TREATING PRODUCED OIL FIELD WATER FOR REUSE IN OILFIELD OPERATIONS, AGRICULTURE AND COMMUNITY NEEDS

HIRAM (HI) LEWIS, WICHITA, KANSAS

In Kansas, water is almost always a by-product of oil production. Simply put, this water is from an ancient ocean long since buried underneath thousands of feet of rock. The water resides in the rock along with the oil. When the oil is pumped up, the water comes along with it. The quality of this water varies from place to place in the state, and from rock formation to rock formation, but all of this water is treatable with existing technology. Treatment costs vary depending on a number of factors, the five most important of which are 1) the amount of total dissolved solids in the water; 2) state and federal government standards and requirement; 3) the amount of labor and electric power needed to operate the treatment facility; 4) the size of the treating facility; 5) transportation costs, both for getting produced oilfield water to treatment facilities, and for getting freshly treated water delivered to end users. When all of these factors are considered, the cost of treatment is very high, on order of many cents per gallon.

Currently oil and gas companies dispose of the water produced in their oil production operations by injecting into "salt water disposal wells" permitted by the Kansas Corporation Commission. Literally, thousands of such wells exist throughout the state, some permitted for as small as 100 barrels per day, and some for 20,000 barrels or more. Transportation of produced oil field water to disposal facilities is done by both trucking and pipelines, with trucking being the most common method for transporting the water from small volume wells, and pipelines being the most common method for transporting water from large volume wells. In all of these disposal wells, produced oil field water is injected into pre-determined rock formations approved by the KCC. The cost of salt water disposal is very low except in situations where salt water is trucked from a producing well to a remotely located disposal well. On the low end of costs, disposal can be done for close to zero; on the high end, for 3 to 4 cents per gallon.

As a potential fresh water resource, it is estimated that in excess of 25 billion gallons (77,000 acre-feet) of produced oil field water is disposed of each year in Kansas at the present time.

Oil and gas companies are receptive to ideas for treating produced oil field water for reuse in their own operations, for use by the agricultural community or for use as fresh water supplies for municipalities. However, such treatment will need to be motivated by economics. Even in the best of times, oil companies do not have enough profitability to withstand the extra cost burdens that are associated with treatment facilities. Controlling, managing and lowering costs is an inherent aspect of all oil field operations. Liability issues are another concern. Salt water spills onto agricultural lands result in damaged soils, reduced crop yields and considerable excess costs to oil companies for damages and/or remediation. It will be essential for oil companies, state and local governmental authorities, and landowners in the area of treatment operations, to have a paradigm shift in their thinking in order for treatment of produced oil field water to become feasible.

From a financial perspective, it seems clear that there will have to be a market for selling the fresh water produced from treatment operations, along with a state or federally funded program for getting treatment plants built. It is doubtful that tax credits or other forms of tax incentives would spur the oil and gas industry to invest in such facilities, as there are few large companies in Kansas who would be able to utilize these credits. At the end of the day, it is likely that the state or federal government would have to financially sponsor treatment operations in Kansas for it to be successful.

Blue Ribbon Funding Task Force for Water Resource Management

Additional Sources of Supply

Duane Hund, Contracting Officer Mill Creek Watershed District #85

Thank you for this opportunity to share how watershed districts across Kansas could be instrumental with the development and conservation of the future water supply in the state of Kansas. The Mill Creek Watershed District covers nearly 270,000 acres mostly in Wabaunsee County. We have plans to build a total of 61 detention structures, we have 27 already completed.

In 1990 Mill Creek was pursuing the development of a Flood Detention control structure 3 miles south of the city of Alma. It was widely known that the primary source of water for Alma was an unreliable city owned reservoir and an equally unreliable source being directly from Mill Creek.

We became aware of the Multi-Purpose Small Lake Program (MPSL) and in 1990 began to work with the City of Alma to develop the plans for coordinating our two local government agencies with the State of Kansas. Our partnership was a balance of utilizing tax dollars in a highly efficient manner to achieve mutual goals, flood control and a reliable source of drinking water.

As the plans were nearing the construction phase in 1994 our design engineer came to us with a suggestion. The city by regulation could not qualify for more annual appropriated water storage than what was needed for the next 20 years. However it would only require a minimal amount of additional design to double the available water storage. It seemed foolish to miss out on such an opportunity.

What happened next was an example of governmental common sense. The state of Kansas will pay for the additional water storage and hold the rights for the next 20 years. If no request to purchase was made by a qualified downstream user at the end of 20 years the city of Alma would then agree to purchase the remaining water rights. The city did agree to this outcome and construction of Site #52 in the Mill Creek Watershed general plan was completed in 1995.

In the 20 year period from 1995 to 2015 no requests were received by the state to purchase the available water rights. The city of Alma recently completed the purchase of those additional water appropriations.

A second project change during the planning process was the inclusion of 4 sediment control structures just above the main reservoir. These small structures serve to not only extend the life of the surface water available storage capacity but cattle grazing the native rangeland surrounding the site routinely will use these smaller ponds for their needs and stay off of the main reservoir water body.

For the past 21 years this water resource has been a key to economic opportunity for the city of Alma. A subsidiary of Hormel known as “Alma Foods LLC” has expanded dramatically to become of the largest employers in Wabaunsee County.

The funding of MPSL Site #52 was a combined effort by the Mill Creek Watershed District, the city of Alma and the State of Kansas.

The example of cooperation, forward thinking and goal setting place this precious resource of flood control and a safe reliable resource of water in a position of being taken for granted. How often do we think about preparing for the future?

I have served in the capacity on the board of directors or as Contracting Officer in the Mill Creek Watershed District for 40 years. We have seven board members ranging from 26 to 80 + years of age. Similar to planting a fruit tree we prepare for the future. Flood control along with clean and available water will be needed by many more communities like Alma. The Multi-Purpose Small Lakes program is a highly beneficial program to achieve these goals.

Thank you again for this opportunity.

Duane Hund
Contracting Officer
Mill Creek Watershed District #85
Alma, Kansas

Written testimony regarding The Blue Ribbon Funding Task Force for Water Resource Management: *Long-Term Vision for the Future of Water Supply in Kansas* (The Vision).

Dr. Howard Neibling, P.E.

Extension Water Management Engineer, University of Idaho

Thank you for the opportunity to provide public comments regarding this plan. Water is as important an issue in Idaho as it is in Kansas, and both states are confronting many of the same challenges, particularly the decline of water levels in major regional or local aquifers over time.

Because of my farm experience, training and work experiences, I am quite familiar with a number of issues related to water management. I have almost 40 years' experience in University Teaching, Research and Extension in the soil erosion /sedimentation and irrigation equipment design and management areas. I am the 5th generation of my family born and reared on grain and livestock farms in NE Kansas and I have BS and MS degrees in Agricultural Engineering from KSU, and a Ph. D. in Agricultural Engineering from Purdue University. I am a registered professional engineer in Idaho and Oregon.

Several components can be used singly or in combination to stabilize groundwater levels:

- Reduction in pumping (less water per acre or fewer acres irrigated),
- Groundwater recharge using surface runoff water or excess canal water when available,
- Import of water from areas of excess surface water,
- …

Because of water law considerations, we are restricted to the first two options, with water use curtailment based on seniority of water rights, as established by the recently completed lengthy re-adjudication of all surface and groundwater water rights in the state. A major lawsuit between senior surface water users and junior groundwater users was settled this last year after 10 years in the courts. It provides among other things, that groundwater users must reduce pumping by an average of about 12-14%, groundwater recharge efforts will be greatly enhanced and the Snake River Plain aquifer water levels will continue to be monitored and the approach adjusted as needed to stabilize the aquifer.

Reduction in water use per acre can be achieved by adoption of more efficient irrigation technologies, more efficient water management practices, and changes in cropping mix to reduce seasonal irrigation water use. My colleagues in Kansas have done an excellent job in developing and promoting the best practices for each area of the state.

In some areas of Idaho, Nevada and California, even after adopting the most efficient equipment and practices, some level of reduction in irrigated acreage is required to stabilize aquifer levels. Several large areas of high-lift pumping have reverted to dryland production due consistent revenue deficits caused primarily by the cost of lifting water over 400-500 feet and then pressurizing it for irrigation.

Route B Water Transfer System

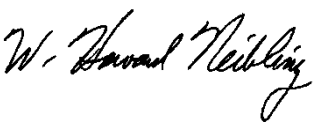
My primary interest at this point lies with the portion of the long term vision related to Collection and transport of Missouri River water to western Kansas to sustain irrigated acreage as the Ogallala aquifer continues to drop. Although water transfers are appealing, the bottom line in determining the feasibility of such projects must be the "bottom line" – can the farmer pay the cost of transferred water and still have an economically-viable operation? Therefore, all the elements that determine this cost are very important in the final evaluation of such projects. Based on my experiences and the experiences of colleagues in Idaho Power and In Washington, the work with high volume, high lift pumping from the Snake and Columbia Rivers, have concerns with a number of the costs used in this study. A number of costs are too low and will result in an artificially low cost per acre foot that cannot actually be achieved and sustained through long-term operation.

White Cloud Lake:

- Soils are silt loam and prone to piping. When at the University of Missouri as a faculty member in Agricultural engineering, I studied methods for reducing frequent and significant piping failures in the soils of the deep loess hills near Mound City. The soils at the proposed dam site are similar. For a 200 + ft embankment, what soil will be used for dam fill and how will piping be prevented?
- The Missouri River bluffs have a thick mantle of loess soil in places, how do you stabilize a joint between the dam and abutments? How fractured is underlying Limestone and how suitable as anchoring abutment?
- Interest rates are currently low, but most likely will not remain at these levels over the life of the project
- What is actual cost of electricity for this level of usage? 4.5 cents /kwh seems very low. Idaho has major low-cost hydroelectric and large pumping system costs are still around 7 cents/kwh
    - Assumed pump efficiency is too high ((82%). Similar applications in Idaho have efficiencies of around 65-70% efficiency, and in Washington, about 72-75%.
- Land costs are definitely not the same as used in the 1982 study. ($1300/ac is low for anywhere along the route and certainly low for the supply reservoir area (recent land sales are around $10K there).
- The 1982 study did not use a cost for supply reservoir area since it was described as primarily steep wooded slopes unsuitable for farming – they obviously did not visit the site.
- Increased earthquakes in OK and KS may be problematic for pipes and lined canals
- Cost/ac-ft is low due to land and pumping cost estimates. Cannot compare other large transfers like CAP or CA aqueduct because higher value, double-cropping and non-ag use can succeed with higher water costs. In western KS, primary crops are small grains and corn. Small grains use a little over half the water of corn and neither are of high profit margins.
- Sustainability is a growing trend. Crops produced with water from this project would definitely not be seen as sustainably produced.
- Evaporation losses appear to be understated.

Thank you again for the opportunity to share my experiences and observations.

Sincerely,



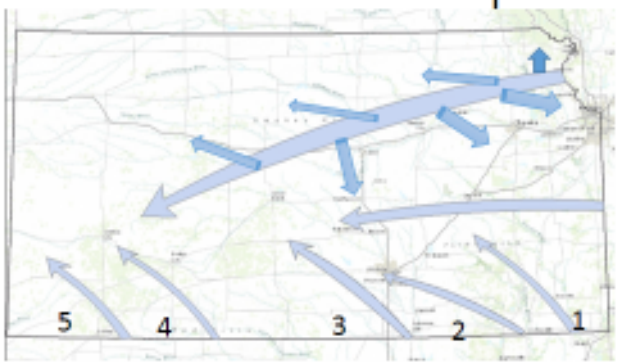
Dr. Howard Neibling, P.E.

S Sub HB2059 Fact Sheet

March 17, 2016

- **Establishes a filing fee structure** to allow permit applications to appropriate surface waters leaving the state unused to be conserved and transferred for new benefits in Kansas.
- **Preserves long standing policy** for Kansans to propose water projects as an application with fees.
- **Assures full fee payment** under the highest existing fee scenario in Kansas law, if needed.
- **Protects fees for agency action** by avoiding big fee sweeps to the state general fund.
- **Removes deadlines on the chief engineer.** Existing deadlines are too short for large project proposals and fees today can be returned to the applicant after 150 days final form if no final agency action occurs.
- **Delays implementation to December 1, 2016** to provide time for the state department of agriculture to develop standards for reasonable action plans with milestones required with such applications.
- **First step** to implement "option 1" use of WAA from "Aqueduct Study" that was accepted by the Kansas Water Authority over a year ago. See http://www.kwo.org/Projects/AqueductStudy.html
- **The Water Appropriation Act and the Water Transfer Act protect public interest:** permit Kansas water projects; protect water users; control out of state appropriations; and dedicate all waters of Kansas to benefit the people of Kansas through appropriate requests that are considered in the public interest.

Potential appropriations of surface water for transfers to multiple uses in Kansas.



Kansas - Oklahoma Compact

Subbasin	Conservation Storage Allocation,	Available Transfer Allocations
1) Grand-Neosho River Basin	650,000 acre-feet	513,028 acre-feet
2) Verdigris River Subbasin	300,000 acre-feet	1,214,930 acre-feet
3) Mainstem Arkansas River	600,000 acre-feet	598,515 acre-feet
4) Salt Fork River Subbasin	300,000 acre-feet	295,967 acre-feet
5) Cimarron River Subbasin	5,000 acre-feet	5,000 acre-feet
	Total =	2.623 million acre feet

The Verdigris subbasin has an allocation above that allocated by the compact because it has been credited additional storage as a result of conservation storage constructed in Oklahoma.

Information from *The Economic Importance of Water in Kansas*, 2015. A Kansas Aqueduct Coalition funded study