Methodologies and Data Sources Used in Determining the Landlord's Share of 2014 Calendar Year Net Returns for Irrigated Cropland for the Agricultural Land Use-Values.

The Department of Agricultural Economics, Kansas State University (KSU), in cooperation with the Division of Property Valuation (PVD), has developed the following procedures for determining the landlord's share of net income for irrigated cropland in Kansas following the guidelines set forth in K.S.A. 79-1476. The methodology and sources of data are outlined in this document.

K.S.A. 79-1476 requires that an 8-year average of landlord net returns be used by PVD in determining the agricultural land use-values. For the 2016 valuation year, the 8-year average is comprised of 2007 through 2014 calendar year data. KSU calculated landlord net returns for 2007, 2008, 2009, 2010, 2011, 2012, 2013, and 2014 according to directives issued by PVD. Thus, the 2014 calendar year data were added to the data series, and 2005 calendar year data were excluded to keep the 8-year average intact. The 2007-2013 calendar year data, which were used in previous year valuation calculations, are documented and explained in previous editions of this text. This text edition documents the methodologies and data sources used to calculate the 2014 calendar year net returns, which were combined with the prior seven years of data by PVD to yield the 8-year average. The main components of the irrigated analysis explained in this text are the homogeneous regions, well depths, Kansas Irrigated Productivity Index (KIPI), crop mix, yields, prices, landlord’s share of crop, landlord’s share of expenses, production costs, equipment ownership expenses, management fee, and landlord’s share of net income.

HOMOGENEOUS REGIONS

Six homogeneous regions established by PVD are used in the irrigated cropland analysis. They are NW-10, WC-20, SW-30, NC-40, C-50, and SC-60. Districts NW-10, WC-20, and SW-30 lie in the 2 Acre Feet Region established by the Kansas Division of Water Resources, while districts NC-40, C-50, and SC-60 are in the 1.5 Acre Feet Region. All data used to calculate landlord net returns are aggregated to these regions. An illustrative map is included in the appendix.

WELL DEPTH

The depth to water has a significant effect on the cost of irrigating crops in Kansas. Fuel pumping costs and irrigation equipment requirements are calculated for up to seven well depths in 100' intervals. County appraiser surveys and Kansas Geological Survey data were used to identify the relevant well depths for each district. Landlord net returns were calculated individually for each well depth. Each county appraiser then applies the appropriate net return to each parcel after identifying the well depth.

KANSAS IRRIGATED PRODUCTIVITY INDEX (KIPI)

The 2014 calendar year net returns were calculated by irrigation district using KIPI data as directed by PVD. All data including the yields and crop mixes were aggregated to the district level using data for 2014. The Natural Resource Conservation Service (NRCS) developed the Kansas Soil Rating for Plant Growth (KS_SRPG) system to rank the productivity of each soil mapping unit (soil type). In cooperation with the PVD, the Department of Agronomy at KSU developed the Kansas Irrigated Productivity Index (KIPI) system, using the KS_SRPG, to rank the productivity of each irrigated soil mapping unit (soil type). For each irrigation district, the weighted average KIPI was calculated using the KIPI and the irrigated acreage by soil mapping unit. Specifically, the weighted average KIPI is calculated by multiplying the number of acres for each soil type by the KIPI for each respective soil. These values are then summed to get a single total. This total (KIPI*MU Acres) is then divided by the total acres in the district to arrive at the weighted average KIPI. The weighted average KIPI is used to index the KIPI's by soil mapping unit. The indexed KIPI's are calculated by dividing the KIPI for each individual soil by the weighted average KIPI. Thus, the average productivity or KIPI in the district should correspond to an index value of 1.0.

CROP MIX

A crop mix is the percentage of planted acres for each crop in a district relative to the total planted acres in that district. This procedure establishes the typical cropping practice in each irrigation district and weights each crop according to its importance. Only the crops comprising 5% or more of the total planted acres for a district were considered in the calculations. The crop mix percentages are used to weight gross income and production expenses. The percentages are the same for each soil mapping unit in a given irrigation district.

The crop mix calculations were completed for each irrigation district using 2014 acreage data. The Method of Moving Averages methodology was then used to calculate the average crop mix at the district level (Albright, Featherstone, and Cole). This method uses an 8-year average to generate the average crop mix percentages as directed by PVD. Specifically, once the annual 2014 crop mix was determined, the crop mix percentages for the previous seven years were determined using only the crops included in the 2014 annual crop mix. The 2014 calendar year net returns were based on a crop mix average for the years 2007-2014.

The irrigated planted acres for wheat, soybeans, and non-oil type sunflowers were provided by the United States Department of Agriculture's Risk Management Agency (RMA). The harvested acres for alfalfa were provided by the United States Department of Agriculture's National Agricultural Statistics Service (NASS). Harvested acres were used for alfalfa because alfalfa is not planted annually. Planted acres for corn and grain sorghum available from RMA do not account for silage production individually for irrigated and non-irrigated cropland. Thus, KSU developed a procedure to calculate the non-irrigated and irrigated acres planted for corn and grain sorghum (Marden and Albright). Specifically, the methodology allocates silage acreage and abandoned acreage between irrigated and non-irrigated corn and grain sorghum production.

Note: Harvested acres of alfalfa from NASS include both non-irrigated and irrigated alfalfa. The alfalfa acreage in the eastern three NASS Crop Reporting Districts was assumed to be non-irrigated and included in the non-irrigated crop mix analysis. For the remaining six districts, 65 County Extension Agricultural Agents were contacted to determine the percentage of non-irrigated versus irrigated alfalfa acres in their respective counties. This information was combined with data provided by the Farm Service Agency (FSA) Data Center in Kansas City, MO. If the FSA irrigated acre percentage was missing, then the Extension agent's estimate was used for a county. The average percentage of irrigated alfalfa for each county was multiplied by the total harvested acres of alfalfa in each county. These acres were then used in the irrigated crop mix analysis.

YIELDS

The source for the 2014 alfalfa yield data is the Kansas office of NASS. All other crop yield information, from 2012 forward, is provided by the RMA. Yields for all crops are based on planted acres (Yield / Acre = Crop Production ÷ Planted Acres), with the exception of alfalfa which uses harvested acres as the basis for calculating average yield per acre. The 8-Year Method of Moving Averages was used to calculate the average yield per acre for each crop at the irrigation district level (Albright, Featherstone, and Cole). This method uses an 8-year average to generate the average yields as directed by PVD. The 2014 calendar year net returns are based on a yield averages for the years 2007-2014.

Soil Mapping Unit Yields

K.S.A. 79-1476 dictates that agricultural land will be valued for agricultural purposes based on its inherent capability to produce. In other words, the best soils in a district utilize above average yields, and conversely, the relatively poorer soils in a district will have their Agricultural Use Values determined using yields which are below the district average.

The KIPI system utilizes the irrigation district average yields in the calculations. The indexing system accounts for the differences in productivity across the various soil types. The system indexes landlord gross income rather than the average yields by soil type, which will be explained later and is illustrated in the appendix. Mathematically, the results are the same whether indexing gross income or indexing average yields. This results occurs because of multiplication rules which state that (1*2)*3 is identical to (2*3)*1. Thus, indexing landlord gross income results in the same LNI as indexing yields using the KIPI system.

PRICES

NASS collects the average monthly price paid to farmers for wheat, grain sorghum, corn, soybeans, alfalfa, and sunflowers at the state level. These are the prices received by farmers, and therefore, reflect any dockage or adjustment for quality or moisture content. Further, for each of these crops, NASS collects the percentage of the total crop sold during each month. The monthly prices were weighted with the percentage of the crop sold during the corresponding month. The

sum of these weighted monthly prices is the weighted annual price for each crop. The state prices for wheat, grain sorghum, corn, and soybeans were entered into the Grain_seasonalscash.xls spreadsheet, developed at Kansas State University to use basis adjustments to calculate prices received on a crop reporting district level. As NASS no longer publishes prices at the crop reporting district level, an alternative source for this information was utilized for the 2010-14 calendar years, as directed by PVD.

The Method of Moving Average methodology was used to calculate price for the 2014 calendar year net returns. For these net returns, the average price for 2007-2014 was utilized in the calculations. Again, this weighted price reflects the actual price paid to landowners and is weighted to reflect the time of the year each portion of the crop was sold. The prices for wheat, grain sorghum, corn, and soybeans are specific to each crop reporting district. Alfalfa and sunflower prices are statewide averages for the 8-year period.

Note: Riley and Geary counties lie within the NC-40 Irrigation District, but they also lie in the NE-70 and EC-80 Kansas Agricultural Statistics' Crop Reporting Districts, respectively. Morris and Chase counties lie in the C-50 Irrigation District, but fall within the EC-80 Crop Reporting District. Finally, Butler and Cowley counties are in the SC-60 Irrigation District, but also lie in SE-90 NASS Crop Reporting District. The irrigation net returns for these six counties were calculated using the crop prices from their respective crop reporting districts. All other data are unchanged from the irrigation district level calculations. For example, Riley county irrigated net returns are based on the aggregated yield, crop mix, landlord share, and cost data for the NC-40 Irrigation District, but crop prices are an 8-year average (2007-2014) for the NE-70 Crop Reporting District.

LANDLORD'S SHARE OF CROP

K.S.A. 79-1476 requires that the share of net income normally received by the landlord be used as the basis for determining agricultural income. Thus, the landlord's share of the crop is defined as the most frequently occurring arrangement for a homogeneous region or irrigation district and irrigation system. The Kansas office of NASS, in cooperation with the Department of Agricultural Economics, Kansas State University, conducted a lease arrangement survey of irrigators and owners of irrigated land during the spring of 2012. This information was tabulated at the irrigation district level for flood and sprinkler systems individually. From these data, the mode or most frequently occurring landlord's crop share was identified for flood and sprinkler irrigation using acreage as the measure. These crop share data were used in the 2014 calendar year net return calculations. The crop shares by district and system were:

	Flood Irrigation	Sprinkler Irrigation
NW-10	33.3%	33.3%
WC-20	33.3%	33.3%
SW-30	33.3%	33.3%
NC-40	33.3%	40.0%
C-50	33.3%	33.3%
SC-60	33.3%	33.3%

LANDLORD'S SHARE OF EXPENSES

The landlord's share of production expenses and ownership of irrigation equipment was taken from the aforementioned 2012 Irrigated Farm Lease Arrangement Survey conducted by NASS/KSU. The average share for each expense category was calculated using the most frequent crop share arrangement. For example in WC-20, the landlord's share of the crop for flood irrigated crops is 1/3. Thus, the average share of expenses was calculated using only the flood irrigation surveys with a 1/3 crop share for the landlord. Subsequently, all other survey information from that district was excluded from the analysis. Once a crop share for the landlord was established for an irrigation district and irrigation system, only the surveys with the corresponding crop share were included in the analysis.

PRODUCTION COSTS

The production costs per acre were taken from various sources. Those sources are the 2013 Input Cost Survey of custom applicators and coops, NASS *Kansas Custom Rates 2013* publication, *Kansas Irrigation Water Use*, the 2012 Irrigated Farm Lease Arrangement Survey, and the Kansas State University Farm Management Guides. Costs for years in which a survey was not conducted were indexed using the NASS Quickstats Database Agricultural Outlook Prices Paid by Farmers.

Fertilizer, herbicide, insecticide, and seed costs were collected via the 2013 Input Cost Survey of custom applicators and coops. Costs for the predominant crops in each NASS Crop Reporting District were gathered for the 2013 calendar year from local coops, elevators, and fertilizer dealers with this survey.

Fertilizer and chemical application, harvesting, grain hauling, land leveling maintenance, and ditching costs were taken from the *Kansas Custom Rates 2013* publication. Land leveling maintenance costs were estimated by running a disk over a field 4 times, once every five years. Ditching costs were estimated with row crop cultivation costs per acre.

Irrigation equipment repair and maintenance costs, crop machinery repair and maintenance costs, crop machinery fuel costs, and lime costs for flood and sprinkler irrigated crops were taken from the Farm Management Guide crop budgets, 2014. The Department of Agricultural Economics, KSU, publishes these crop budgets annually.

Fuel pumping costs were calculated using irrigation water-use data from various issues of *Kansas Irrigation Water Use*, which is published by the Division of Water Resources, rainfall data from Kansas State University Department of Agronomy Weather Data Library, cost data from the 2012 Irrigated Farm Lease Arrangement Survey, and energy cost data from the KSU Farm Management Guides. The ratio of water use for flood and sprinkler systems was determined so that pumping costs could be calculated for flood and sprinkler systems individually by irrigation district. The acre-inches of water applied to irrigated crops for 2014 were first determined from the Water Resource data. The typical fuel type, cost per unit, fuel cost per acre-inch pumped, and the landlord’s share of fuel costs were then determined using the 2012 Irrigated Farm Lease Arrangement Survey and the KSU Farm Management Guides. Given a specific Total Dynamic Head (TDH) and fuel cost, the cost per acre inch of water can be

calculated. The water use in acre inches multiplied by the landlord's share and cost per acre inch yields the total landlord's share of fuel pumping costs per acre.

EQUIPMENT OWNERSHIP EXPENSES

K.S.A. 79-1476 allows for the depreciation of irrigation equipment to be used as an expense in the calculation of irrigated cropland net income. The costs associated with asset (irrigation equipment) ownership were investigated. The annual ownership cost of a durable asset normally includes depreciation, interest, repairs, property taxes, and insurance (DIRTI five). For this study (Use Value Appraisal), property taxes, repairs, and insurance are handled elsewhere in the analysis. Thus, depreciation and interest costs comprise the ownership cost for the durable asset, irrigation equipment in this case. The irrigation equipment, for each of the seven well depths, required to flood and sprinkler irrigate a 1/4 section of land was studied in cooperation with irrigation engineers in the Department of Biological and Agricultural Engineering at Kansas State University. This equipment includes the well, pump, gearhead, underground pipe and wiring, and the power unit for both systems. A furrow flood system, a tailwater recovery system, and initial land leveling costs were utilized for flood irrigation, while a low pressure sprinkler system was included for sprinkler irrigation.

New costs for this equipment were originally collected in 1994 from 28 irrigation equipment dealers, 20 engine dealers, and published research. These costs were then deflated using an Irrigation Systems index published by the USDA to create a time series of annual costs for this equipment. New costs were again collected from irrigation equipment dealers, engine dealers, and published research for 1997, 2002, 2005, 2009, and 2014. The ownership cost was calculated for each item of irrigation equipment based on an 8-year average of equipment costs (2007-2014). Interest rates on agricultural real estate loans (2007-2014) as reported by the Kansas City Federal Reserve, and an inflation rate (2007-2014) from the annual Personal Consumption Expenditures index were used in the calculations. The resulting amount is the annual ownership expense for the entire piece of irrigation equipment. For sprinkler irrigation only, PVD directed KSU to utilize only 50% of the annual ownership cost for the sprinkler system. The annual ownership expense was divided by either 155 acres for flood irrigation, or 130 acres for sprinkler irrigation to derive a per acre cost for the 2014 calendar year net returns. The landlord's share of ownership of the equipment, from the 2012 Irrigated Farm Lease Arrangement Survey, was applied to determine the landlord's equipment costs. It is assumed that the landlord is responsible for 100% of the tailwater recovery system and land leveling charges.

FLOOD AND SPRINKLER SYSTEMS COMBINED

As previously stated, the flood and sprinkler data were combined to produce aggregate landlord net returns for irrigation. Net returns were not calculated individually for flood and sprinkler systems for several reasons. First, the yield and crop mix data are not system specific, i.e. yield and acreage data are not available for flood and sprinkler systems individually. Secondly, the large capital investment required for sprinkler irrigation translates into a

substantial amount of equipment cost. Flood irrigation does not require as much equipment; therefore, the ownership cost of equipment is much lower. This would create an inequity in flood and sprinkler net returns, especially if the lease arrangements in use do not adjust for the cost difference, which appears to be the case. Thus, the production costs and equipment ownership costs were weighted by the number of acres under each irrigation system for each district.

MANAGEMENT FEE

A management fee was calculated to account for the costs associated with business and managerial decisions. The fee is 10% of the weighted landlord gross income, which is consistent with the current rates charged by farm management and consulting firms in Kansas. The 10% fee was verified by ten firms and is supported by Kansas State University management fee surveys conducted in 2013, 2009, 2005, 2002, 1998, 1994, and a 1990 survey that investigated farm management practices and fees in Kansas.

GOVERNMENT PROGRAM PAYMENTS

The Division of Property Valuation directed Kansas State University to exclude any government program payment data from the 2014 irrigated landlord net return calculations.

LANDLORD'S SHARE OF NET INCOME

Net Returns by Soil Mapping Unit

The landlord’s share of net income was determined by combining the previously explained factors into a system of equations. PVD directed that the 2014 calendar year landlord net returns for irrigated land be calculated by soil mapping unit using the KIPI data. The KIPI data for each soil mapping unit were indexed based on the weighted average KIPI. The average landlord gross income by crop for the irrigation district was calculated by multiplying the average yields, prices, and landlord’s crop share together. This average landlord gross income was then weighted by the crop mix percentage for each crop, producing the landlord’s weighted gross income for each crop. These values were summed to arrive at the landlord’s weighted gross income for the irrigation district. The district weighted landlord gross income was then indexed for each soil type within the irrigation district. Thus, each soil mapping unit has a gross income, from which the average production costs, which were also weighted by the crop mix, and a 10% management fee were deducted to arrive at the 2014 calendar year net returns by soil mapping unit.

APPENDIX:

Included in the appendix are the 2014 calendar year landlord net return calculations for a sample Irrigation District. The tables illustrate the procedures and data sources for each factor used to calculate the landlord net returns for the 2014 calendar year by soil mapping unit. These data represent only one year of the statutorily required 8-year average. Specifically, the following items are included in this appendix:

- Kansas Agricultural Statistics' Crop Reporting Districts
- Irrigation District Map
- 2014 Irrigation Land Analysis: 100 Ft. Well Depth by Soil Mapping Unit
- 2014 Crop Mix Calculations
- 2014 Average Yield Calculations for use in KIPI calculations
- 2014 Monthly Crop Prices Received by Farmers
- Annual Crop Prices Received by Farmers, 2007-2014
- 2014 Landlord's Share of Production Cost Calculations: Flood Irrigation
- 2014 Landlord's Share of Production Cost Calculations: Sprinkler Irrigation
- 2014 Weighted Landlord's Share of Production Costs
- 2014 Landlord's Share of Fuel Pumping Costs: Flood Irrigation
- 2014 Landlord's Share of Fuel Pumping Costs: Sprinkler Irrigation
- 2014 Equipment Ownership Cost Calculations: Flood Irrigation
- 2014 Equipment Ownership Cost Calculations: Sprinkler Irrigation
- Water Ratio Table