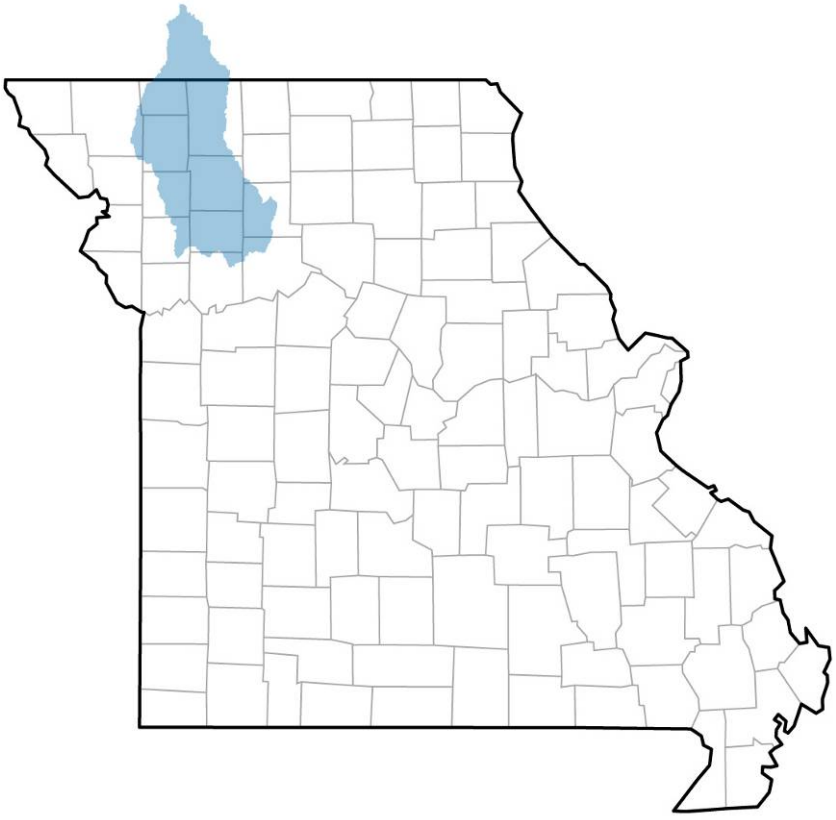
United States Department of Agriculture
Natural Resources Conservation Service

Upper Grand Sub-basin

HUC # 10280101



RAPID WATERSHED ASSESSMENT

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Upper Grand Sub-basin

HUC #10280101

A rapid watershed assessment (RWA) evaluates resource conditions and needs on an 8-digit hydrologic unit (HU) basis. The assessment identifies the primary resource concerns for the watershed being profiled and provides estimate as to where conservation investments would best address the concerns of landowners, conservation districts, stakeholders, and others. The RWA provides information on which to base decisions about conservation priorities, allocation of resources, and funding for implementation.

Introduction[1]

Rapid watershed assessments (RWAs) provide initial estimates of where conservation investments would best address the concerns of land owners, conservation districts and other stakeholders within drainage sub-basins. These assessments are designed as quick looks over large drainage areas to provide a starting point for area-wide, watershed or site-specific planning. Missouri has 66 sub-basins averaging 628,000 acres in size.

RWAs contain two parts: a resource profile based on readily available resource information and an assessment matrix of current and future resource conditions and related installation and maintenance costs. The resource profiles provide a general description of the location and primary physical attributes of the sub-basin; known resource concerns; and selected agricultural and socio-economic characteristics. The assessment matrices contain condition tables detailing the current level of conservation in the sub-basin; future considerations tables identifying appropriate suites of conservation practices needed to deal with the primary resource concerns for each major land use; and summary tables that summarize the various costs associated with the Resource Management Systems (RMS) identified in the future considerations tables.

The Upper Grand River sub-basin drains 2,075,400 acres (3,243 square miles) from its upper reaches in southwest Iowa's Union, Ringgold and Decatur counties through portions of 12 northwest Missouri counties to its outlet on the Grand River just south of Chillicothe, Missouri in Livingston County. The sub-basin, dominated by the broad Grand River alluvial plain, is bounded on the east by the drainage divide with the Thompson River and on the west by the divide with the Platte River drainage system. The flat Grand River alluvial bottoms, covered with deep, moderately well drained, silty and clayey soils, give way to rolling hills in glacial till with some remaining loess cover. Eighty-four percent of this large sub-basin (1,743, 300 acres) lies in Missouri and 16 percent (32,100 acres) in Iowa.

The sub-basin's primary land uses are agricultural, with only 4 percent (74,900 acres) of the sub-basin converted to developed uses. Forty percent of the of the sub-basin's land area is cropped (846,000 acres) and 32 percent (662,500 acres) is grazed. Sixteen percent (324,200 acres) of the sub-basin is enrolled in CRP and ungrazed forest covers 5% (115,500 acres) of the sub-basin. Minor land (23,900 acres) and water (28,400 acres) each account for about 1 percent of the Upper Grand's total land area. Cattle, followed by hogs and pigs, poultry, horses and sheep are the major livestock types in the sub-basin.

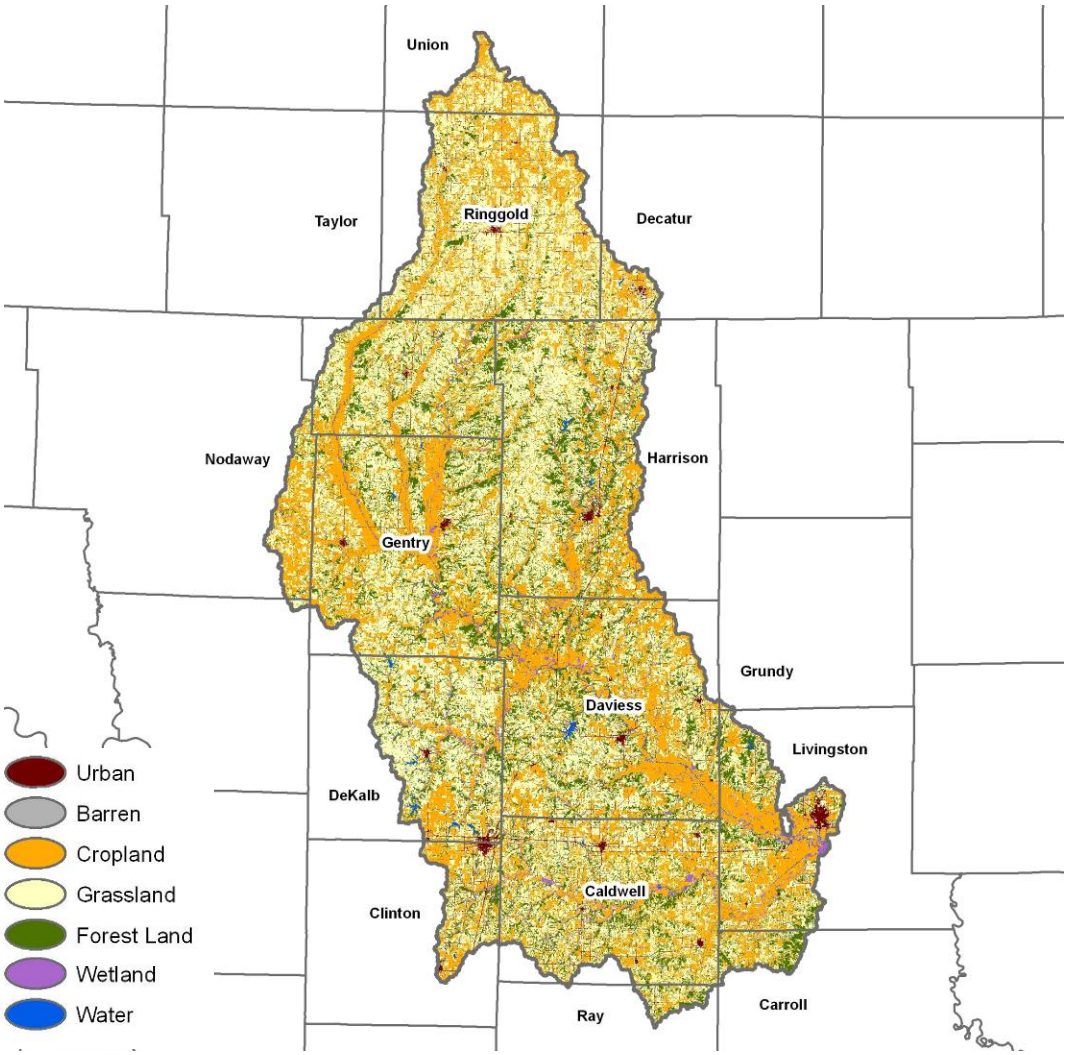
Figure 1

Sub-basin Primary Land Cover/Use Percentages By State					
State	Cultivated Cropland	Non-Cultivated Cropland	Pasture Land	Forested Land	Developed Land
Iowa	5%	1%	5%	1%	1%
Missouri	26%	8%	21%	10%	3%

Physical Description

A. Land Use/ Land Cover[2]

Figure 2



Land Use/ Land Cover NRI	Urban	Cultivated cropland	Conservation Reserve Program	Non-cultivated cropland	Pastureland	Forest land	Minor land cover/uses	Water
1982 Acres	70,600	1,001,400	NA	123,000	668,900	162,300	24,900	24,300
1987 Acres	70,900	891,900		117,700	650,300	168,100	25,200	24,800
1992 Acres	71,500	678,700	307,400	152,000	637,400	177,500	24,500	26,200
1997 Acres	74,900	654,400	324,200	191,600	548,400	229,600	23,900	28,400
Five Year trend 92-97	**Up 5%**	**Down 4%**	**Up 5%**	**Up 26%**	**Down 14%**	**Up 29%**	**Down 2%**	**Up 8%**
Ten year trend 87-97	**Up 6%**	**Down 27%**	**Up 156%**	**Up 63%**	**Down 16%**	**Up 37%**	**Down 5%**	**Up 15%**
Fifteen year trend 82–97	**Up 6%**	**Down 35%**	**NA**	**Up 56%**	**Down 18%**	**Up 41%**	**Down 4%**	**Up 17%**

Land Cover / Land Use Definitions

- Urban – This map category corresponds to the tabled category called Developed Land. Developed Land is a combination of the NRI land cover/use categories large urban and built-up areas, small lbuilt-up areas and rural transportation land. Rural transportation land consists of all highways, roads, railroads and associated right-of-ways outside urban and built-up areas and also includes private roads to farmsteads, logging roads and other private roads.

- Barren – This map category is typically, the surface of sand, rock or exposed soil with less than 5 percent vegetative cover. Barren land acreage is included in the tabled NRI Minor Land category. Minor land is a miscellaneous grouping of land covers and uses that includes farmsteads and farm structures, field windbreaks, and barren land.

- Cropland – This map category most closely corresponds to the tabled category called Cultivated Cropland. Cultivated Cropland comprises land in row crops, close-grown crops and hayland or pastureland in rotation with row or close-grown crops.

- Grassland – This map category includes 4 tabled NRI land cover/use categories:
  Non-cultivated cropland; Conservation Reserve Program (CRP) lands; Pastureland; Rangland. on-cultivated cropland includes permanent hayland and horticultural cropland. The CRP is a federal program established under the 1985 Food Security Act to convert highly erodible cropland to vegetative cover (primarily grass) under 10 year contracts. Pastureland is land managed primarily for the production of introduced forage plants for livestock grazing. Rangeland is land on which the climax or potential plant cover is composed principally of native grasses, grass-like plants, forbs or shrubs suitable for grazing and browsing and introduced forage species that are managed like rangeland.

- Forestland and Woodland – A majority of the acreage for these map categories is captured by the tabled NRI Forestland category, defined as land that is at least 10 percent stocked by single-stemmed woody species of any size that will be at least 4 meters tall a maturity. Ten percent stocked, equates to an areal canopy cover of 25 percent or greater.

- Wetlands – Acreage for this mapped category is not reflected in any of the NRI tabled acreage estimates. The wetland map category is a combination of satellite derived wetland classes, National Wetland Inventory (NWI) acres and Wetland Reserve Program (WRP) acres. (See Wetlands Section for NWI acreage estimates)

- Water – This map category closely corresponds to the NRI table acreage estimate representing water bodies and streams that are permanent open water.

B. Grassland[2]

	Rangeland (acres)			Pastureland (acres)			Grazed Forest Land (acres)		
State	State portion of sub-basin total	State percent of sub-basin total	Percent of state land use total	State portion of sub-basin total	State percent of sub-basin total	Percent of state land use total	State portion of sub-basin total	State percent of sub-basin total	Percent of state land use total
Iowa	0	0	0%	106,800	19%	3%	17,100	15%	2%
Missouri	0	0	0%	441,600	81%	4%	96,400	85%	3%
Total	0	0	-	548,400	100%	-	113,500	100%	-

C. Crop History[2]

	Close Grown Crops (acres)		Row Crops (acres)			Hayland (acres)		
State	Oats	Wheat	Corn	Sorghum	Soybeans	Grass	Legume	Grass-Legume
Iowa	2,300	0	45,100	0	54,400	3,500	3,500	18,700
Missouri	1,600	19,900	149,700	5,900	342,000	85,800	6,000	93,600
Sub-basin Total	3,900	19,900	194,800	5,900	396,400	89,300	9,500	112,300

D. Public Land[3,33]

About 25,511 acres or 1.2% of the sub-basin are in public ownership. These public lands include 15 conservation or wildlife management areas, 8 river accesses, 15 city/county lakes or parks, 1 state park and 1 fish hatchery. Public ownership in this region is below Missouri's state average of 6.7%, but is typical of highly agricultural areas.

Figure 3

Public Land Ownership (acres)					
	Missouri Department of Conservation	Missouri Department of Natural Resources	Ringgold County, Iowa	Iowa Department of Natural Resources	Other
Total Acres	19,284	488	493	4,878	368

E. Soil Capability

Land Capability[2]

Land Capability is a classification system used to identify the erosion potential of farmland. For over forty years the USDA has used land capability classification as a planning tool in laying out conservation measures and practices to farm without serious deterioration from erosion or other causes. The current system includes eight classes of land designated by Roman numerals I through VIII. The first four classes are arable land--suitable for cropland--in which the limitations and the need for conservation measures and management increase from I through IV. The remaining four classes, V through VIII, are not to be used for cropland, but may have uses for pasture, range, woodland, grazing, wildlife, recreation, and aesthetic purposes.

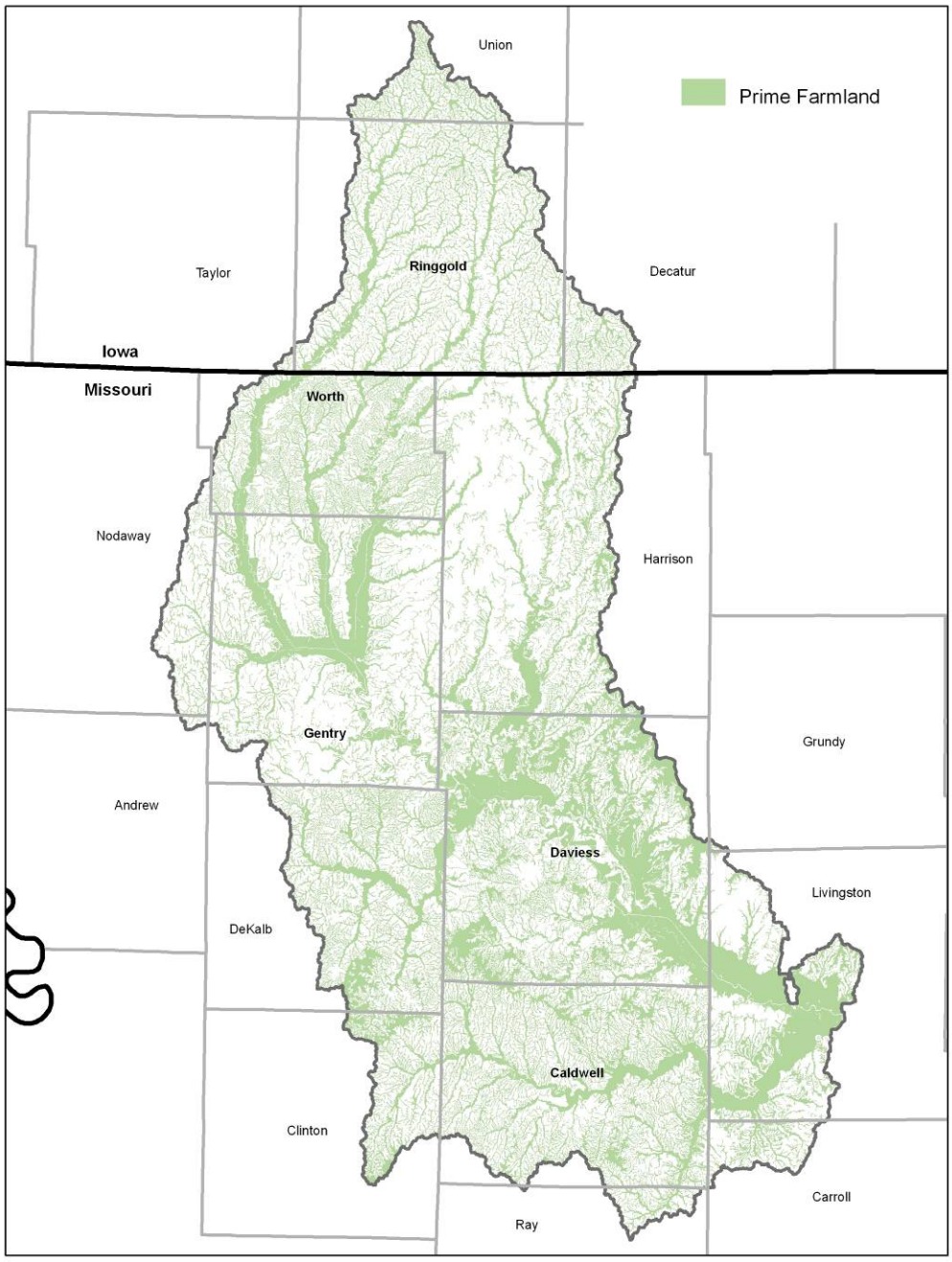
Figure 4

Land Capability Class	Cultivated cropland (acres)	Non-cultivated cropland (acres)	Pastureland (acres)
I - slight limitations	20,700	0	5,700
II - moderate limitations	298,900	50,900	113,100
III - severe limitations	277,200	110,700	285,100
IV - very severe limitations	41,500	19,300	87,000
V - no erosion hazard, but other limitations	-	-	3,600
VI - severe limitations, unsuited for cultivation, limited to pasture, range, forest	10,900	10,700	35,700
VII - very severe limitations, unsuited for cultivation, limited to grazing, forest, wildlife	5,200	0	18,200
VIII - misc. areas have limitations, limited to recreation, wildlife and water supply	-	-	-
Total	**654,400**	**191,600**	**548,400**

Prime Farmland[4,5]

Prime Farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for these uses. It has the soil quality, growing season, and moisture supply needed to produce economically sustained high yields of crops when treated and managed according to acceptable farming methods, including water management. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.

Figure 5. Prime Farmland in the Blackwater Sub-basin [5]



Prime Farmland[2]—Change in Acres from 1982 to 1997			
Year	Iowa	Missouri	Sub-basin Total
1982	91,200	631,200	722,400
1997	91,400	628,500	719,900
Difference	**Up 200**	**Down 2,700**	**Down 2,500**

F. Common Resource Areas[6]

NRCS has divided the Nation into ecological type land regions called Major Land Resource Areas (MLRA). MLRAs are defined by their agricultural potential and soils capabilities and provide a spatial framework for addressing national and regional agricultural issues. A Common Resource Area (CRA) is a geographic and ecologic subdivision of an MLRA within which there are similar resource concerns and treatment requirements.

Each Missouri CRA is a grouping of Land Type Associations (LTA) taken directly from the state's ecological classification system (ECS). Missouri's LTAs are primarily differentiated on the basis of local climate, landforms and topography, geologic parent materials, soil types and potential vegetation.

The Upper Grand River Sub-basin occupies portions of MLRA 108D.1 and MLRA 109.1.

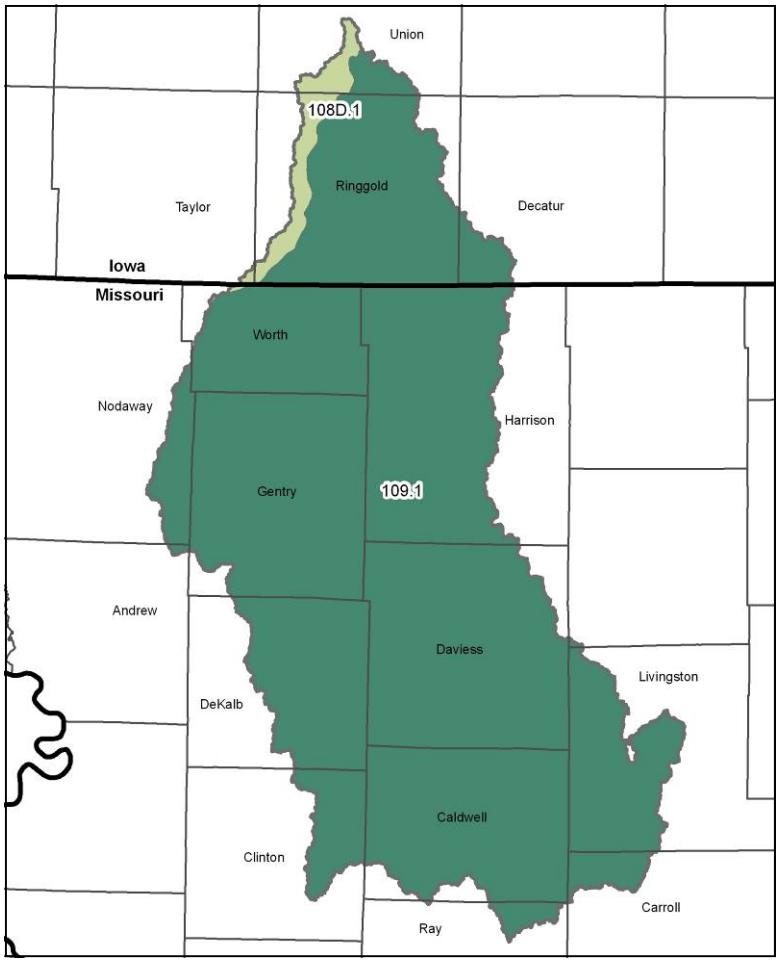
108D.1– Nodaway River Loess Hills and Till

The Nodaway River Loess Hills and Till CRA is gently undulating to hilly area incorporates a variety of landscapes but dominantly pre-Illinoisan glacial till with a thin cover of loess. Native vegetation was prairie and timber, spatially associated with the pattern of ridges and valleys. Most of this area is devoted to farming, with row crops on the smoother uplands and broad valley bottoms and with pastures and woodlands on sloping lands. Resource concerns are water erosion, nutrient management, and pasture and woodland management.

109.1– Grand River Hills

The Grand River Hills CRA is gently undulating to steep, dominantly pre-Illinoisan glacial till with a thin cover of loess. Native vegetation was prairie and timber, spatially associated with the pattern of ridges and valleys. The less sloping areas are in cropland, hayland and pasture. Corn and soybeans are the major cash crops. Pastures and woodlands dominate on the more sloping lands. Resource concerns are water erosion, nutrient management, pasture and woodland management and water quality.

Figure 6. Common Resource Areas

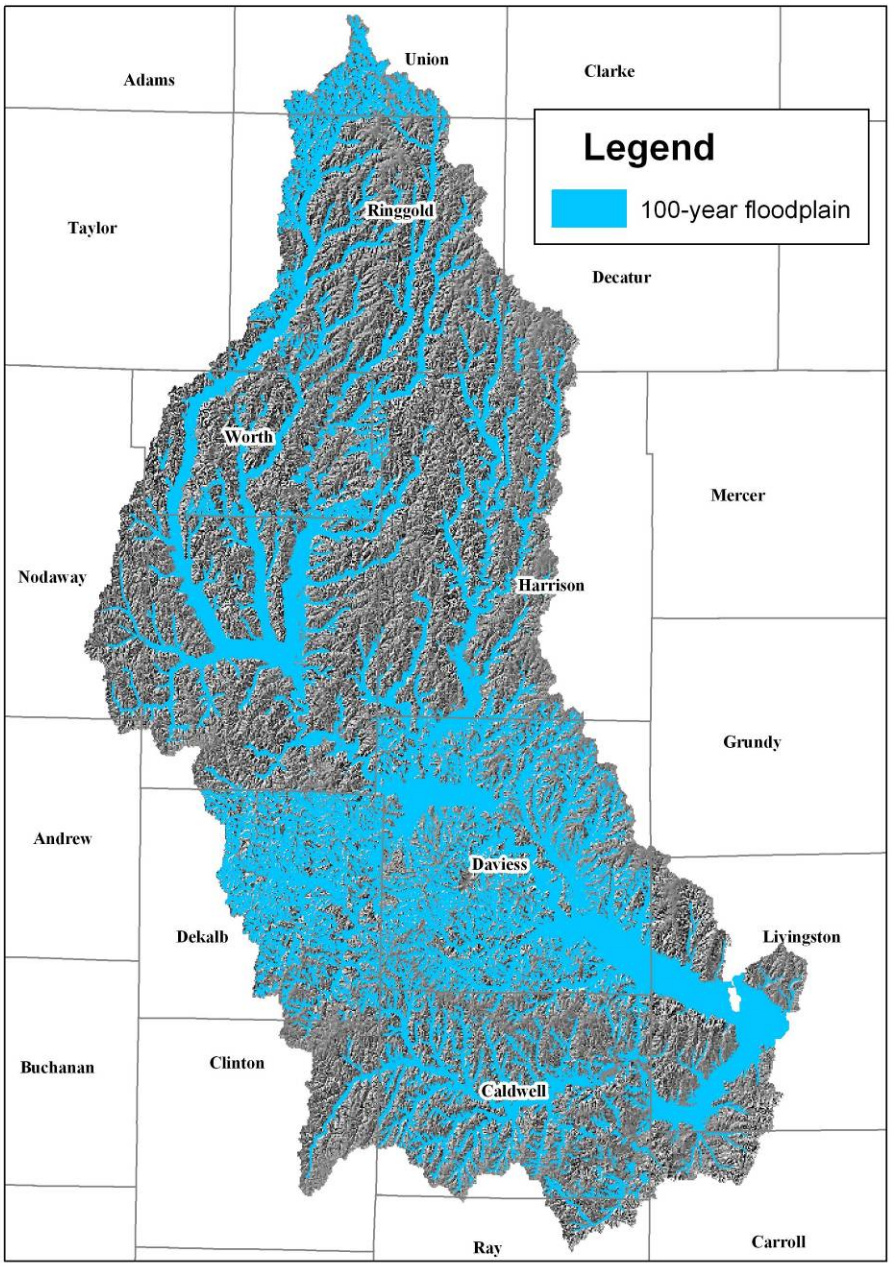


G. Streams

Floodplains[7]

The Federal Emergency Management Agency (FEMA) maps areas of flood vulnerability. FEMA has produced maps for 7 of the 17 counties in this sub-basin. For the remaining counties, the SSURGO soil attribute 'flooding frequency' was used. Flooding frequency documented a rare, occasional, frequent and very frequent cumulatively represent the 1% annual chance of flooding, or 100-year floodplain, as shown from the FEMA data. Using these combined methods, 419,425 acres (19.7%) of the sub-basin are in the 100-year floodplain.

Figure 7

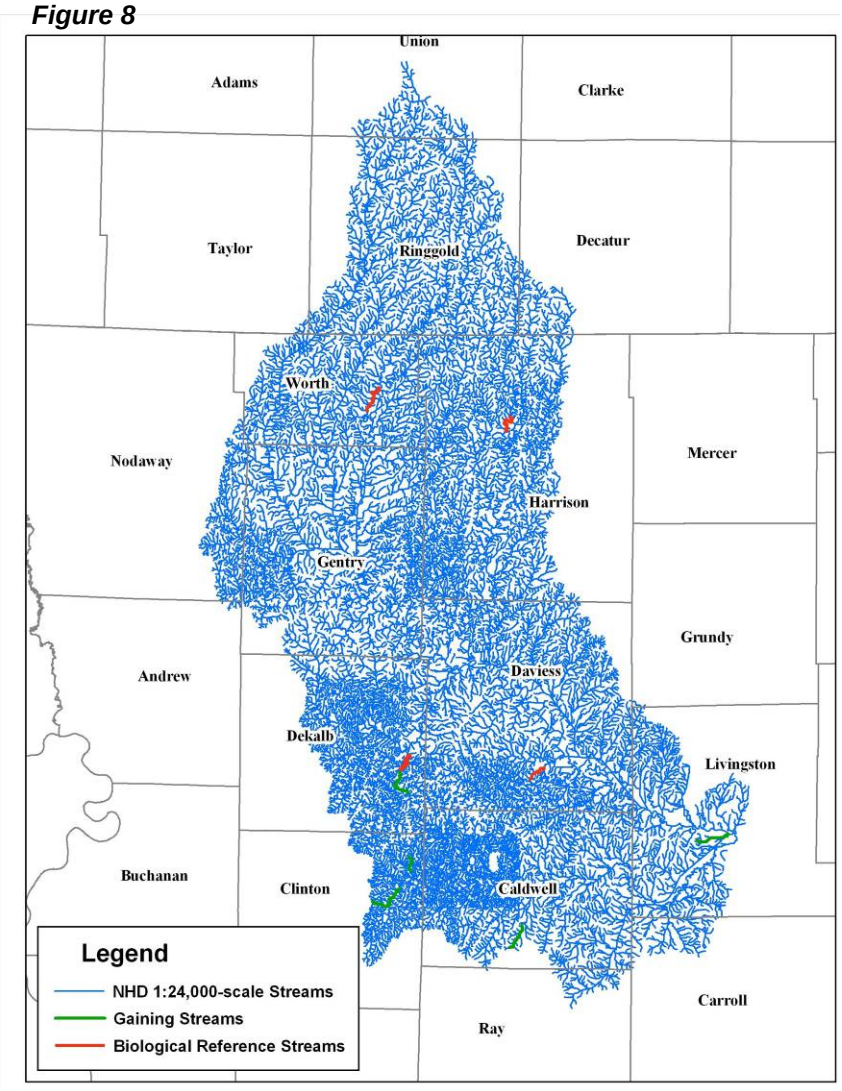


National Hydrography Dataset (NHD) with Gaining Streams and Biological Reference Streams [8 & 15]

High-resolution (1:24,000-scale) data from the National Hydrography Dataset show a total of 10,971 miles of intermittent and perennial streams in this sub-basin. Stream segments are classified 'gaining' or 'losing' by the Missouri Department of Natural Resources (MoDNR), Division of Geology and Land Survey (DGLS). The classification depicts sections of streams which are either losing water flow to the subsurface or gaining water flow from the subsurface, based on change in flow rate over a set distance. About 22.3 miles of Upper Grand sub-basin streams are considered gaining streams and there are no designated losing streams. MoDNR also designates biological reference streams for watersheds. Biological reference streams are segments of streams that represent the best stream conditions to support aquatic life for a given area. Stream segments, 3-5 miles in length, of the East Fork of the Grand River, Grindstone Creek, Marrowbone Creek and West Fork Big Creek are biological reference streams in this region.

Iowa Department of Natural Resources has not created data files directly analogous to the gaining/losing and biological reference streams data available for Missouri. A file mapping streams protected from channelization by Iowa law was consulted and no streams were indicated in this sub-basin.

Figure 8



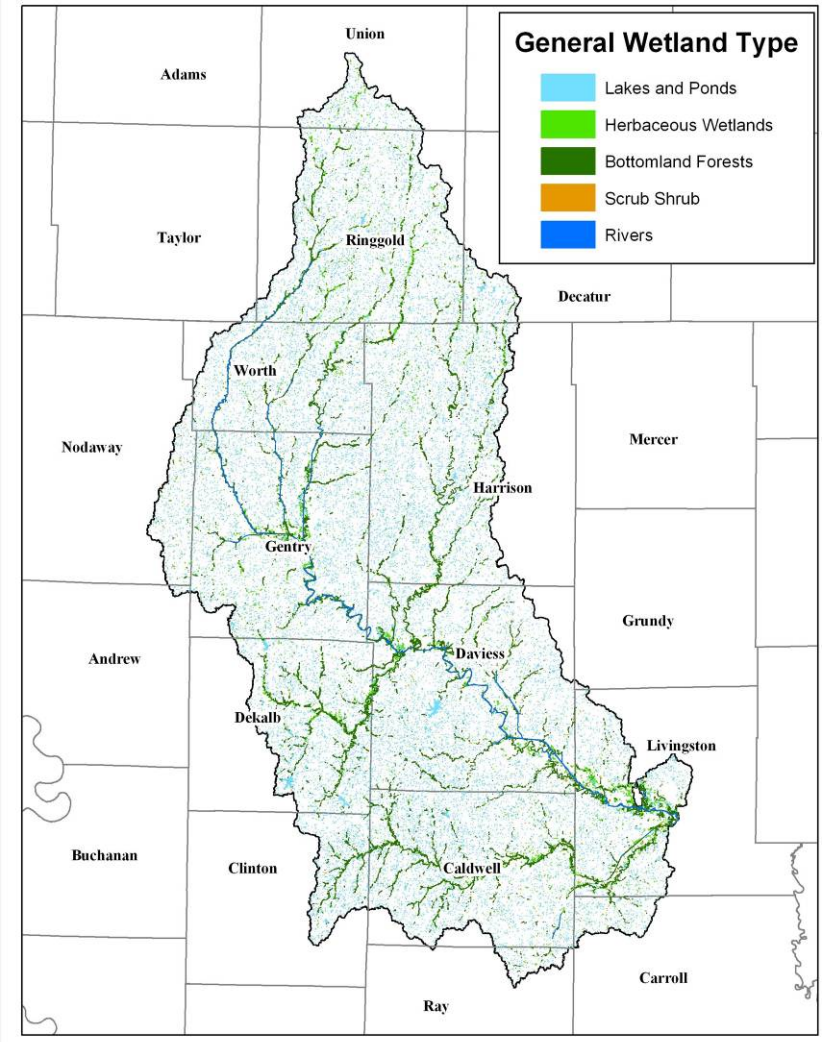
H. Wetlands[9,10]

Wetlands consist of land areas that are flooded or saturated by surface or ground water often enough to support plant and animal lifeforms that are adapted to wet environments.

The National Wetland Inventory (NWI) delineated wetlands from early 1980s aerial photography and classified wetlands using a wetland classification scheme developed by Cowardin, et al. About 62,031 acres of various wetland types were identified by NWI within the Upper Grand sub-basin.

Figure 9

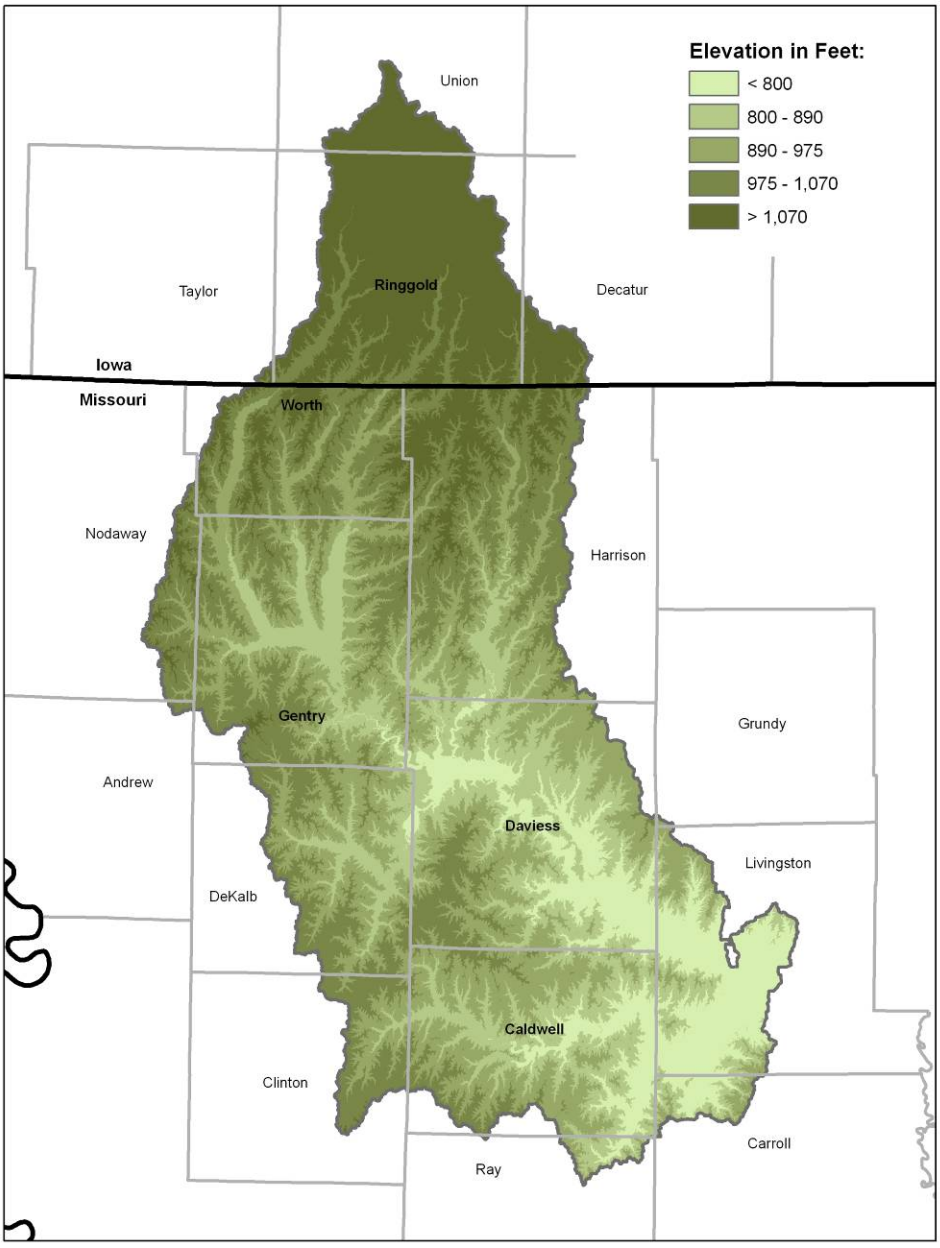
General Wetland Type	Acres	Percent of Sub-basin
Lakes and Ponds	18.030	0.85%
Herbaceous Wetlands	7,241	0.34%
Bottomland Forests	31,674	1.50%
Scrub Shrub	1,213	0.05%
Rivers	3,873	0.18%
Total	**62,031**	**2.92%**



I. Relief Map[1,11,12]

The shaded relief map of the Upper Grand sub-basin depicts elevations above sea level. The shaded relief and elevation values were derived from digital elevation models generated from U.S. Geological Survey 7.5 minute elevation contours. The area is primarily a dissected plain formed on glacial till with a thin cover of loess. Concentrated water flow erosion has dissected the land surface creating various degrees of roughness and relief. Elevations can range from 650 feet in the lowest valleys to over 1000 feet on the highest ridges. The sub-basin's local relief can vary from 2 to 10 feet on upland flats and valley bottoms and from 100 to 200 feet in the hilly uplands, rolling hills and dissected areas.

Figure 10



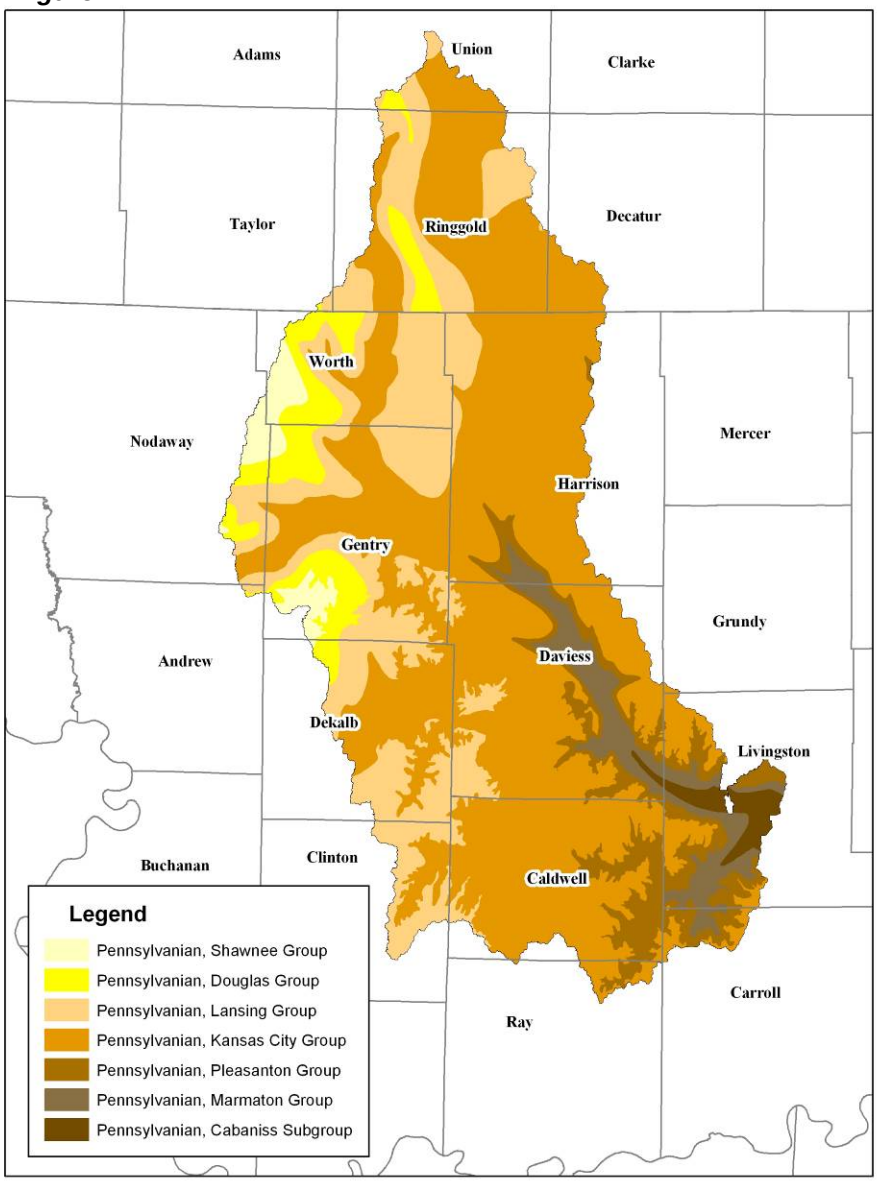
J. Geology[1,13,14,34,35]

Geology Map

This bedrock geology map is derived from the Bedrock Geology Maps of Missouri and Iowa. The Upper Grand River Sub-basin, like much of western and northern Missouri, is dominated by Pennsylvanian-age bedrock formations consisting of shales, sandstones, and limestones. These units dip northwesterly away from the Precambrian and Ordovician formations dominating the Ozarks. The entire sub-basin has been glaciated and the predominant soils are derived from glacial drift and loess.

Bedrock units in the Upper Grand River Sub-basin can be further divided into the following stratigraphic groups in descending order:

Figure 11



Pennsylvanian Sub-System

- Shawnee group – Characterized by an abundance and greater thickness of limestone members. Intervening members consist of shales, sandstones and thinner limestones.
- Douglas group – Consists predominantly of clastic materials which have formed sandstones and shales. Thin limestone members are sometimes present.
- Lansing group – Consists of alternating beds of limestone and shale. A channel-fill sandstone is sometimes present in the upper portion of the group.
- Kansas City Group—Consists of alternating beds of limestone and shale. Occasional beds of sandstone and thin coal beds can be present.
- Pleasanton Group—Consists predominately of clastic materials which have formed sandstones and shales. Thin beds of coal and conglomerate are sometimes present.
- Marmaton Group—Consists of a succession of shales, limestones, sandstones, clays and coal beds.
- Cherokee group (Cabaniss Subgroup) – Consists of cyclic deposits of sandstone, siltstone, shale, underclay, limestone and coal beds.

Karst features[15,35]

Karst topography is generally formed over carbonate bedrock such as limestone and dolomite by dissolving or solution. It is often characterized by sinkholes, caves, underground drainage and losing streams. The Upper Grand sub-basin is not a highly-developed karst region. Karst-indicating GIS data layers were consulted for the portions of Missouri and Iowa in the sub-basin; although of different format, neither showed much evidence of karst. Eighteen minor springs with flows less than 100 gallons per minute or unmeasured flows are mapped in Missouri. No sinkholes, caves or losing streams are identified. No features were mapped in the Iowa portion of the sub-basin.

Resource Concerns

Resource concerns are issues related to the natural environment. Natural resources include soil, water, air, plants, animals, and humans. Field office personnel of the USDA-Natural Resources Conservation Service were asked to complete inventory sheets in order to identify the 4 primary resource concerns for 5 landuse categories within the Upper Grand River Watershed (Hydrologic Unit 10280101). The identified concerns are: PASTURELAND - (1) soil erosion-classic gully; (2) plant condition-productivity, health, and vigor; (3) plant condition-forage quality and palatability; (4) domestic animals-inadequate stock water. CULTIVATED CROPLAND - (1) soil erosion-sheet and rill; (2) soil erosion-ephemeral gully; (3) water quality-excessive nutrients and organics in surface water; (4) water quality-excessive suspended sediment and turbidity in surface water. DEVELOPED LAND - (1) soil erosion-classic gully; (2) soil erosion-road, roadsides, and construction sites; (3) soil condition-compaction; (4) soil condition-damage from sediment deposition. FOR-ESTLAND - (1) soil erosion-classic gully; (2) soil erosion-streambank; (3) plants not adapted or suited; (4) plant condition-productivity, health, and vigor. NON-CULTIVATED CROPLAND - (1) soil erosion-sheet and rill; (2) plant condition-productivity, health, and vigor; (3) plant condition-forage quality and palatability; (4) domestic animals-inadequate quantities and quality of feed and forage.

Figure 12

Resource Concerns/Issues by Land Use

Soil, Water, Air, Plant, Animal, plus Human (SWAPA+H) Concerns	Specific Resource Concern/Issue	Pasture/Grass	Cropland	Non-Cultivated Cropland	Forestland	Urban	Floodplain	Developed Land	Water
Soil Erosion	55% of all cropland eroding at levels above "T"		X	X					
	Erosion on streambanks and streambeds	X	X		X	X	X		
	Erosion and runoff from construction sites					X			
	Erosion from ephemeral gullies		X						
	Erosion from classical gullies	X			X	X		X	
Sedimentation	Damage to waterbodies, increased flooding					X	X		X
Prime Farmland	2,500 acres lost between 1982 and 1997	X	X		X		X		
Soil Quality	Degradation of soil quality		X			X			
Water Quality	Cultivated cropland primary nonpoint source of pollutants		X						X
	Certain waterbodies are not meeting water quality standards								X
Floodplains	Nearly 420,000 acres fall within the 100-year flood area						X		
Riparian Corridors	39% of riparian zones unprotected or vulnerable	X	X			X	X		

Soil Erosion

- Streambank, streambed, and classical gully erosion occurs in pasture/grassland, cropland, forestland, and urban areas. However, due to a lack of reliable data at the sub-basin (8-digit hydrologic unit) level, the degree and amount of soil loss from these sources is not known.
- Ephemeral gully erosion occurs primarily on cultivated cropland eroding at levels above the tolerable limit ("T"). No sub-basin level data are available to determine the degree and extent.
- An estimated 55 percent (361,700 acres) of all cultivated cropland is eroding at levels above "T".
- The estimated USLE soil loss on highly erodible, cultivated cropland (eroding above "T") is 16.9 tons/acre/year.
- Erosion and runoff is occurring from construction sites primarily found in and near urban areas.

Sedimentation

- Excessive sedimentation can reduce the useful life of ponds, lakes, reservoirs, and wetlands and can increase the severity and frequency of flooding by reducing the water carrying capacity of streams and rivers.

Soil Quality

- Excessive soil erosion is a primary contributor to soil quality degradation. This limits the productivity and sustainability of the soil resource.

Water Quality

- Highly erodible and cultivated croplands with USLE soil losses above tolerable limits ("T") are a primary non-point source of sediment, nitrogen, and phosphorus pollutants that enter the stream system.
- Seven waterbodies within the sub-basin appear on the 303(d) list and are not meeting water quality standards. Pollutants listed include atrazine, biological, bacteria, ammonia, and low dissolved oxygen.

Floodplains

- An estimated 419,425 acres fall within the 100-year return period flood area. This can result in damages to crops, pastures, and other resources, as well as damages to roads, bridges, and buildings.

Riparian Corridors

- The data suggest that about 39 percent of the riparian corridors, primarily in cropland, pasture/grass, and urban areas, are unprotected or vulnerable. Protected riparian corridors can act as filters to trap nutrients, sediment, and other pollutants.

A. Soils

The upland soils of this sub-basin formed in loess (silty wind blown deposits) of variable thickness and the underlying glacial till. These soils are typically very deep and range from well drained to somewhat poorly drained. Most of the soils in the area formed under prairie vegetation and as a result have a thick, dark surface layer.

The loess deposits tend to be thickest on the gently sloping upland divides. Soils there formed entirely in loess. As the slope increases on the adjacent side slopes, the loess deposits are thinner and the soils formed in a combination of loess in the upper part and pedisediment and glacial till in the lower part. On the steeper lower slopes the soils formed mainly in glacial till. In a few areas, the underlying Pennsylvanian age shale and limestone are exposed. The soils in these areas tend to be clayey and contain fragments of the underlying bedrock.

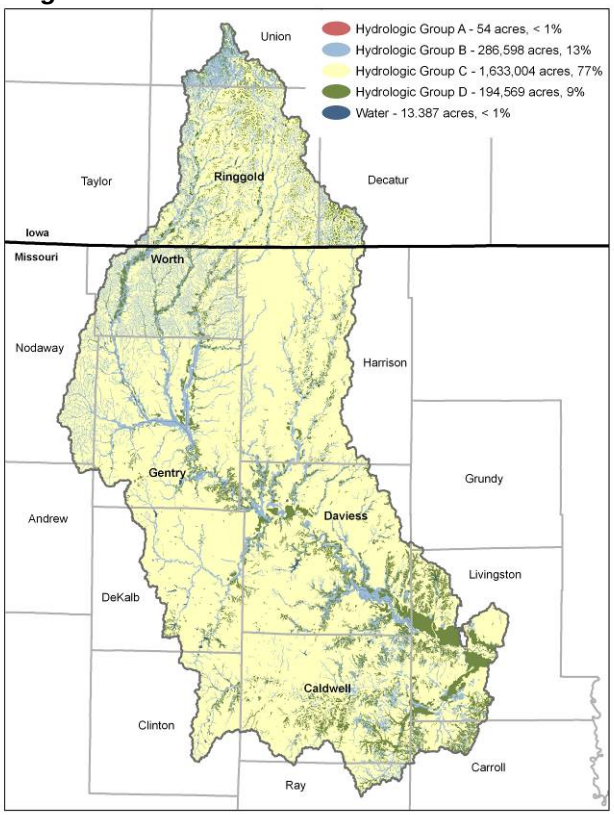
The floodplain soils along the tributaries of the Missouri River formed in alluvium washed mainly from the adjacent uplands. Typically, the soils along the main channels tend to have coarser textures and are well or moderately well drained. Soils in the slack water areas adjacent to the uplands generally are clayey and poorly drained. The broad transitional areas are intermediate in texture and drainage.

Hydrologic Soil Groups[5]

In addition to the sub-basin-wide NRI erosion estimates, a spatial assessment of erosion potential was implemented using SSURGO soils data and land cover. The acres most in need of conservation practices (acres with the highest potential for sediment loss, if cropped) have been targeted based on a major finding from model simulations of soil loss outcomes reported by the NRI-Conservation Effects Assessment Project (CEAP), (NRCS, 2006): ***Hydrologic soil group and soil texture account for a large part of the variability in the loss of sediment, nitrogen and phosphorus from field to field.*** Based on average per acre sediment loss rates by hydrologic soil groups and soil texture groups reported in the CEAP study, each hydrologic soil group was divided into three classes of sediment loss potential: (1) higher average, (2) moderate average and (3) lower average.

The amount of sediment loss from sheet and rill erosion is determined by the amount of precipitation, tillage practices, soil characteristics and the presence or absence of conservation practices and can vary considerably from field to field. A significant portion of this variability can be accounted for by hydrologic soil groups (HSG) and soil texture differences within the hydrologic groups. This map shows the spatial distribution of hydrologic soil groups A,B,C and D.

Figure 13



Sediment Loss Potential on Hydrologic Soil Group A (if used for cropland)

The lowest sediment losses can be expected on these well-drained soils with high infiltration rates. They represent a very small percentage of a sub-basin and a small percentage of cropland acres. The lower average loss rate category is defined using the moderately coarse and coarse texture groups.

Sediment Loss Potential on Hydrologic Soil Group B (if used for cropland)

Acreages for this hydrologic soil group are typically high with a large number of cropland acres. Acres with the highest potential for sediment loss are defined by medium and fine soil texture groups. Soils with a medium average sediment loss potential are represented by moderately coarse and moderately fine textured soils. Coarse textured soils in hydrologic soil group B dominate the areas with the lowest average sediment loss rate potential. Average soil loss rates for all texture groups will tend to be at or below the average for the sub-basin.

Sediment Loss Potential on Hydrologic Soil Group C (if used for cropland)

This is the largest hydrologic soil group in the sub-basin with a large cropland acreage. Higher average sediment loss rates are reflected in the medium texture soil group. The moderate average sediment loss rate category is made up of the coarse and moderately coarse and fine and moderately fine soil texture groups. Average soil loss rates for all the texture groups will tend to exceed the average for the sub-basin.

Sediment Loss Potential on Hydrologic Soil Group D (if used for cropland)

This is the second smallest hydrologic soil group in the sub-basin but it is dominated by cropland. The higher average sediment loss rates are on the medium textured soils and the moderate average sediment loss rates are produced by the fine and moderately fine soil texture groups. The coarse and moderately coarse soil texture groups generate the lower average sediment loss rates.

Acres of Cultivated Cropland on Soils with the Highest Sediment Loss Potential[5]

This map is a composite of the acres that have the highest soil loss potential in each hydrologic soil group. The qualifying soils in each hydrologic soil group are: Group A (no qualifying soils);Group B medium and fine textured soils); Group C medium textured soils); and Group D (medium textured soils). The salmon colored areas are currently under cultivation and represent the acres that could benefit the most from the application of conservation practices, if not already implemented.

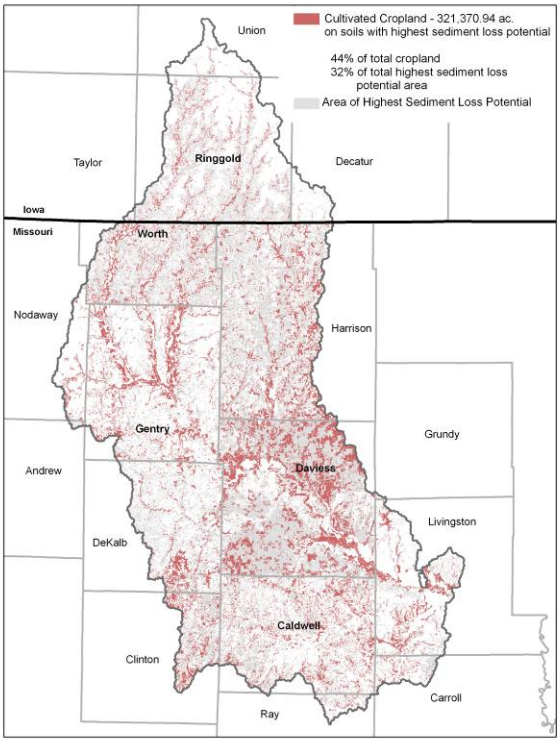
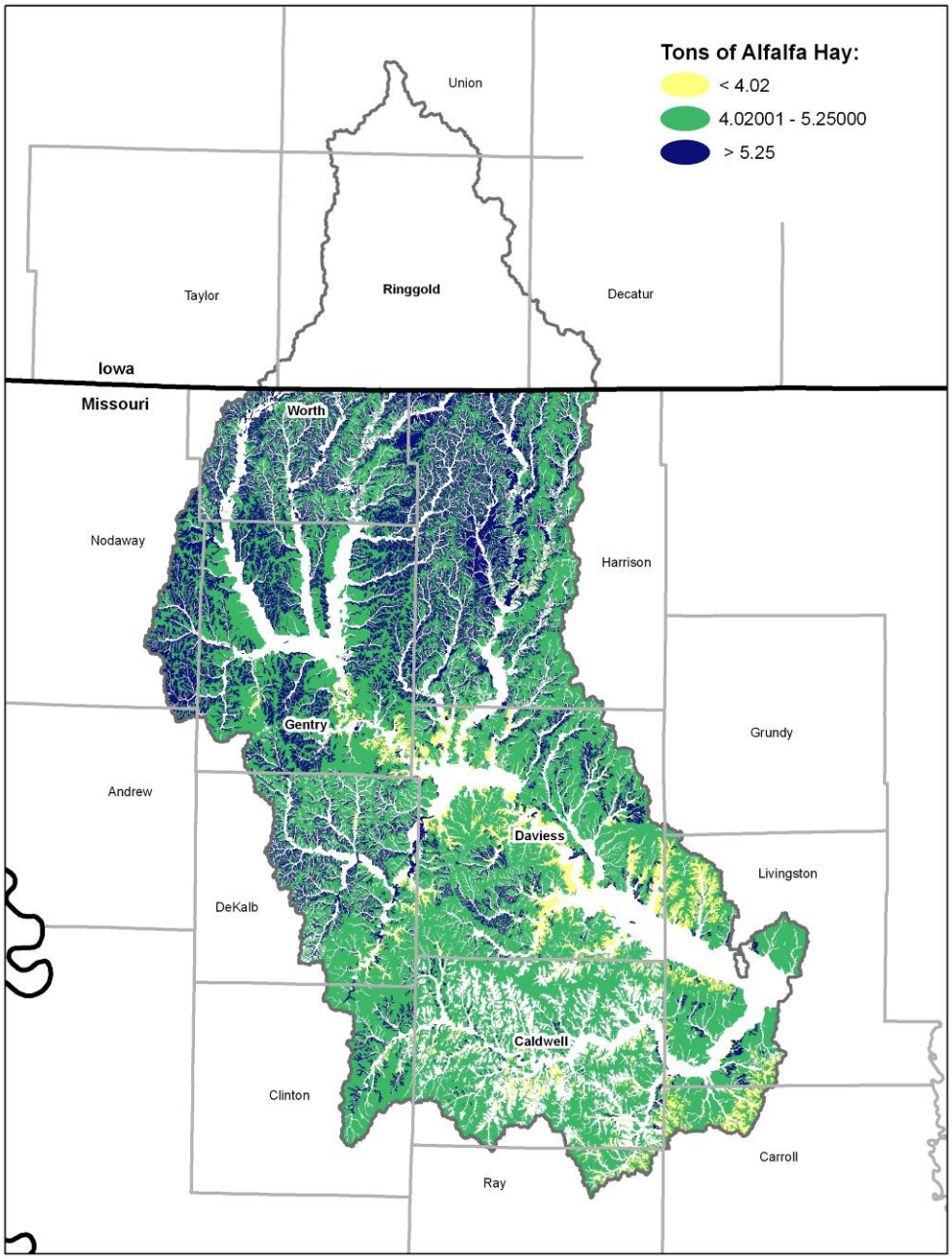


Figure 14

Pasture Productivity[5,30]

“Alfalfa is the most productive legume for Missouri, with potential yields exceeding six tons of hay per acre on good soils. Unlike red or white clover, established alfalfa is productive during midsummer except during extreme drought. Alfalfa is a tap-rooted crop and can last five years and longer under proper management. Whether grazed or fed as hay, alfalfa is an excellent forage for cattle and horses. Alfalfa is best adapted to deep, fertile, well-drained soils with a salt pH of 6.0 to 6.5, but it can be grown with conservative management on more marginal soils.”

Figure 15

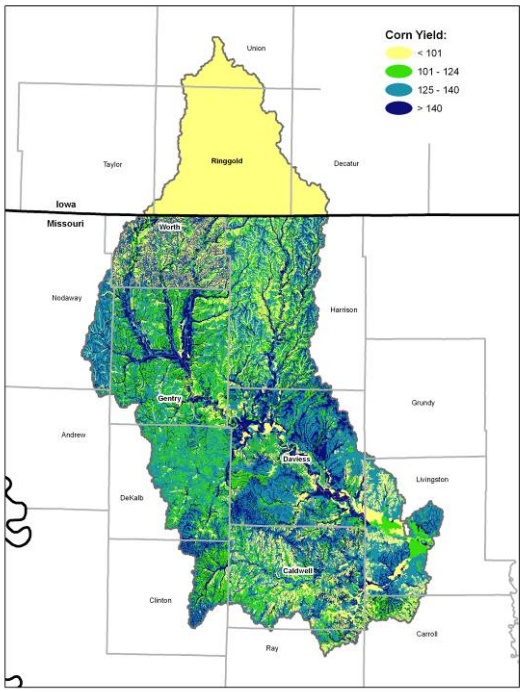


Soil Productivity[5]

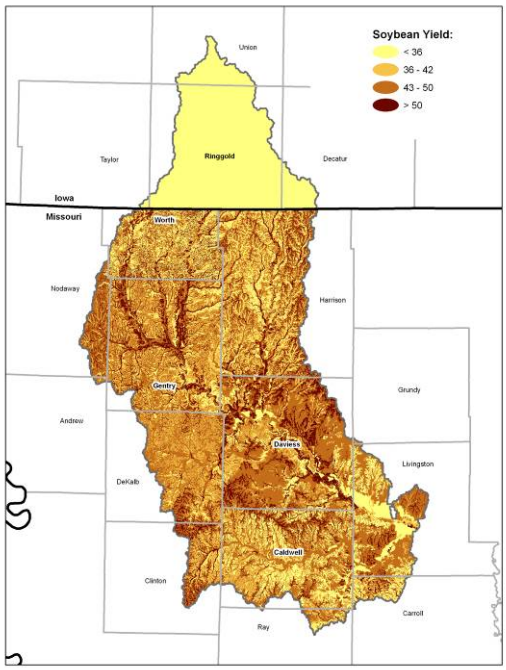
Yield estimates were developed using Missouri's Productivity Index (PI). The PI is a method developed by soil scientists that "automatically" evaluates specific soil properties directly related to plant growth. The soil properties used are a record of many years of soil survey data stored in USDA's National Soils Information System (NASIS) . The properties include: nutrient- supplying power (Organic matter, cation exchange capacity and pH), root penetration (depth to barriers, retarding layers, etc.), wetness effects (depth to seasonal high water table), available water capacity, surface restrictions (rocks, clayey, etc.), flooding restrictions (frequency), phase restrictions (gullied, channeled), slope restrictions and climate.

Figure 16

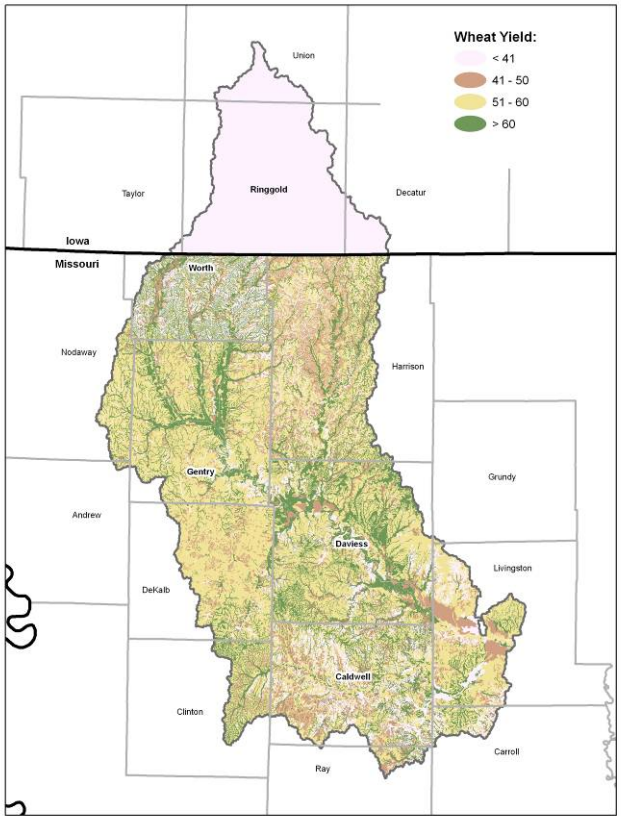
Corn Yield Estimates (bushels per acre)



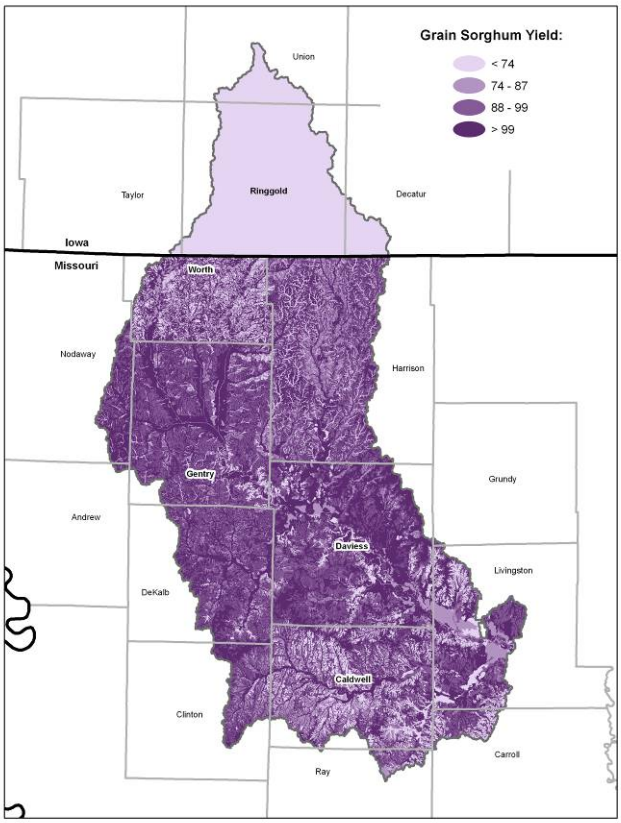
Soybean Yield Estimates (bushels per acre)



Wheat Yield Estimates (bushels per acre)



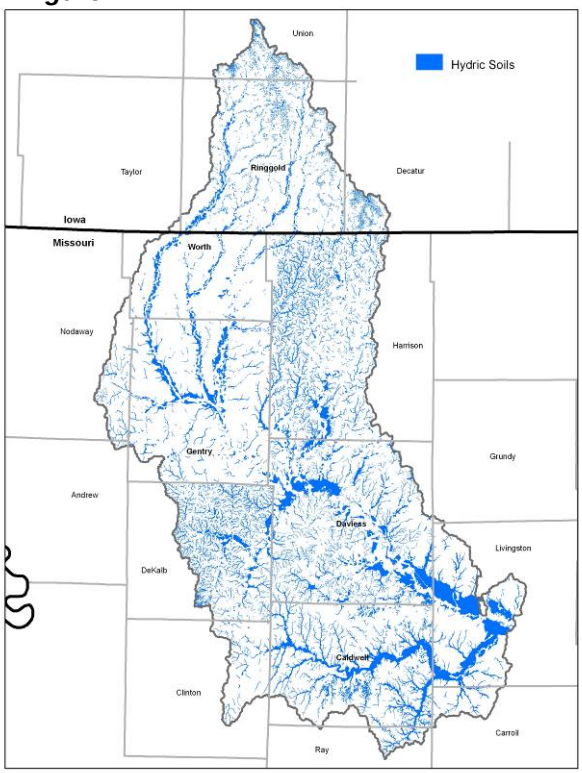
Grain SorghumYield Estimates (bushels per acre)



Hydric Soils[5]

Hydric soils are those that developed under sufficiently wet conditions (saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions) to support the growth and regeneration of hydrophytic (water-loving) vegetation. Soils that are sufficiently wet because of artificial measures are included in hydric soils.

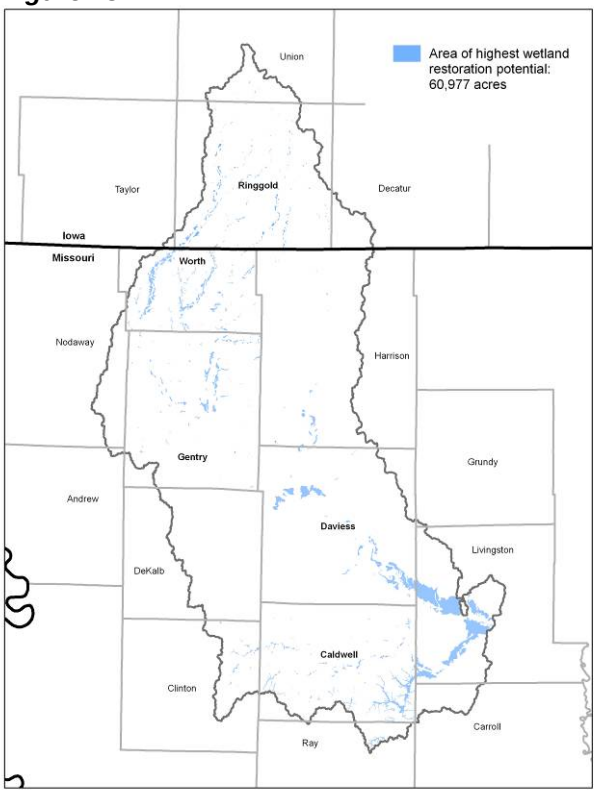
Figure 17



Wetland Restoration Potential[5]

Soils with the greatest potential for wetland restoration are located on flood plains, have a high runoff potential when thoroughly wet. Typically, they have greater than 40 percent clay, less than 50 percent sand, and have clayey textures. In some areas, they also have high shrink-swell potential.

Figure 18



B. Soil Erosion[16]

The objectives of this section are to profile cropland erosion rates and identify cropland areas within the Upper Grand sub-basin that would benefit the most from the application of conservation practices to limit sediment loss.

"**The production practices and inputs used by agriculture can result in a number of pollutants entering water resources, including sediment, nutrients, pathogens, pesticides and salts." (USDA-Economic Research Service).**

"Sediment is the largest contaminant of surface water in the United States by weight and volume (Koltun et al., 1997) and the second leading pollution problem in rivers and streams and third leading problem in lakes" (USEPA, 2002).

Sediment losses from soil erosion on cropland, streambanks and streambeds and runoff from construction sites and developed land are an ongoing resource concern throughout the Upper Grand sub-basin. Cultivated cropland is the primary nonpoint source of sediment loss in this heavily cropped sub-basin and accounts for 32 percent of the sub-basin's total surface area. In sub-basins like the Upper Grand throughout the Upper Midwest Region, the acres most in need of conservation treatment are those with waterborne sediment, nitrogen and phosphorus losses.

The consequences of excessive soil erosion are well known. Waterborne sediments are inextricably linked to degraded water quality through turbidity and loss of fertilizers and pesticides attached to soil particles. Suspended sediments degrade aquatic habitats, increase water treatment costs and marginalize water recreation. Sedimentation reduces the useful life of ponds, lakes and reservoirs; increases the probability and severity of flooding; and clogs drainage networks. Excessive soil erosion is a primary contributor to soil quality degradation, limiting the productivity and sustainability of the soil.

This assessment concentrates on sheet and rill erosion on cropland for which there are scientifically based soil erosion estimates for the entire sub-basin. This focus does not suggest that sedimentation related to urban stormwater runoff, stream bank erosion, classical gully erosion and ephemeral gully erosion on cropland is not significant in volume or impact. However, there is a lack of reliable data at the sub-basin level for these other sources of sediment. The erosion rate data have been extracted from the 1997 National Resources Inventory (NRI). Erosion rates and their relationship to "T" values are reported in tons/acre/year for cultivated cropland and non-cultivated cropland on highly erodible and non-highly erodible land. Also included are erosion rates and their relationship to "T" values for pastureland.

Universal Soil Loss Equation (USLE) Cropland Erosion Rates in Tons/Acre/Year[2]

USLE - This table reports estimated soil loss rates from the 1997 NRI based on the Universal Soil Loss Equation (USLE). USLE estimates average annual sheet and rill soil movement down a uniform slope using rainfall energy as the erosive force acting on the soil. Soil characteristics and slope for the fields in which the NRI sample points fall or those portions of the fields surrounding the points that would be considered in conservation planning are used in the NRI USLE calculations.

"T" FACTOR – This is the maximum rate of annual soil erosion that will still permit crop productivity to be sustained economically and indefinitely.

HEL – Highly erodible land (HEL) is land that has an erodiblity index (EI) value of 8 or more. The EI index provides a numerical expression of the potential for a soil to erode, considering the physical and chemical properties of the soil and climatic conditions where it occurs. The higher the index value, the greater the investment needed to maintain the sustainability of the soil if intensively cropped.

Figure 19

USLE Cropland Erosion Rates Tons/Acre/Year[2]

CROPLAND CATEGORY	CULTIVATED CROPLAND	NON-CULTIVATED CROPLAND
HIGHLY ERODIBLE LAND (HEL)		
HEL Eroding at or below "T"	2.09	0.77
HEL Eroding above "T"	16.93	3.93
All HEL	15.63	0.79
NON-HIGHLY ERODIBLE LAND (Non-HEL)		
Non-HEL Eroding at or below "T"	2.45	0.08
Non-HEL Eroding above "T"	5.59	0
All Non-HEL	2.73	0.08
ALL CROPLAND		
All Land Eroding at or below "T"	2.41	0.66
All Land Eroding above "T"	3.93	3.93
All Land	9.97	0.68

Cropland Erosion in Relationship to "T"[2]

This table reports acres and percentages of cultivated cropland, non-cultivated cropland and all cropland by HEL and "T" categories for the sub-basin.

Cultivated Cropland

CROPLAND CATEGORY	Total Acres	% of Cropland Category	% of all Cropland	% of Sub-basin
HEL				
Highly Erodible Cropland at or below "T"	32,400	9%	100%	2%
Highly Erodible Cropland above "T"	335,100	91%	100%	16%
TOTALS FOR HIGHLY ERODIBLE CROPLAND	**367,500**	**100%**	**100%**	**18%**
NON-HEL				
Non-Highly Erodible Cropland at or below "T"	261,500	91%	100%	13%
Non-Highly Erodible Cropland above "T"	25,400	9%	100%	1%
TOTALS FOR NON-HIGHLY ERODIBLE CROPLAND	**286,900**	**100%**	**100%**	**14%**
GRAND TOTALS	**654,400**	**100%**	**100%**	**32%**

Non-Cultivated Cropland

CROPLAND CATEGORY	Total Acres	% of Cropland Category	% of all Cropland	% of Sub-basin
HEL				
Highly Erodible Cropland at or below "T"	160,700	99%	100%	8%
Highly Erodible Cropland above "T"	1,200	1%	100%	<1%
TOTALS FOR HIGHLY ERODIBLE CROPLAND	**161,900**	**100%**	**100%**	**8%**
NON-HEL				
Non-Highly Erodible Cropland at or below "T"	29,700	100%	100%	1%
Non-Highly Erodible Cropland above "T"	0	0%	0%	0%
TOTALS FOR NON-HIGHLY ERODIBLE CROPLAND	**29,700**	**100%**	**100%**	**1%**
GRAND TOTALS	**191,600**	**100%**	**100%**	**9%**

All Cropland

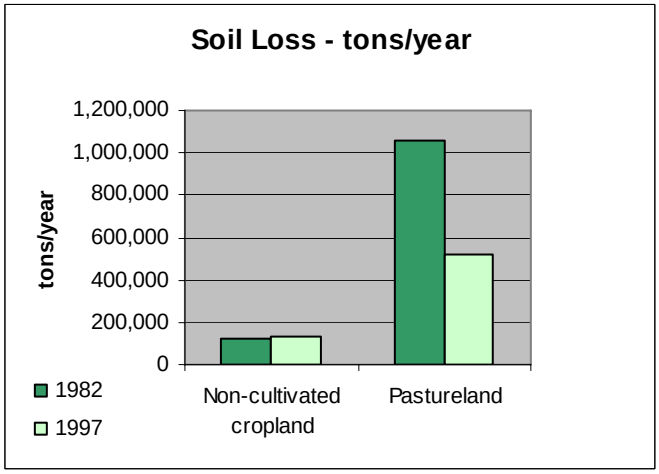
CROPLAND CATEGORY	Total Acres	% of Cropland Category	% of all Cropland	% of Sub-basin
HEL				
Highly Erodible Cropland at or below "T"	193,100	36%	100%	9%
Highly Erodible Cropland above "T"	336,300	64%	100%	16%
TOTALS FOR HIGHLY ERODIBLE CROPLAND	**529,400**	**100%**	**100%**	**25%**
NON-HEL				
Non-Highly Erodible Cropland at or below "T"	291,200	92%	100%	14%
Non-Highly Erodible Cropland above "T"	25,400	8%	100%	1%
TOTALS FOR NON-HIGHLY ERODIBLE CROPLAND	**316,600**	**100%**	**100%**	**15%**
GRAND TOTALS	**846,000**	**100%**	**100%**	**40%**

Pastureland Erosion[2]

This table reports USLE rates and acres in relationship to “T” for pastureland (tons/acre/year).

PASTURELAND CATEGORY	Total Acres	% of Category	USLE tons/acre/year	% of Sub-basin
HEL				
Highly Erodible Cropland at or below "T"	0	0%	0	0%
Highly Erodible Cropland above "T"	0	0%	0	0%
TOTALS FOR HIGHLY ERODIBLE CROPLAND	**0**	**00%**	**0**	**0%**
NON-HEL				
Non-Highly Erodible Cropland at or below "T"	530,300	97%	0.76	26%
Non-Highly Erodible Cropland above "T"	18,100	3%	6.3	1%
TOTALS FOR NON-HIGHLY ERODIBLE CROPLAND	**548,400**	**100%**	**0.94**	**27%**
GRAND TOTALS	**548,400**	**100%**	**0.94**	**27%**

USLE Soil Loss Rates (tons/year)[2]



Non-cultivated Cropland

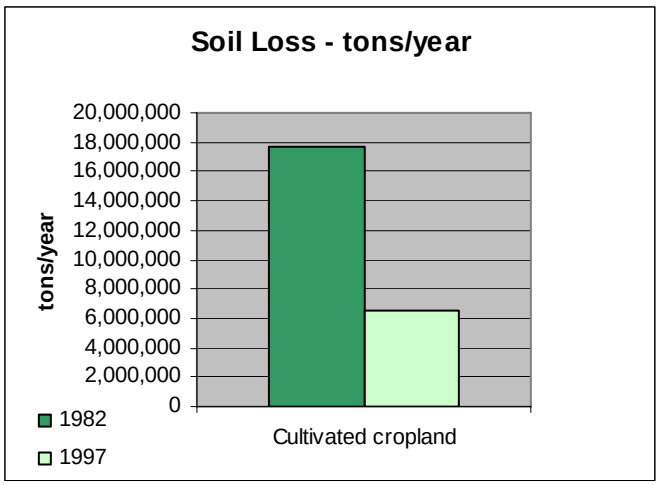
1982 120,200 tons per acre

1997 130,800 tons per acre

Pastureland

1982 1,058,200 tons per acre

1997 518,200 tons per acre



Cultivated Cropland

1982 17,629,100 tons per acre

1997 6,528,700 tons per acre

C. Water Quality

303d Listed Waters[17]

Section 303(d) of the federal Clean Water Act requires that each state identify waters that are not meeting water quality standards and for which adequate water pollution controls have not been required. Water quality standards protect such beneficial uses of water as whole body contact and secondary contact recreation, maintaining fish and other aquatic life, and providing drinking and processing water for people, wildlife, livestock and industry. The 303(d) list helps state and federal agencies keep track of waters that are impaired but not addressed by normal water pollution control programs.

Figure 20

Water Body	County, State	Pollutant	Impaired Use(s)*	Other Designated Uses*
Big Creek	Harrison, MO	Ammonia, Low Dissolved Oxygen	AQL	FC,LWW,WBC,DWS
East Fork Grand River	Gentry, MO	Bacteria	WBC	FC,AQL,LWW,DWS,IRR
Home Pond	Decatur, IA	Atrazine	DWS	**
Loch Ayr	Ringgold, IA	Atrazine	DWS	**
Lotts Creek	Ringgold, IA	Biological	AQL	**
Middle Fork Grand River	Gentry, MO	Bacteria	WBC	AQL,FC,SCR,IRR,LWW
Middle Fork Grand River	Ringgold, IA	Biological	AQL	**

*** Impaired and Other Designated Uses:**

AQL Protection of Aquatic Life (Warm, Cool or Cold Water)
FC Fish Consumption
WBC Whole Body Contact
SCR Secondary Contact Reaction
DWS Drinking Water Supply
IRR Irrigation
LWW Livestock and Wildlife Watering
IND Industrial
GRR Ground Water Recharge

** Data not available

Riparian Corridor Condition[8,18]

The condition of the riparian zone adjacent to streams has a critical impact on water quality. Permanent and deeply-rooted streambank vegetation slows run-off of nutrients and pollutants, and reduces sedimentation and solar heating. NRCS riparian practice standards specify 50-feet vegetated buffers along first and second order streams and 100-feet for third order and higher streams.

The 1:24,000 National Hydrologic Dataset (NHD) stream network is the highest resolution stream representation available consistently for the sub-basin states. Stream order is not an attribute of these data; therefore, the streams were all buffered by 50-feet to give the most conservative representation of riparian condition. Buffered streams were used to subset the common land unit (CLU) data, land parcel data developed and maintained by the USDA-Farm Service Agency. The land cover attribute in the CLU was used to characterize the vegetative condition of the buffers. Cropland (which includes pasture and hayland), urban, mined and barren cover types were considered "unprotected" or vulnerable riparian conditions, while forestland, rangeland and water were considered "protected". Results are presented by county and sub-basin in the table and map.

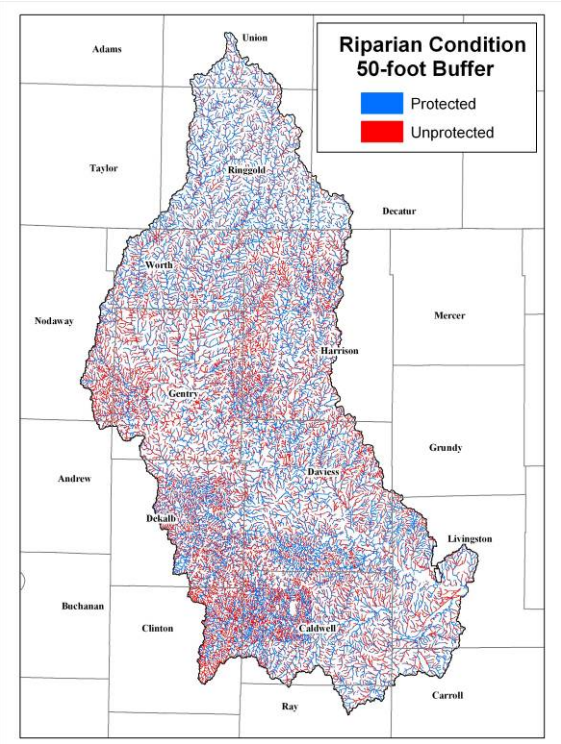


Figure 21

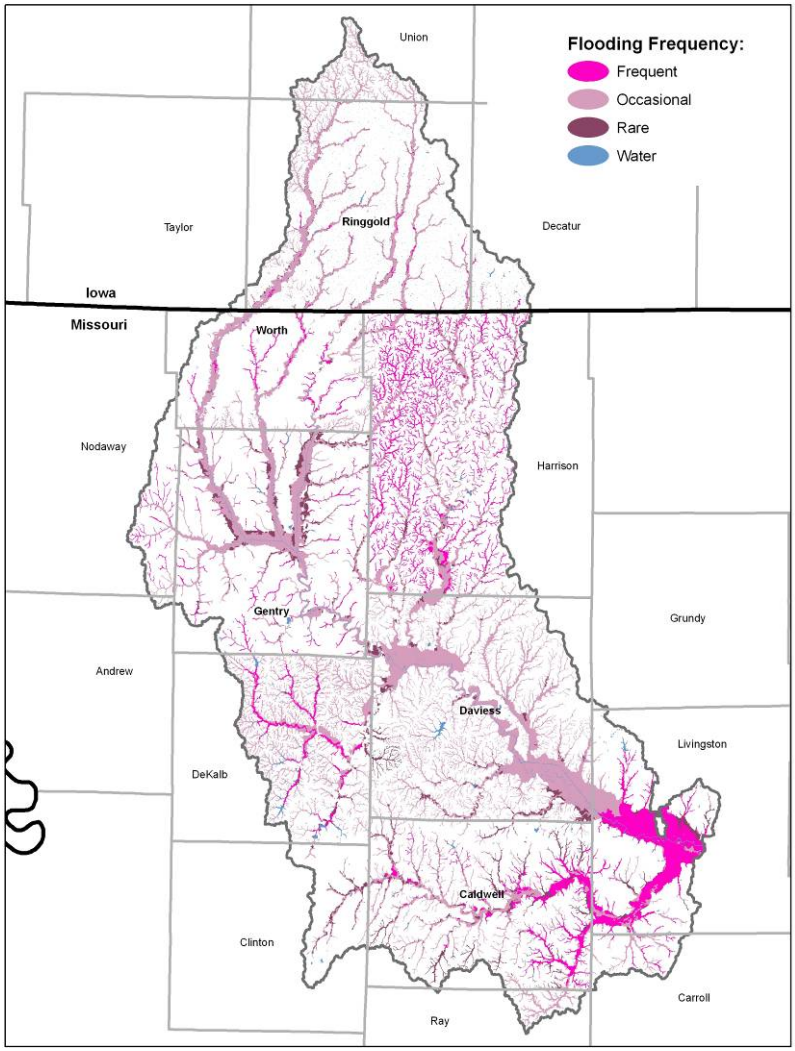
County, State	Stream Miles (in sub-basin)	50-ft. Stream Buffer (in acres)	Percent Protected
Andrew, Missouri	5	64	43%
Caldwell, Missouri	1,524	17,676	64%
Carroll, Missouri	85	1,017	60%
Clinton, Missouri	435	5,150	43%
Daviess, Missouri	1,807	21,458	63%
Decatur, Iowa	92	944	81%
DeKalb, Missouri	1,064	12,638	65%
Gentry, Missouri	1,446	16,336	54%
Grundy, Missouri	2	28	4%
Harrison, Missouri	1,567	18,429	54%
Livingston, Missouri	603	6,946	62%
Nodaway, Missouri	235	2,807	43%
Ray, Missouri	58	622	66%
Ringgold, Iowa	1,134	12,904	76%
Taylor, Iowa	6	66	94%
Union, Iowa	127	1,452	72%
Worth, Missouri	780	9,216	70%
Total in Sub-basin	**10,970**	**127,753**	**61%**

Flooding Frequency[5]

Flooding frequencies are defined by the number of times flooding occurs over a period of time and expressed as a class. The classes of flooding are defined as follows:

- Rare—Flooding unlikely but possible under unusual weather conditions; 1 to 5 percent chance of flooding in any year or nearly 1 to 5 times in 100 years
- Occasional—Flooding is expected infrequently under usual weather conditions; 5 to 50 percent chance of flooding in any year or 5 to 50 times in 100 years.
- Frequent—Flooding is likely to occur often under usual weather conditions; more than a 50 percent chance of flooding in any year or more than 50 times in 100 years, but less than a 50 percent chance of flooding in all months in any year.

Figure 22



D. Water Quantity

Public Water Supply[20,21,22,23]

Missouri's 5.8 million residents draw their water supplies from ground and surface sources that vary tremendously in both quality and quantity. These variations are, to a large extent, controlled by geology and land use. North of the Missouri River, herbicides, sediments, and nutrients are the primary concerns in surface water sources while well sources contend with heavy mineralization, nitrates, and pesticides. In the Ozark Highlands, ground water, the primary water supply source, is vulnerable to aquifer degradation from contaminated surface runoff and leachates through highly permeable soils and bedrock. Missouri's alluvial aquifers supply large quantities of high quality water, primarily to population centers located near the larger rivers and the Mississippi embayment covering most of the southeastern corner of the state. Shallow wells are vulnerable to nitrate and pesticide contamination and the deeper wills in highly urbanized areas are at risk from a wide variety of chemical pollutants.

Detailed information is available for individual public drinking supply systems and the spatial distribution of other drinking water supply features (wells, intakes, tanks, treatment plants, pumping stations, springs, and lakes) from MDNR. The 2006 Missouri Water Quality Report provides current water quality assessments and summarizes water quality issues around the state. The 2007 Census of Missouri Public Water Systems is a comprehensive description of city, water district, subdivision, and non-community water systems including type of treatment processes and chemical analyses of community water systems. The 2005 Missouri Water Supply Study provides detailed technical hydrologic and water resource engineering data for drought planning for 34 community water systems in north and west central Missouri.

Waste Water Treatment Facilities and Concentrated Animal Feeding Operations[19,36]

The National Pollutant Discharge Eliminations System (NPDES) facilities database is a point data set depicting outfall locations of waste water facilities requiring and holding NPDES operating permits. One type of NDPES facility is a concentrated animal feeding operation, or CAFO. A CAFO is defined as having more than 7000 animal units confined in an area with less than 50% vegetation ground cover. Smaller animal unit operations may be designated a CAFO if they discharge directly into waters of the State or have a post history of discharge violations. The animal unit is a unit of measurement to compare waste produced by various animal types, using one beef feeder as a reference.

The data sets covering this sub-basin differed between Iowa and Missouri. The Iowa concentrated animal operations layer included all confined animal operations required to be registered with Iowa DNR, regardless of animal unit size. In the Missouri layer, smaller animal operations (not meeting the CAFO definition) are lumped together with other non-municipal facilities such as sand and gravel operations. Additionally, the Missouri non-municipal facilities were more comprehensive than in Iowa.

The Upper Grand sub-basin has 39 confined hog operations in Iowa and 44 hog CAFOs and 52 other hog confinement operations in Missouri. Missouri has documented 31 municipal and 102 non-municipal waste water facilities, in addition to the 52 hog operations. Iowa data show 22 municipal sites in the sub-basin. A majority of the municipal sites are for sewage treatment.

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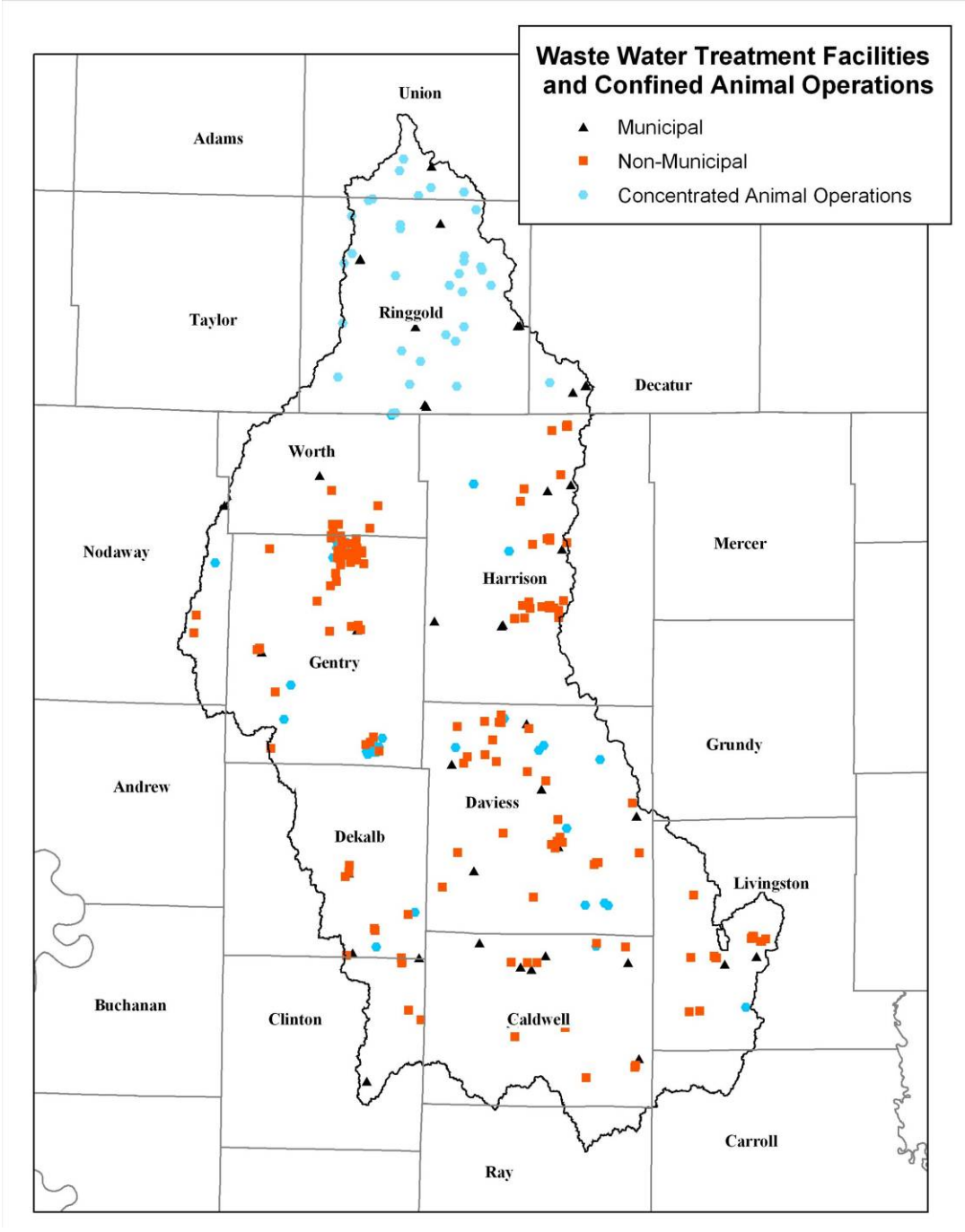
Figure 23


Waste Water Treatment Facilities and Confined Animal Operations
Municipal
Non-Municipal
Concentrated Animal Operations
Union
Adams
Taylor
Ringgold
Decatur
Worth
Nodaway
Harrison
Mercer
Gentry
Grundy
Andrew
Daviess
Dekalb
Livingston
Buchanan
Clinton
Caldwell
Carroll
Ray

D. Forestry

Forests cover about a third of Missouri - forests containing some of the finest oak, walnut, and red cedar found anywhere. Forests are Missouri's greatest renewable resource, providing many economic, environmental and social benefits. They protect hillsides from erosion, keeping streams and rivers clean. They filter the air, soften the extremes of the weather, and add beauty to cities and towns. Much of Missouri's recreation and tourism industry is centered in the forested regions of the state. And forests are a diverse resource of plants, animals, birds, and other life forms. Annual growth of forests in Missouri far exceeds the amount harvested, ensuring ample forests for future generations. The majority of tree species are hardwoods with softwoods locally important in certain regions of the state. Forest products are also important to Missouri. Harvesting and processing trees into wood products gives thousands of people jobs and contributes about $3 billion each year to Missouri's economy. Private landowners control 85 percent of the forest land in Missouri. Most of these private forested acres in Missouri are not following a management plan.

The following tables for this sub-basin are based on data compiled from The Forest Inventory and Analysis (FIA) Program of the U.S. Department of Agriculture (USDA) Forest Service. Information from USDA-Forest Service, National Forest Inventory and Analysis Database, 2005 is available at www.fia.fs.fed.us/tools-data/default.asp.

Area of Forestland by Ownership in Sub-Basin

Private	235,436 acres
Federal	0 acres
State	6,836 acres
County and municipal	5,787 acres
Other	0 acres
Total	248,079 acres

Area of Forestland by Stocking Class in Sub-Basin

Overstocked	8,137 acres
Fully stocked	54,074 acres
Medium stocked	100,763 acres
Poorly stocked	78,222 acres
Non-stocked	6,882 acres
Total Growing Stock	248,078 acres

Area of Forestland by Productivity Site Class in Sub-Basin

165-224	0 acres
120-164	0 acres
85-119	52,946 acres
50-84	122,240 acres
0-49	72,892 acres
Total	248,078 acres

Net Volume of Growing Stock on Forestland by Species Type in Sub-Basin

Softwoods	71,985 cubic feet
Hardwoods	239,204,880 cubic feet
Other	0 cubic feet
Total	239,276,865 cubic feet

E. Threatened and Endangered Species[20,33]

The Missouri and Iowa Natural Heritage databases store locations, population status and habitat information about species and communities of conservation concern. The table below is a subset of the Heritage records that occur in the Upper Grand sub-basin, restricted to federally threatened, endangered or candidate and state threatened or endangered species. While Heritage data can not prove the absence of a species in an area, it is the best collection available of known locations of sensitive species and is used to assess potential impacts of various land management activities in the region.

Figure 24

Species Type	Species Common Name	Scientific Name	Threatened, Endangered, or Candidate	Federal or State Listing
Amphibians/ Reptiles	Massasauga Rattlesnake	Sistrurus catenatus	Endangered	State-MO
	Speckled Kingsnake	Lampropeltis getulus	Threatened	State-IA
	Western Fox Snake	Elaphe vulpina vulpina	Endangered	State-MO
Birds	American Bittern	Botaurus lentiginosus	Endangered	State-MO
	Bald Eagle	Haliaeetus leucocephalus	Endangered	State-IA
	Barn Owl	Tyto alba	Endangered	State-MO
	Greater Prairie-chicken	Tympanuchus cupido	Endangered	State-MO
	Henslow's Sparrow	Ammodramus henslowii	Threatened	State-IA
	King Rail	Rallus elegans	Endangered	State-IA
	Northern Harrier	Circus cyaneus	Endangered	State-MO
	Short-eared Owl	Asio flammeus	Endangered	State-IA
Crustaceans/ Fish/Mollusks	Pallid Sturgeon	Scaphirhynchus albus	Endangered/ Endangered	Federal/ State-MO
	Topeka Shiner	Notropis topeka	Threatened	State-IA
Mammals	Indiana Bat	Myotis sodalis	Endangered/ Endangered	Federal/ State-IA,MO
	Spotted Skunk	Spilogale putorius	Endangered	State-IA
Plants	Eastern Prairie Fringed Orchid	Platanthera leucophaea	Threatened/ Endangered	Federal/ State-IA
	False Hellebore	Veratrum woodii	Threatened	State-IA
	Mead's Miklweed	Asclepias meadii	Threatened/ Endangered	Federal/ State-IA
	Oval Ladies'tresses	Spiranthes ovalis	Threatened	State-IA
	Roundstem Foxglove	Aglalinis gattingeri	Threatened	State-IA
	Slender Ladies'-tressess	Spiranthes lacera	Threatened	State-IA
	Western Prairie Fringed Orchid	Platanthera preclara	Threatened/ Threatened	Federal/ State-IA

Census and Social Data

A. Census Bureau[21,35]

Block group-level GIS data files from the 1990 and 2000 Census were used to illustrate population, population change, income and the agricultural cohort for the sub-basin. Spatial files were clipped by the sub-basin boundary. The percent of the block group falling in the watershed was calculated, and population figures were prorated by this value. Although this technique erroneously assumes even spatial distribution of population, it is a more accurate population count for the sub-basin than including the entire block group population.

Figure 25a. 1990 Population-The 1990 estimated population of the sub-basin was 63,530.

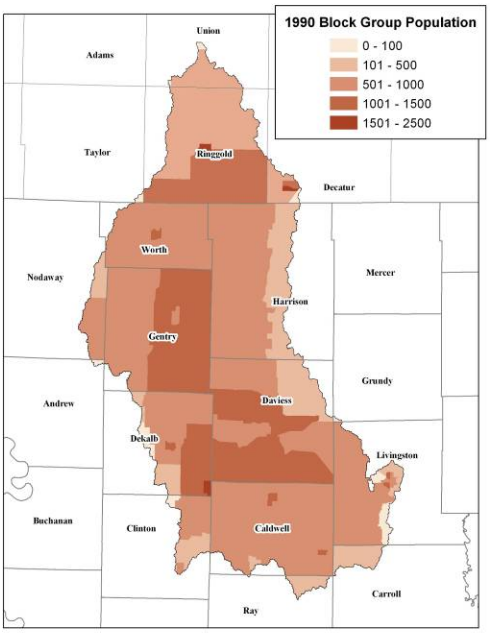
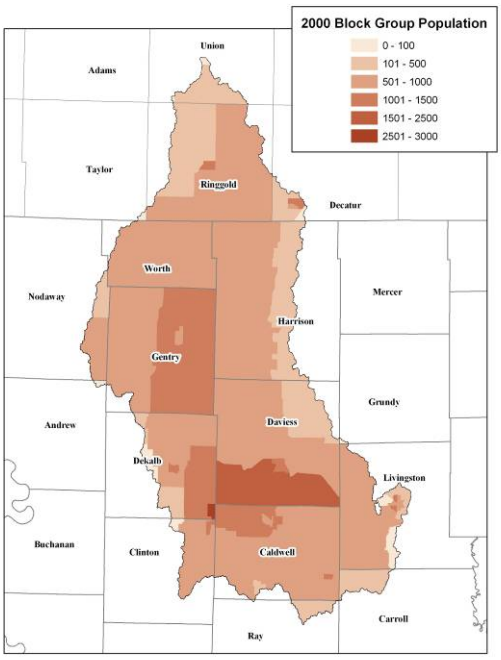


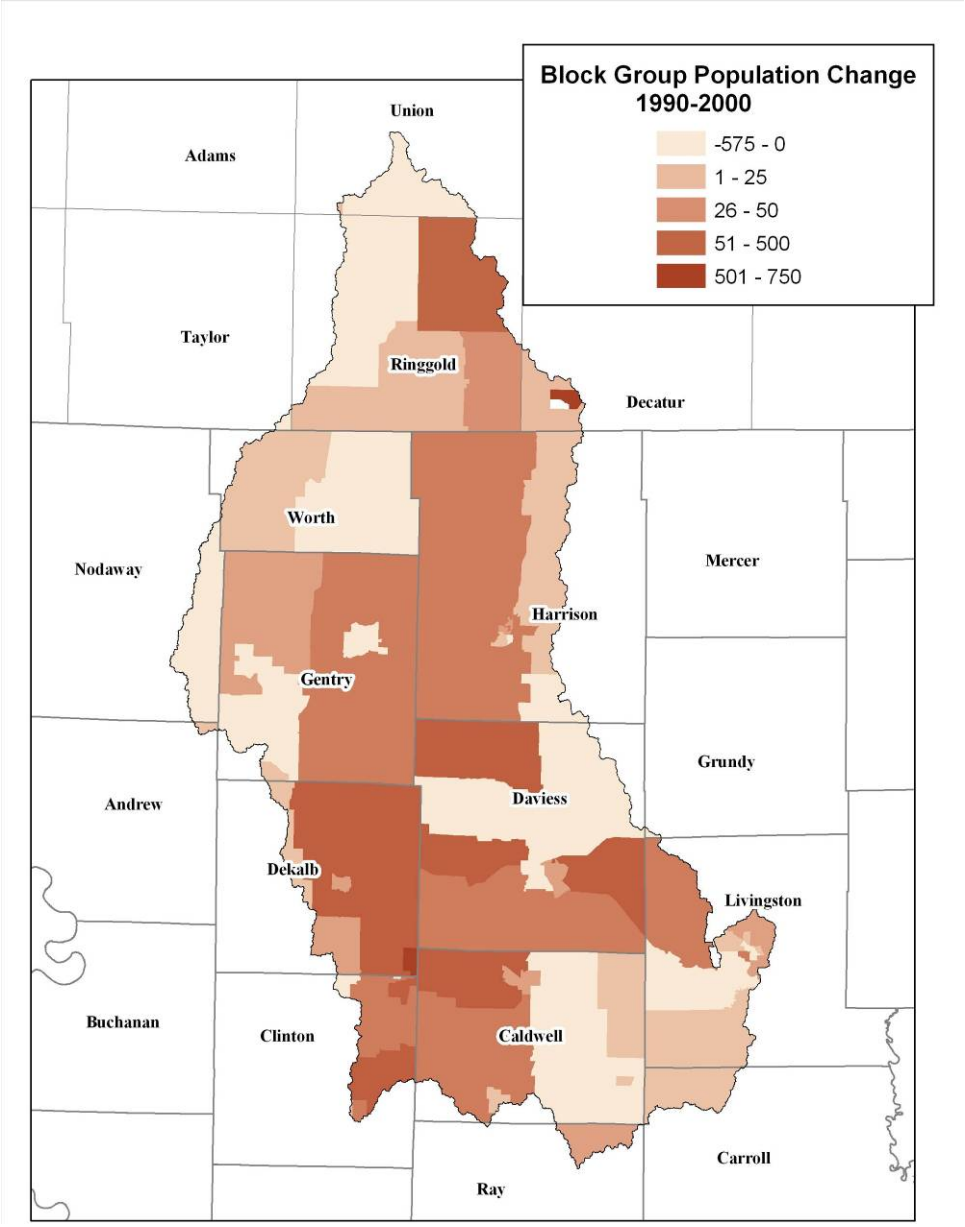
Figure 25b. 2000 Population—The 2000 estimated population of the sub-basin was 66,935.



Change in Population

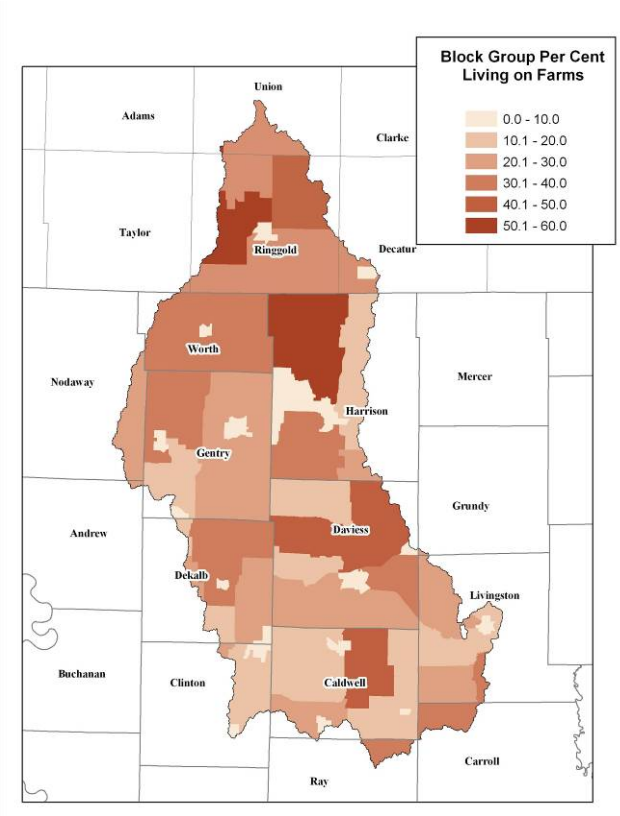
The 1990 estimated population of the sub-basin was 63,530 and grew to 66,935 by 2000, representing a 3,405 person increase or about 5 per cent. With a total of 103 block groups in the sub-basin, 73 showed a modest gain in population while 30 lost population

Figure 25c



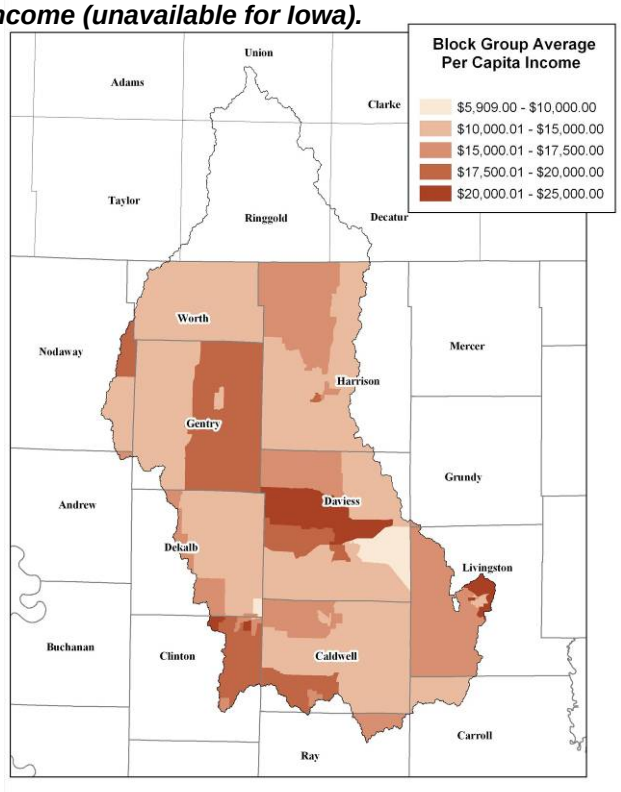
Income

Figure 25d



Farms

Figure 25e—Per Capita Income (unavailable for Iowa).



B. Agricultural Census[23]

Ag. Census data is available by county only. The data shown in the table are the sums of the complete county information. Missouri includes : Caldwell, Carroll, Clinton, Daviess, DeKalb, Gentry, Harrison, Livingston, Nodaway, Ray and Worth. Iowa includes: Decatur, Ringgold and Union. Grazing livestock includes cattle, sheep, horses and ponies and goats.

Figure 26

STATE SUMMARY HIGHLIGHTS, 2002			
	Iowa	**Missouri**	**Total**
Farms	90,655	106,797	197,452
Land in Farms	31,729,490 acres	29,946,035 acres	61,675,525
Hogs & Pigs	15,486,531	2,909,609	18,396,140
Poultry	51,466,152	50,033,279	101,499,431
Cattle	3,535,945	4,460,495	7,996,440
Sheep	249,908	76,015	325,923
Horses & Ponies	77,123	141,362	218,485
Goats	9,232	48,654	57,886
Cropland Used only for Pasture or Grazing	1,355,161 acres	4,178,574 acres	5,533,735 acres
Woodland pastured	548,815 acres	2,281,064 acres	2,829,879 acres
Permanent Pastureland and Rangeland	1,735,421 acres	4,854,438 acres	6,589,859 acres
Pastureland, All Types	3,639,397 acres	11,314,076 acres	14,953,473 acres
Percent Pastureland to All Land in Farms	11.4	37.8	-
Sum of All Grazing Live-stock	3,872,208	4,726,526	8,598,734
Pastureland per Animal	1.1 acres	2.4 acres	

Status of Resources

A. PRS[24]

NRCS' Performance Results System (PRS) is a consolidated reporting system of conservation activities. The following tables summarize conservation systems and practices planned and applied in the sub-basin for the designated time periods. PRS data, in conjunction with other information, are used to assess the current state of the resources in the sub-basin and past efforts to address resource concerns.

FY = Fiscal Year

PRS Data	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Average per Year
Total Acres Conservation Systems Applied	94,759	88,824	56,700	63,380	Not reported by Hydrologic Unit (HU)	53,169	84,181	85,256	74,202

Figure 27. Conservation Practices Applied

Summary Conservation Practices (PRS Number)	FY 05	FY 06	FY 07
Brush Management (314)	178 acres		848 acres
Composting Facility (31)	1		1
Comprehensive Nutrient Management Plan (100)		4	1
Conservation Cover (327)	8,260 acres	12,462 acres	13,103 acres
Conservation Crop Rotation (328)	12,730 acres	21,942 acres	24,012 acres
Contour Farming (330)	6,089 acres	6,779 acres	6,043 acres
Cover Crop (340)			20 acres
Critical Area Planting (342)	162 acres	178 acres	226 acres
Dike (356)	800 feet		
Diversion (362)	2,740 feet	341 feet	1,452 feet
Early Successional Habitat Development/Management (647)	710 acres	9,742 acres	2,447 acres
Fence (382)	155,931 feet	173,597 feet	282,363 feet
Field Border (386)	73,381 feet	120,867 feet	156,466 feet
Filter Strip (393)	159 acres	182 acres	93 acres
Forage Harvest Management (511)	14,254 acres	16,219 acres	13,979 acres
Forest Stand Improvement (666)	41 acres	40 acres	60 acres
Grade Stabilization Structure (410)	128	159	124
Grassed Waterway (412)	71 acres	56 acres	56 acres
Heavy Use Area Protection (561)	6 acres	48 acres	227 acres
Nutrient Management (590)	3,084 acres	3,962 acres	4,031 acres

Conservation Practices Applied (continued)

Summary Conservation Practices	FY 05	FY 06	FY 07
Pasture and Hay Planting (512)	3,131 acres	3,826 acres	3,156 acres
Pest Management (595)	4,822 acres	7,460 acres	8,768 acres
Pipeline (516)	12,979 feet	12,456 feet	35,012 feet
Pond (378)	19	11	31
Prescribed Burning (338)	571 acres	88 acres	660 acres
Prescribed Grazing (528)	1,016 acres	8,400 acres	8,933 acres
Prescribed Grazing (528A)	7,920 acres	987 acres	3,130 acres
Residue and Tillage Management, Mulch Till (345)		3,291 acres	4,133 acres
Residue and Tillage Management, No-Till/Strip Till/ Direct Seed (329)		10,295 acres	17,392 acres
Residue Management, Mulch Till (329B)	5,180 acres	1,864 acres	629 acres
Residue Management, No-Till/Strip Till (329A)	6,639 acres	3,970 acres	743 acres
Residue Management, Seasonal (344)	340 acres	151 acres	172 acres
Restoration and Management of Declining Habitats (643)	363 acres	1,129 acres	492 acres
Riparian Forest Buffer (391)	70 acres	37 acres	26 acres
Sediment Basin (350)		1	4
TA Application (912)			1
TA Check-Out (913)			1
Terrace (600)	405,058 feet	481,061 feet	377,747 feet
Tree/Shrub Establishment (612)	107 acres	30 acres	84 acres
Underground Outlet (620)	200,063 feet	216,380 feet	148,129 feet
Upland Wildlife Habitat Management (645)	13,371 acres	18,637 acres	13,291 acres
Use Exclusion (472)	7,870 acres	14,801 acres	14,242 acres
Waste Storage Facility (313)			2
Waste Treatment Lagoon (359)	1		2
Water and Sediment Control Basin (638)	18	4	1
Water Well (642)			1
Watering Facility (614)	90	89	111
Wetland Enhancement (659)			39 acres
Wetland Restoration (657)	438 acres	382 acres	147 acres
Wetland Wildlife Habitat Management (644)	3 acres	54 acres	54 acres
Wildlife Watering Facility (648)			1

B. Watershed Projects [25,31,32,35]

In addition to conservation activities itemized for individual land units, state and Federal watershed programs contribute to the current state of resources. Past and current activities within this sub-basin are summarized in the table below.

Figure 28

319 Project Name[31]	Status
4-H Teen Environfest Camp	Closed
Albany and Maysville Student Water Festivals	Closed
Farm*A*Syst Program	Closed
Mercury Thermometer Trade	Closed
Mudd Creek Water Quality Education Project	Active
Walnut Creek Watershed	Active
Water Festival for Lathrop, Plattsburg and Gower	Active

PL-566 Project Name[32]	Acres	Status
East Fork Big Creek	61,528	Operational
East Fork of Grand River	170,495	Operational
Grindstone-Lost-Muddy Creeks	209,462	Operational
Little Otter Creek	40,311	Operational
Town Branch (Albany)	8,187	Operational
West Fork Big Creek	190,753	Operational

AgNPS SALT Project Name, County-State[25]	Status
Big Creek, Carroll County-Missouri	In-Progress
Cameron Lake, DeKalb County-Missouri	Completed
Hickory Creek, Daviess County-Missouri	In-Progress
Little Third Creek, DeKalb County-Missouri	In-Progress
McCroskie Creek, Carroll County-Missouri	In-Progress
Shoal Creek, Caldwell County-Missouri	In-Progress
Shoal Creek, Clinton County-Missouri	In-Progress
Sugar Creek, Harrison County-Missouri	Completed
Turkey Creek, Carroll County-Missouri	Completed

C. Farm Bill Program Lands[26]

USDA programs involving long-term contracts or long-term to permanent easements on land units allow for sustained conservation and restoration goals. In this sub-basin, the Conservation Reserve and Wetlands Reserve programs have considerable participation, as summarized in the table below.

Figure 29

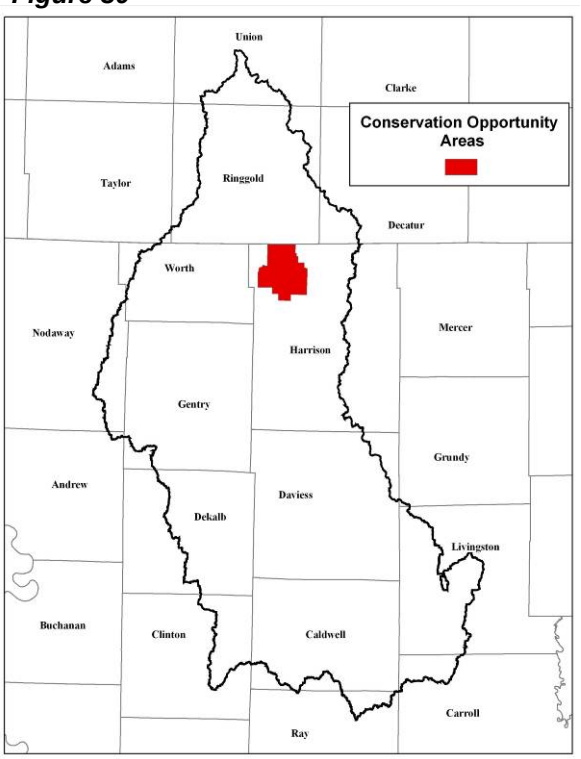
Program	Number of Acres	Number of Contracts or Easements
Conservation Reserve Program (CRP)	323,838	4,616 contracts
Wetland Reserve Program (WRP)	2,618	27 easements

D. Conservation Opportunity Areas[27]

The Missouri Department of Conservation joined with resource partners to take an "all conservation" approach via a framework referred to as Conservation Opportunity Areas (COAs). COAs identify the best places where partners can combine technology, expertise and resources for all conservation, with such focused efforts providing enhanced results. Various future funding opportunities for resource projects will give priority to work addressing the conservation goals within COAs.

Stakeholder groups have been formed and resources profiles developed for thirty-three of the highest priority COAs in Missouri. The Upper Grand River sub-basin contains all of the nearly 34,000-acres Grand River Grasslands COA in Harrison County, Missouri. The Grand River Grasslands offers the best potential in Missouri to restore a functioning tallgrass prairie ecosystem and a high diversity of grassland species. Data similar to the Missouri COA project were not available for Iowa.

Figure 30



E. Environmental Protection Agency Priority Watersheds[28,29]

The Environmental Protection Agency (EPA) has worked in conjunction with Iowa and Missouri Departments of Natural Resources to identify priority watersheds in each state. The prioritization process paid particular attention to those watersheds where there is a high potential to accomplish measurable water quality improvements in a relatively short time. The target watersheds are used to target requests for Clean Water Act 319 funds. The Upper Grand River sub-basin does not contain priority watersheds per this designation.

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