks & Tourism - Gold
Kansas Geological Survey - Gold
KS Groundwater Management Districts – Gold
Netafim - Gold
Sorghum Checkoff - Gold
Stantec - Gold
WaterOne - Gold

Brown & Caldwell - Silver
Kansas Bankers Association - Silver
Kansas Farm Bureau - Silver
Kansas Grain Sorghum Commission - Silver
Kansas Municipal Utilities - Silver
Professional Engineering Consultants - Silver
State Association of Kansas Watersheds - Silver
Tallgrass Brewing Company - Silver

Westar Energy - Student Award

HDR - Bronze
Kansas Association of Conservation Districts - Bronze
Kansas Dairy Commission - Bronze
Kansas Forest Service - Bronze
The Watershed Institute - Bronze

Sponsorship Levels
Reception - $5,000
Platinum - $2,500; Gold - $1,500
Silver - $500; Bronze - $250
Student Award $750
From the Land of Kansas Sponsors

Aunt Susie’s Gourmet Kettle Corn

Grace Hill Winery

Mixes, Inc.

Jose Pepper’s

Original Juan Specialty Foods

Pet-Delights

Prairie Fire Coffee

Prairie Harvest Market & Deli
USGS Summer Intern Program

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Notable Awards and Achievements

USDA Secretary of Agriculture's Honor Award for Outstanding Research Project, Ogallala Aquifer Program, 2013