DRAFT

Procedure used to estimate livestock consumptive water use for counties in the Susquehanna River Basin

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1. USDA Census of Agriculture data was used to tabulate numbers of the following livestock categories for each county in the Susquehanna River Basin (USDA, 2007):
    - Beef cows
    - Milk cows
    - Hogs/pigs
    - Sheep/lamb
    - Horses
    - Goats
    - Poultry (Layers, Pullets, Broilers, Turkeys)

2. Consumptive water use (CU) factors (gallons/animal/day) were used to calculate average gallons per day (gpd) used by each livestock category (Jarrett, 2002). Table 1 provides example Census of Agriculture data for Lebanon County, PA. Total animal counts for each livestock category were multiplied by the associated CU factors to determine the total livestock CU (gpd) in each county of the basin.

$$Total\ Animals\ \times CU\ Factor\ (gallons/animal/day) = Livestock\ CU\ (gpd)$$

Table 1. Lebanon County, Consumptive Water Use For Livestock By Animal Species

Livestock Category	Lebanon County Total Animals[1]	CU Factor (Gallons/Animal/Day)[2]	Lebanon County Livestock CU (gpd)
Beef Cows	25,515	15	382,725
Milk Cows	808,255	35	28,288,925
Hogs and Pigs	399,940	4	1,599,760
Sheep and Lamb	3,530	2	7,060
Horses	25,248	12	302,976
Goats	2,424	0.06	145
Layers	90,289	0.06	5,417
Pullets	45,941	0.08	3,675
Broilers	197,640	1.2	237,168
Turkeys	348,344	2	696,689
Lebanon County Total Livestock Consumptive Water Use (gpd)			31,524,541

1. USDA (2007) Census of Agriculture
2. Jarrett, A.R. (2002) Agricultural Animal Consumptive Water Use Coefficients

3. The Cumulative Water Use and Availability Study (CWUAS) Geographic Information System (GIS) tool will estimate livestock consumptive water use within Watershed Boundary

Dataset 10-Digit (WBD 10) watersheds within the Susquehanna River Basin. In order to build this component of the GIS tool, locations of livestock needed to be identified. An analysis of land use and locations of Concentrated Animal Feeding Operations (CAFOs) performed during the development of the Pennsylvania State Water Plan, Water Analysis Screening Tool (WAST) found that the majority of these locations were in land use areas categorized as cultivated crops in the 2000 Pennsylvania Land Cover dataset (Stuckey, 2008). More recent CAFO locations and water use permits, provided by the Pennsylvania Department of Environmental Protection (PADEP), were overlain on 2006 Chesapeake Bay land use data to verify results from the WAST. Comparison results between these updated datasets showed that more than 70% of CAFOs and 60% of livestock related water use permits were located in cultivated crop and pasture/hay land use classes (Table 2).

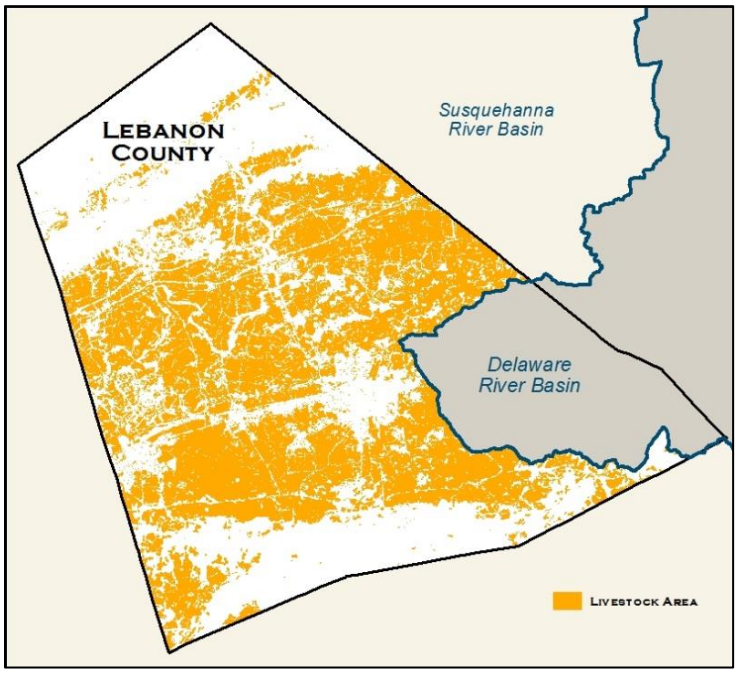
Table 2. CAFO and Livestock Related Water Use Permits by Land Use Class

Land Use Class	Number of CAFOs	Percent	Number of Livestock Water Use Permits	Percent
Open Water	0	0%	5	2%
Low Urban	0	0%	19	6%
Medium Urban	11	5%	11	3%
High Urban	14	6%	7	2%
Developed Open Space	2	1%	8	2%
Barren	10	5%	3	1%
Deciduous Forest	16	7%	38	12%
Evergreen Forest	2	1%	11	3%
Mixed Forest	2	1%	4	1%
Grassland	2	1%	3	1%
Shrub Scrub	4	2%	13	4%
Cultivated Crop	119	53%	115	35%
Pasture/Hay	40	18%	87	27%
Emergent Wetland	0	0%	1	0%
Woody Wetland	0	0%	2	1%
Unconsolidated Shore	1	0%	0	0%
Total	**223**	**100%**	**327**	**100%**

The GIS tool will assume that the majority of the livestock population exists in cultivated crop and pasture/hay land use classes. These land use classes account for 27% of the Susquehanna River Basin area.

4. Cultivated crop and pasture/hay areas were extracted from the 2006 Chesapeake Bay land use dataset and dissolved by county into a new GIS shapefile representing livestock area. Figure 1 illustrates that 2006 Chesapeake Bay land use data is only available within the basin, however, livestock CU values are countywide. A change-in-area ratio was applied to the countywide livestock CU to estimate the in-basin CU of each county lying on the periphery of the basin.

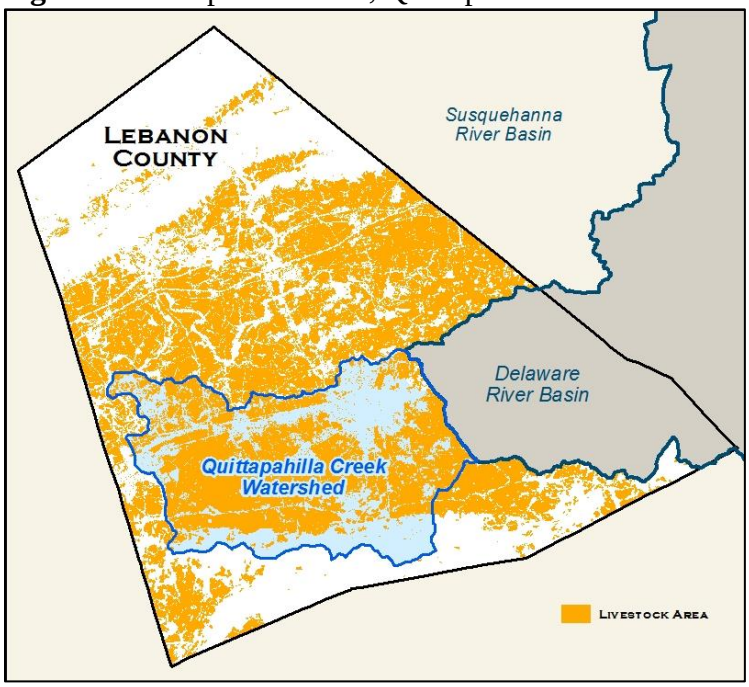
Figure 1. Livestock Areas in the Susquehanna River Basin Portion of Lebanon County



$$Lebanon\ Livestock\ CU \times \left(\frac{Lebanon\ Basin\ Area}{Lebanon\ Area}\right) = Lebanon\ Basin\ Livestock\ CU$$

5. The GIS tool will clip the livestock area shapefile to each WBD 10 watershed and calculate the estimated livestock CU (Figure 2).

Figure 2. Example WBD 10, Quittapahilla Creek Watershed



$$Lebanon\ Basin\ Livestock\ CU\ \times \left(\frac{Quittapahilla\ Livestock\ Area}{Lebanon\ Livestock\ Area}\right) = Quittapahilla\ Livestock\ CU\ (gpd)$$

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