CONSERVATION AND PROTECTION OF REFERENCE STREAMS IN KANSAS

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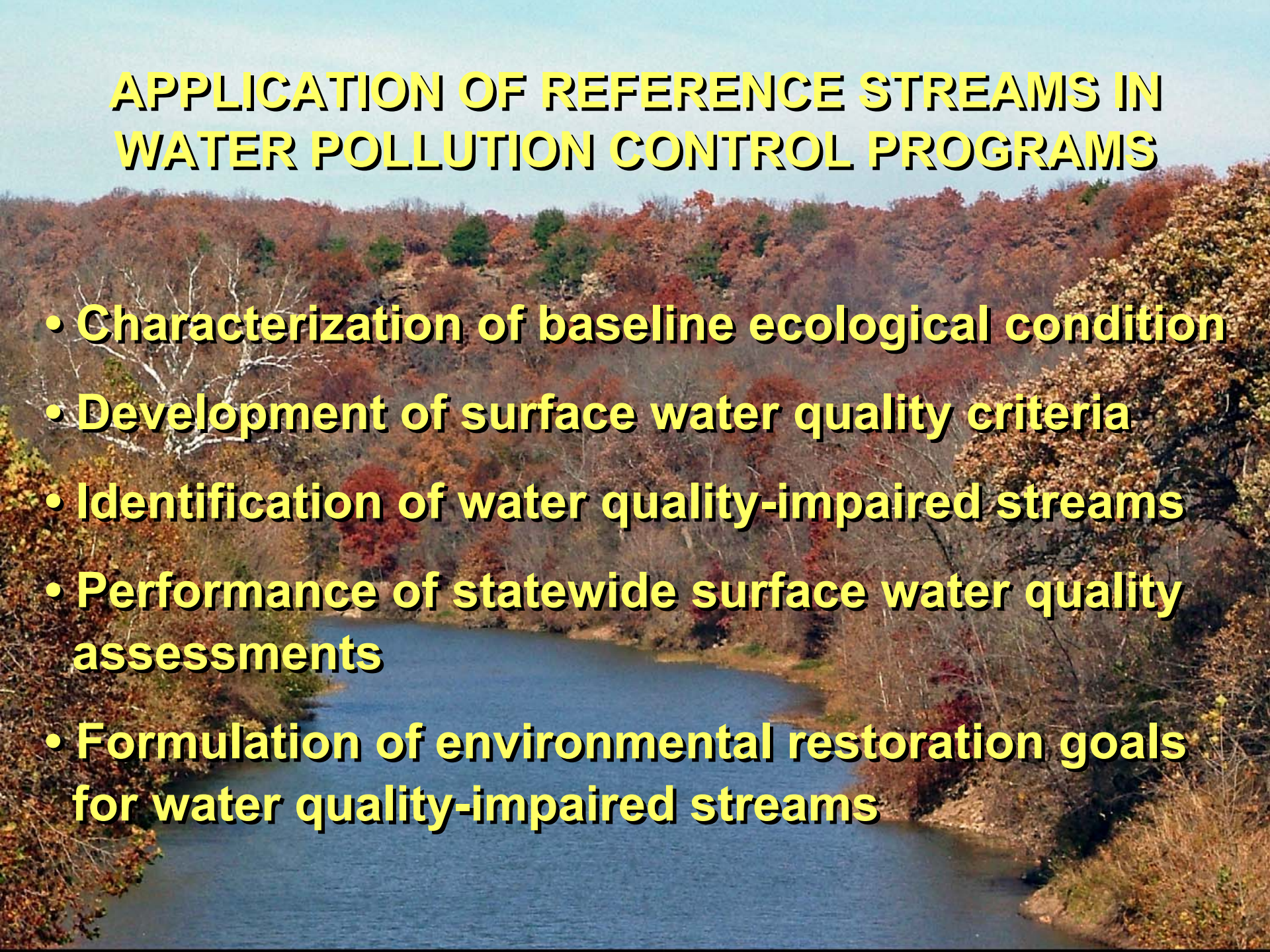
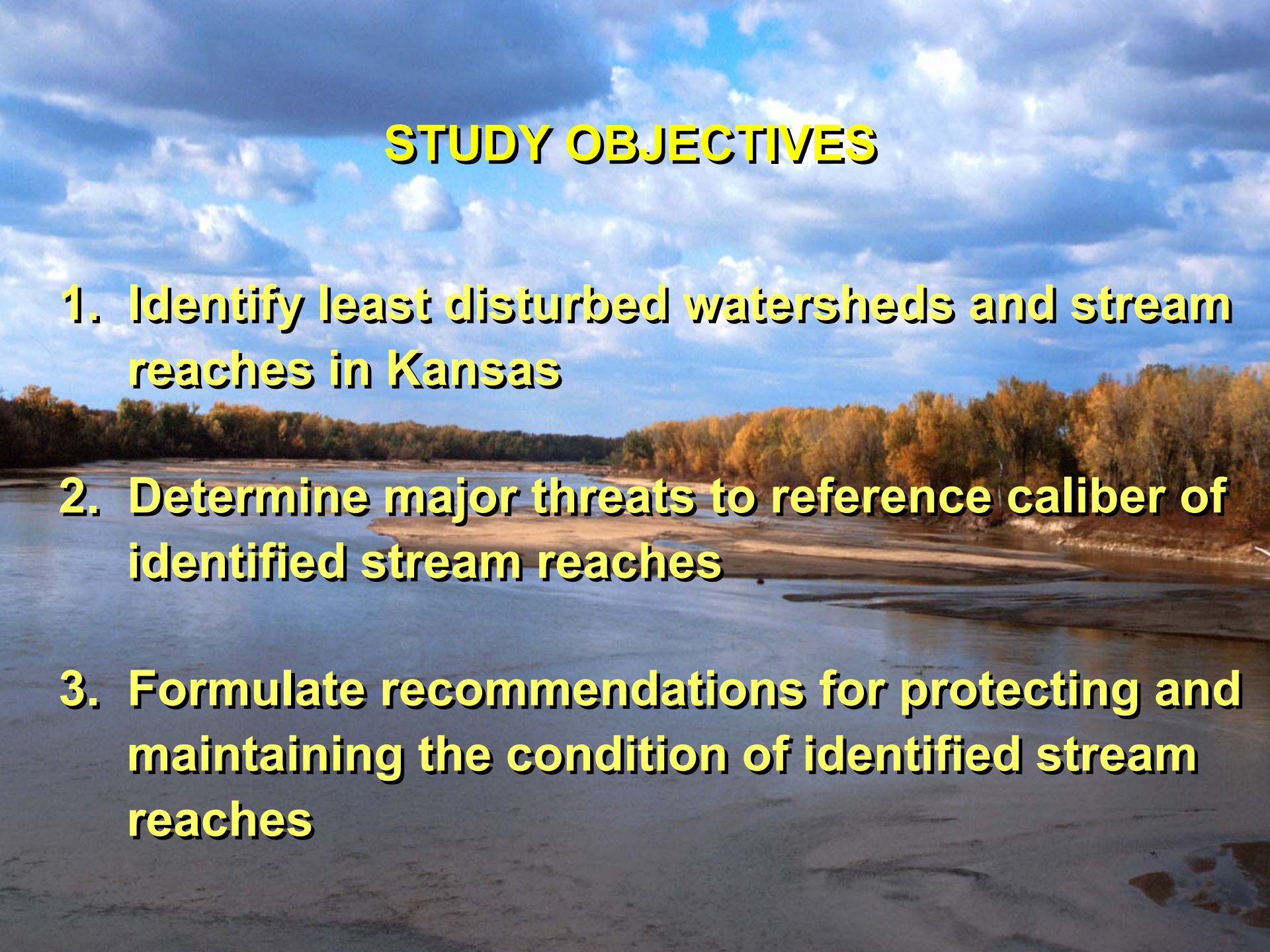
Bureau of Environmental Field Services
and Bureau of Water

APPLICATION OF REFERENCE STREAMS IN WATER POLLUTION CONTROL PROGRAMS



- Characterization of baseline ecological condition
- Development of surface water quality criteria
- Identification of water quality-impaired streams
- Performance of statewide surface water quality assessments
- Formulation of environmental restoration goals for water quality-impaired streams



STUDY OBJECTIVES

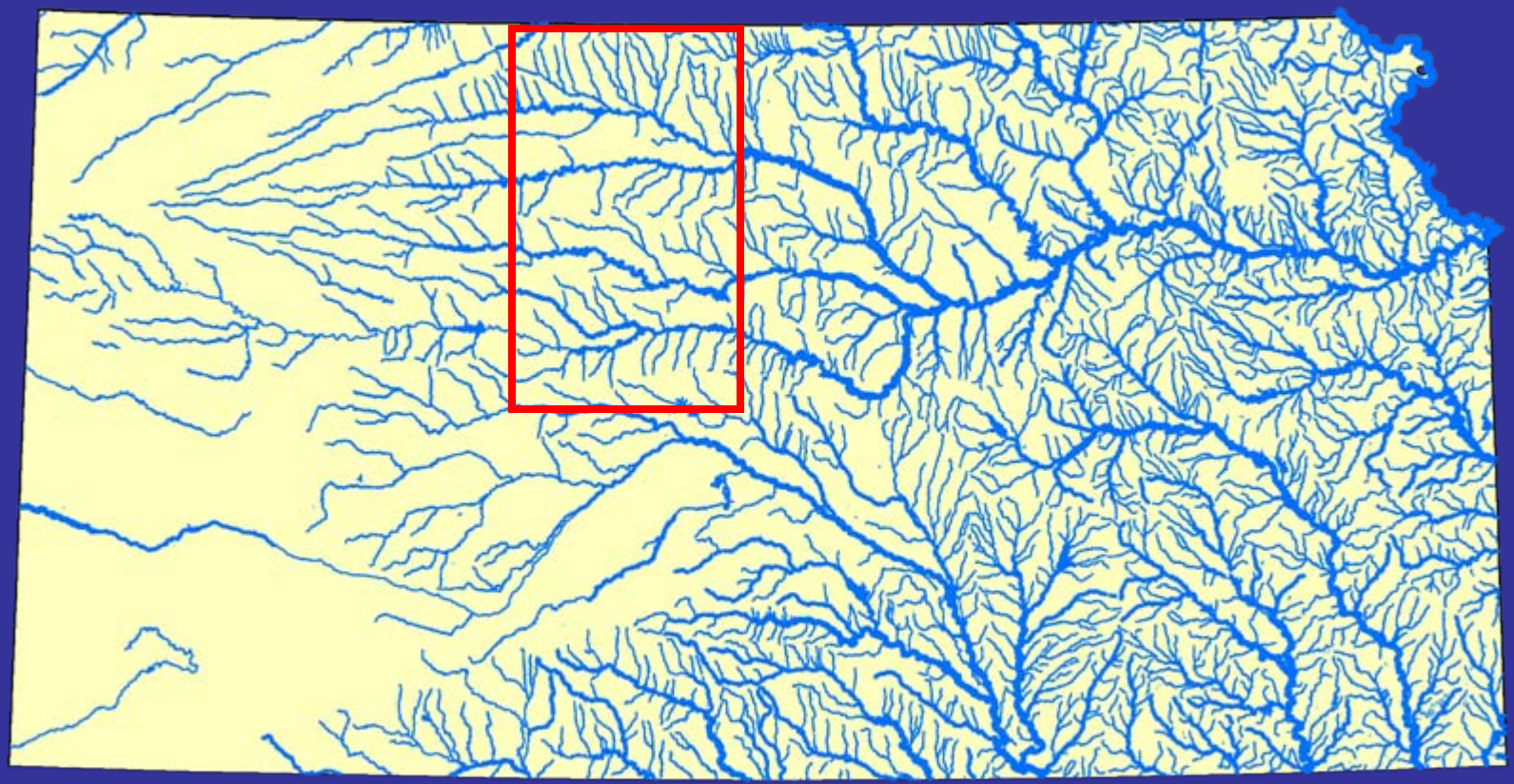
1. Identify least disturbed watersheds and stream reaches in Kansas

2. Determine major threats to reference caliber of identified stream reaches

3. Formulate recommendations for protecting and maintaining the condition of identified stream reaches

STREAMS INCLUDED IN KANSAS SURFACE WATER REGISTER

(AND CORRESPONDING TEN-YEAR MEDIAN FLOW CLASSES)



> 10,000 cfs	10 to 100 cfs
1,000 to 10,000 cfs	0 to 10 cfs
100 to 1,000 cfs	(Source: USGS 2004)

- Classified and unclassified streams represented in the 1:100,000 National Hydrography Dataset (NHD)
- Stream reaches in this study defined on the basis of NHD tributary confluences (about 99,000 stream reaches in KS)
- Allocated watersheds: land surfaces adjoining (draining directly into) defined reaches
- Accumulated watersheds: entire upstream drainage areas

VARIABLES CONSIDERED IN WATERSHED DISTURBANCE ANALYSIS

1. Density of confined livestock (animal units)
2. Ratio of cropland area to total land area
3. Ratio of cropland area to total land area within riparian corridor
4. Density of registered and unregistered dams
5. Density of grazing cattle
6. Density of permitted groundwater diversions
7. Ratio of inundated land area to total land area
8. Density of active and inactive permitted landfills
9. Density of active and inactive permitted mines and quarries
10. Total permitted wastewater output divided by catchment area

VARIABLES CONSIDERED IN WATERSHED DISTURBANCE ANALYSIS (continued)

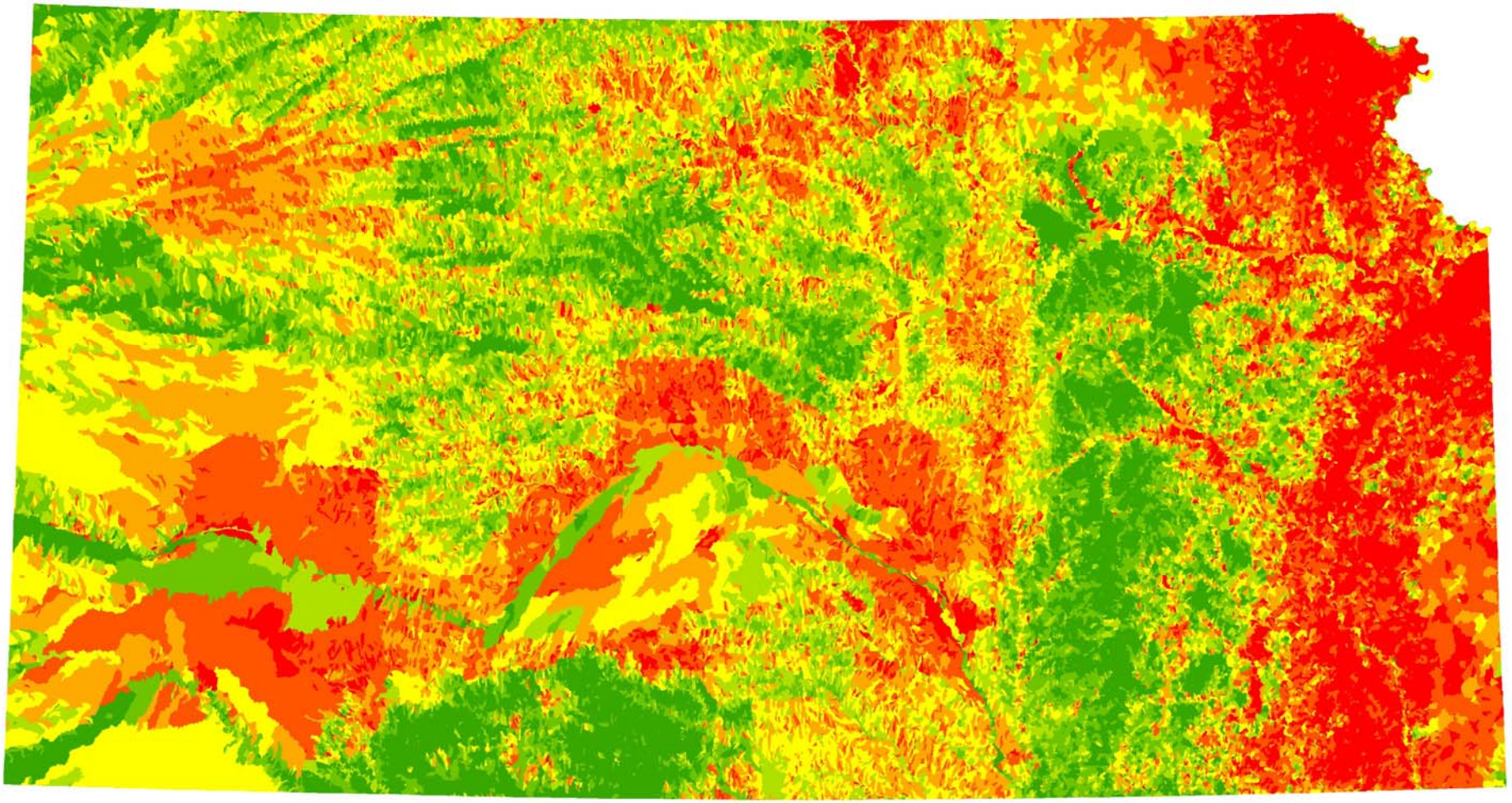
11. Density of registered active and inactive oil and natural gas wells
12. Combined annual application rate for all pesticides
13. Density of stream/industrial pipeline intersections
14. Density of human residents
15. Density of stream/railroad intersections
16. Density of stream/road intersections
17. Density of active and inactive Superfund sites
18. Density of permitted surface water diversions
19. Ratio of urban land area to total land area
20. Ratio of urban land area to total land area within riparian corridor

DEVELOPMENT OF WATERSHED DISTURBANCE INDEX

- Disturbance databases converted to 30-m raster coverages
- Variable means calculated separately for allocated and accumulated watersheds (40 disturbance indicators, total)
- PCA performed on normalized means for all 40 indicators
- Components with eigenvalues ≥ 1.0 extracted for further analysis
- Loadings averaged across components; averages used as weighting coefficients for respective disturbance indicators
- Weighted sum of all 40 indicators calculated for each stream reach and used as an integrated disturbance index for watershed ranking purposes

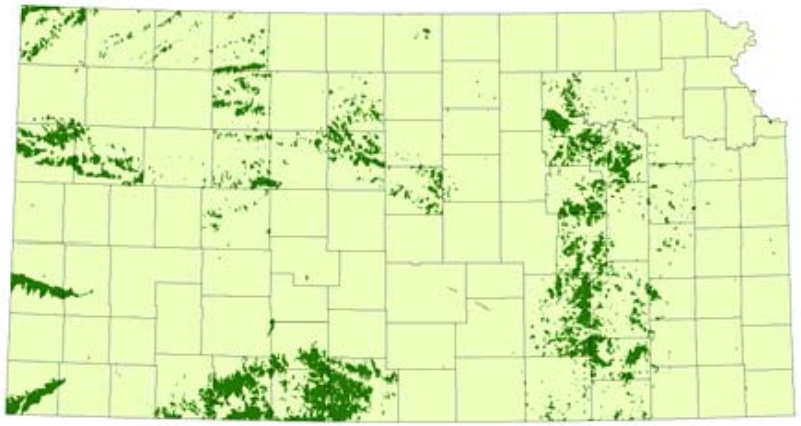
ANTHROPOGENIC DISTURBANCE MAP FOR KANSAS

Watersheds are depicted in different colors based on calculated disturbance scores. Green represents the least altered condition and red the most altered condition. Forty disturbance indicators are applied in this PCA-based analysis.



LOCATIONS OF LEAST DISTURBED WATERSHEDS IN KANSAS

Dark green areas represent best 10%, 15%, 20%, and 25% of all watersheds.



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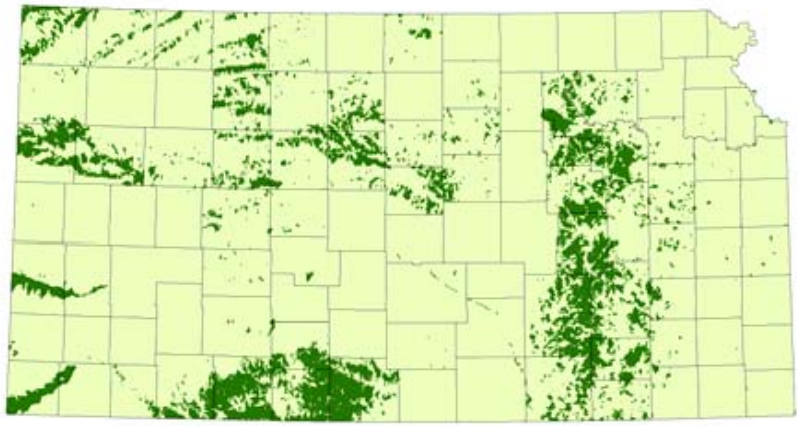

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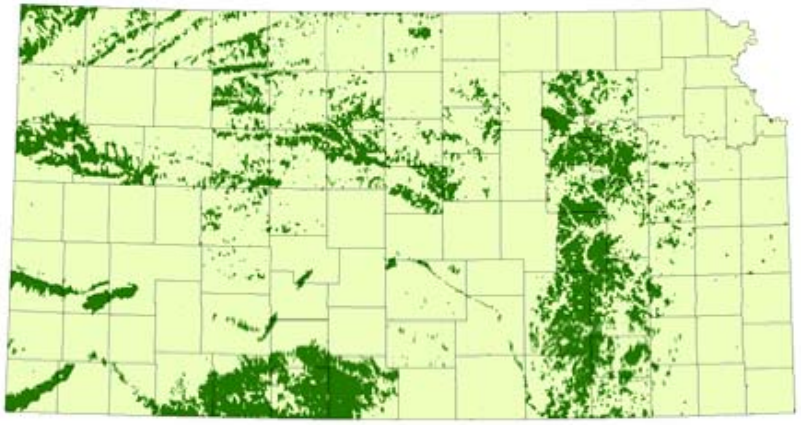

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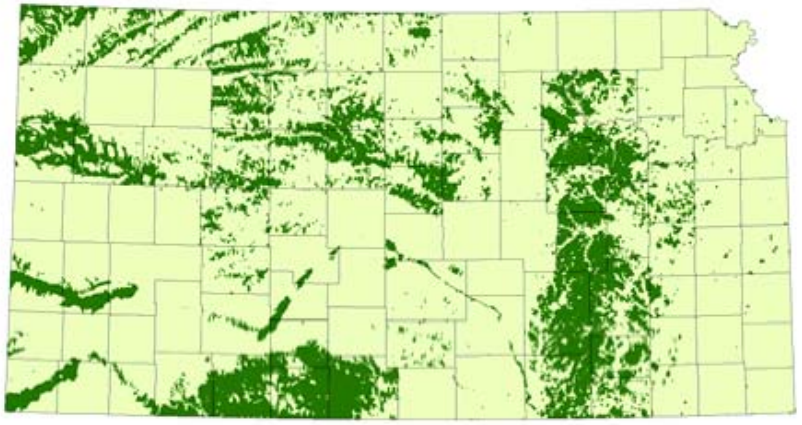
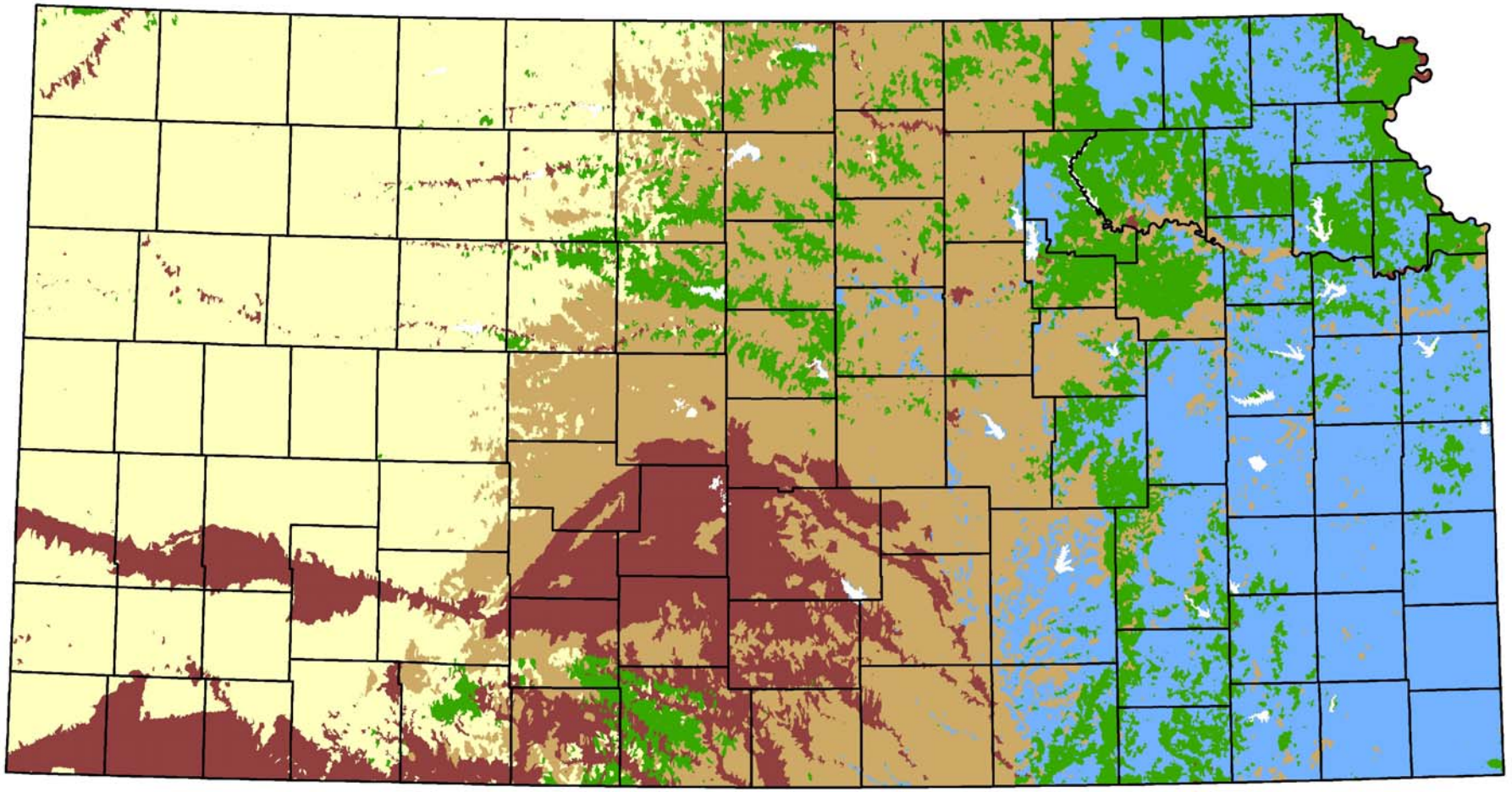


25%

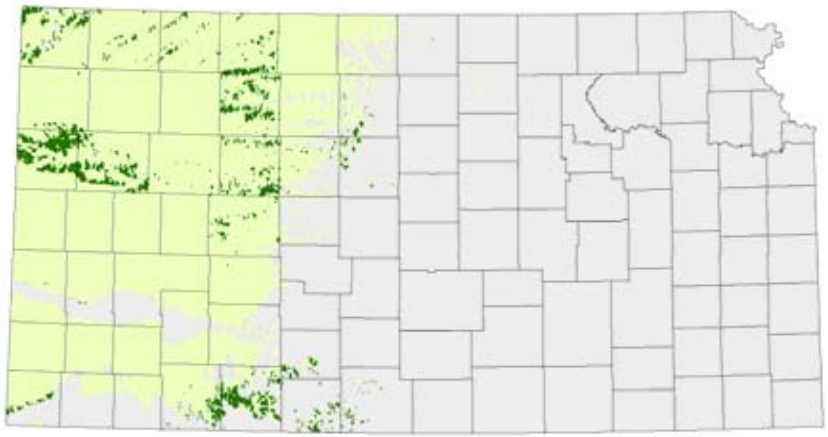
QUANTITATIVE ECOREGIONS IN KANSAS

Boundaries between regions are based on application of *k*-means non-hierarchical clustering to data for 26 environmental indicators obtained from ~100,000 watersheds.

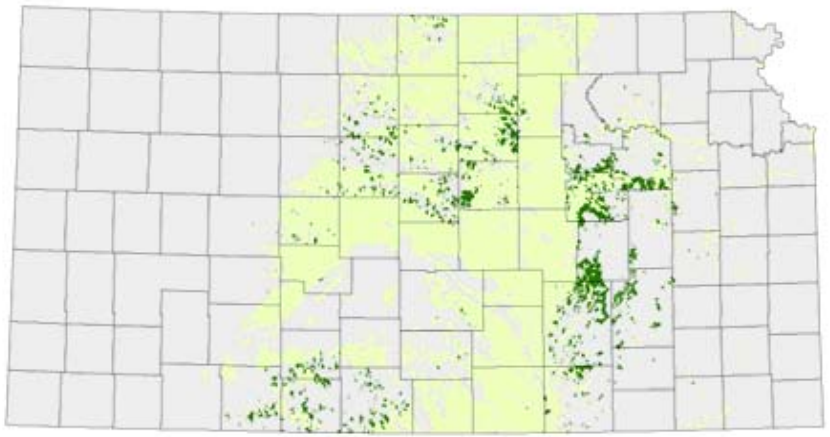


LOCATIONS OF LEAST DISTURBED WATERSHEDS BY ECOREGION

Dark green areas represent best 10% of watersheds within respective ecoregions.



ER1



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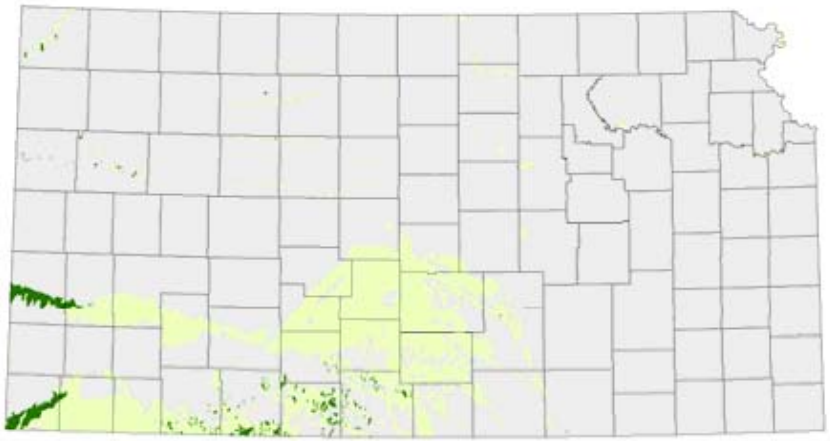

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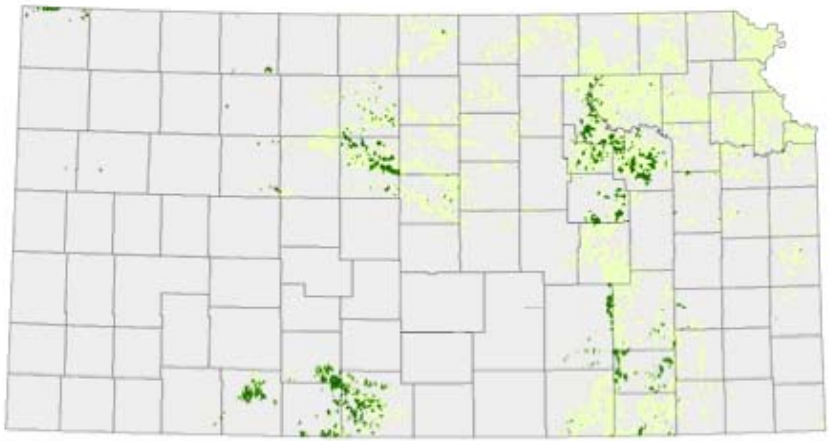


ER4

WATERSHED DISTURBANCE SCORE SUMMARY FOR KANSAS AND COMPONENT ECOREGIONS

		Percentile				
Region	N	10th	25th	50th	75th	90th
ER1	24,460	0.054	0.074	0.095	0.118	0.142
ER2	27,951	0.073	0.097	0.119	0.142	0.163
ER3	7,469	0.045	0.057	0.081	0.104	0.130
ER4	15,311	0.044	0.056	0.076	0.110	0.154
ER5	23,620	0.064	0.095	0.140	0.174	0.198
State	98,811	0.055	0.076	0.106	0.140	0.171

NUMBER OF WATERSHEDS RANKED IN BEST 10% STATEWIDE, PARTITIONED BY STREAM FLOW CLASS AND QUANTITATIVE ECOREGION

Mean flow ($m^3 s^{-1}$)	Ecoregion ER1	ER2	ER3	ER4	ER5	Statewide
< 0.28	2,483	897	1,248	3,437	1,189	9,254
0.28-2.8	20	27	155	55	39	296
> 2.8	21	6	255	22	27	331
Total	2,524	930	1,658	3,514	1,255	9,881


Palmer Creek, Chase County

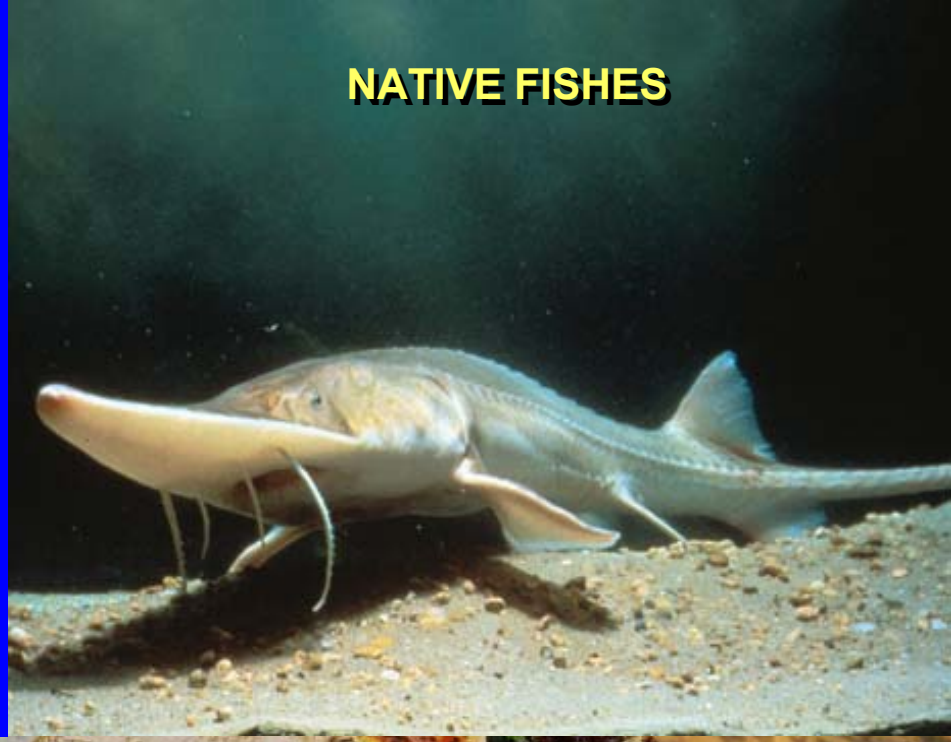

Illinois Creek, Wabaunsee County

Thompson Creek, Kiowa County


Elm Creek, Barber County

Salt Fork Arkansas River, Barber County

THE RELATIONSHIP BETWEEN WATERSHED DISTURBANCE SCORE AND INSTREAM ECOLOGICAL CONDITION WAS EVALUATED USING AVAILABLE SPECIES RICHNESS DATA FOR …

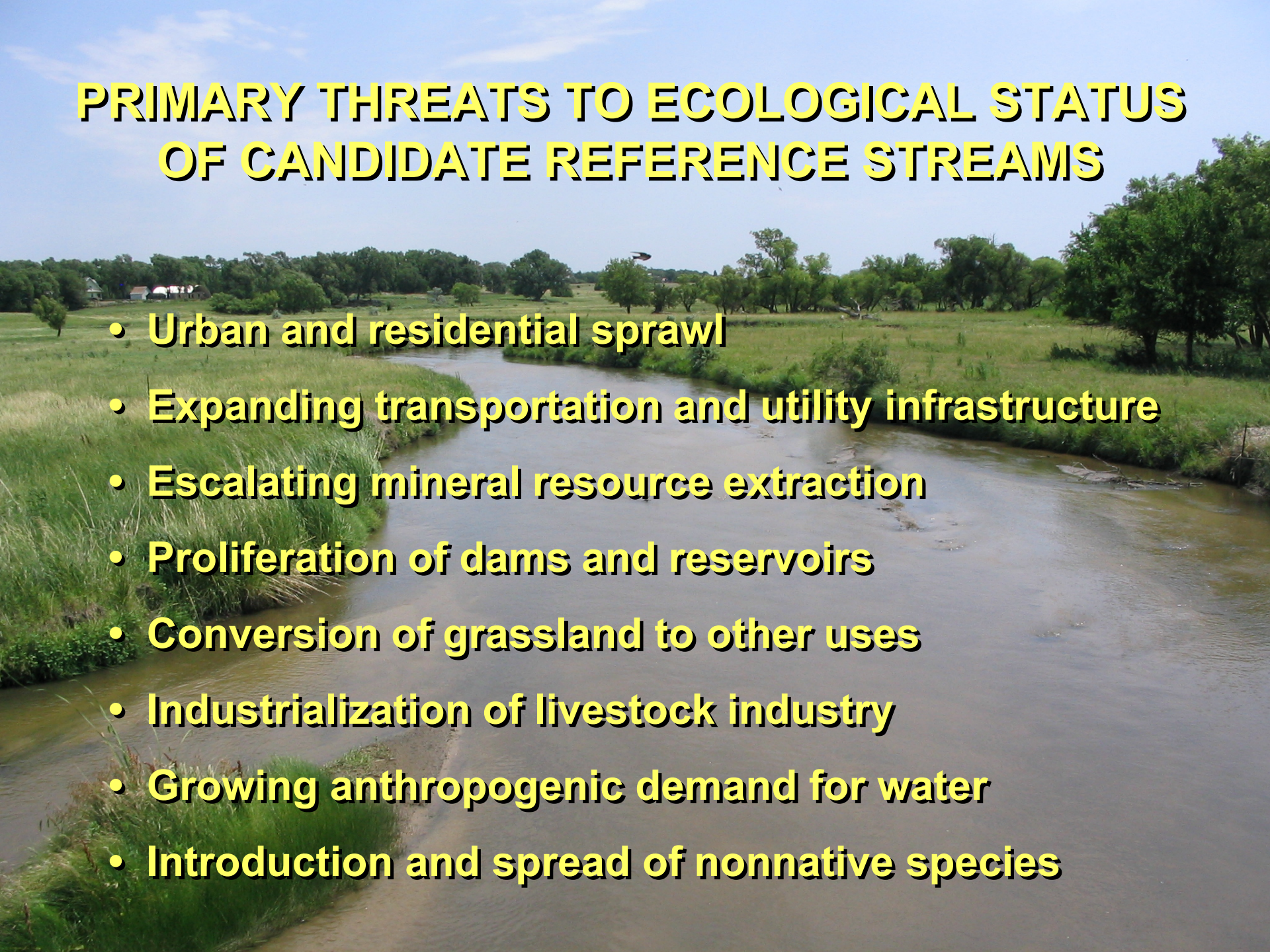


STATEWIDE SPECIES RICHNESS MODELS INCORPORATING LONGITUDE, LATITUDE, STREAM FLOW, AND DISTURBANCE SCORE

Faunal group(s)	Regression model (based on standardized watershed data)	R^2_A	R^2_P
EPT	$0.30x_{coord} + 0.01y_{coord} + 0.43(\log_{10} Q + 1) - 0.21DScore^*$	26.5	24.6
Fishes (F)	$0.66x_{coord} - 0.21y_{coord} + 0.31(\log_{10} Q + 1) - 0.20DScore^*$	40.3	39.8
Mussels (M)	$0.29x_{coord} - 0.06y_{coord} + 0.36(\log_{10} Q + 1) - 0.04DScore$	23.9	23.6
EPT + F	$0.58x_{coord} - 0.30y_{coord} + 0.10(\log_{10} Q + 1) - 0.21DScore$	36.0	28.1
EPT + M	$0.33x_{coord} - 0.07y_{coord} + 0.50(\log_{10} Q + 1) - 0.15DScore^*$	39.0	37.0
F + M	$0.66x_{coord} - 0.19y_{coord} + 0.36(\log_{10} Q + 1) - 0.17DScore^*$	42.3	41.9
EPT + F + M	$0.55x_{coord} - 0.30y_{coord} + 0.14(\log_{10} Q + 1) - 0.14DScore$	35.9	28.8

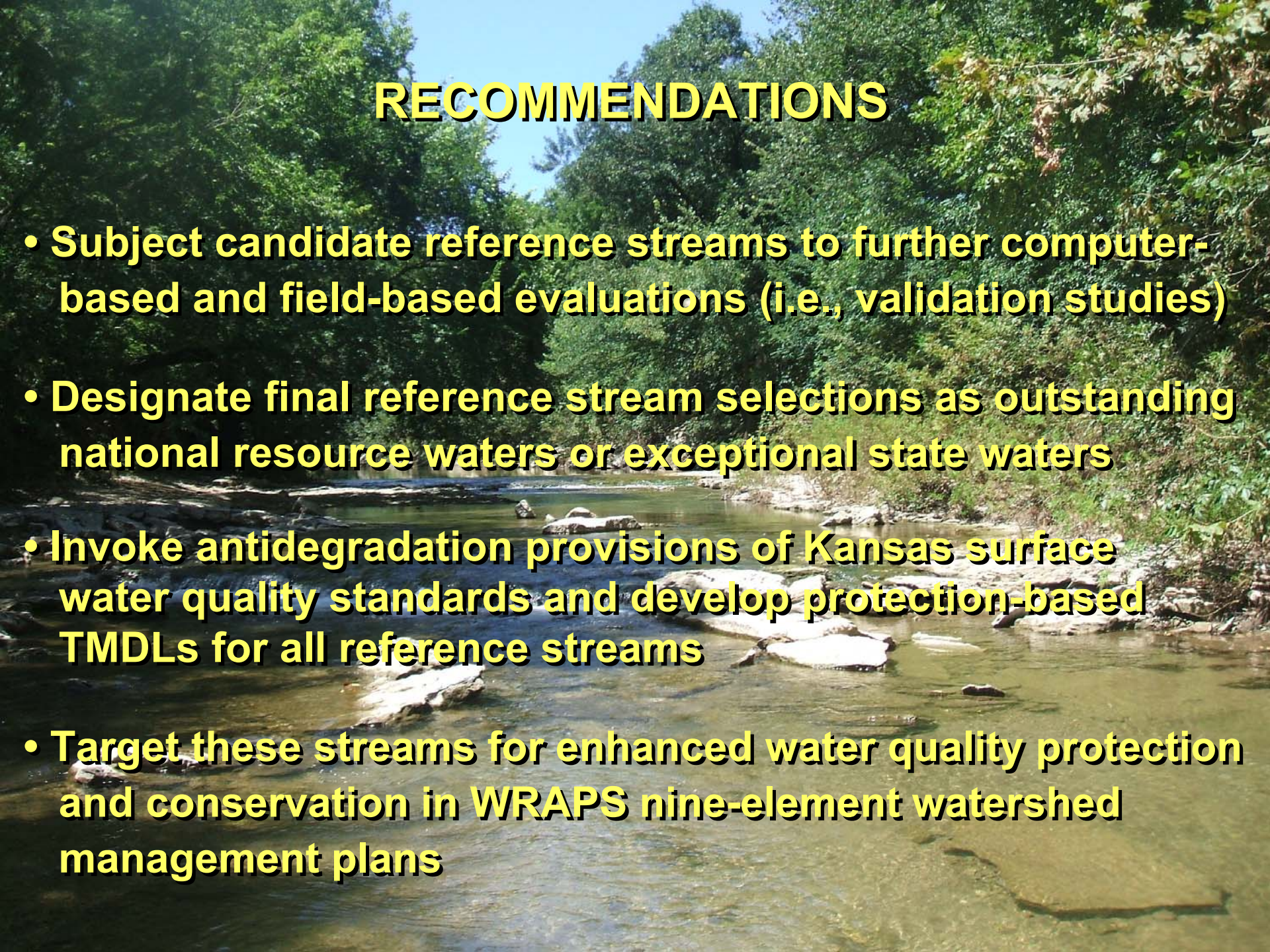
DOCUMENTS CONSIDERED IN REFERENCE STREAM THREAT ASSESSMENT

- Agency planning documents
- Statistical abstracts
- Regulatory permit applications
- Electronic databases
- Published reports
- Unpublished reports



PRIMARY THREATS TO ECOLOGICAL STATUS OF CANDIDATE REFERENCE STREAMS

- Urban and residential sprawl
- Expanding transportation and utility infrastructure
- Escalating mineral resource extraction
- Proliferation of dams and reservoirs
- Conversion of grassland to other uses
- Industrialization of livestock industry
- Growing anthropogenic demand for water
- Introduction and spread of nonnative species



RECOMMENDATIONS

- Subject candidate reference streams to further computer-based and field-based evaluations (i.e., validation studies)
- Designate final reference stream selections as outstanding national resource waters or exceptional state waters
- Invoke antidegradation provisions of Kansas surface water quality standards and develop protection-based TMDLs for all reference streams
- Target these streams for enhanced water quality protection and conservation in WRAPS nine-element watershed management plans

RECOMMENDATIONS (continued)

- Establish minimum desirable streamflows for selected reference streams
- Reserve a portion of available BMP cost-share funds and conservation easement funds for watersheds containing reference streams
- Enhance communication between governmental agencies, private conservation organizations, farm groups, WRAPS groups, watershed districts, etc.
- Incorporate above recommendations in future revisions of State Water Plan

PILOT EFFORTS PLANNED FOR 2011

- Meet with stakeholders to assess prevailing level of public and private support for this initiative
- Conduct field-based validation studies for a small subset of state's candidate reference streams
- Develop recommendations with respect to protective stream classifications, minimum desirable streamflows, and on-site conservation measures
- Develop protection-based TMDLs for nutrients and TSS
- Discuss findings/accomplishments with other agencies, interest groups, landowners, and the general public

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