

**ARS Conservation Effects
Assessment Project
Watershed Assessment Studies**

**March 1-3, 2005
Harvey Hotel, Irving, TX**

**Reporter: M.J.M. Römken
Model Development and Regionalization
(Objective 5 Tasks 5.1 and 5.2)**

OBJECTIVES

- **Develop and verify regional watershed models that quantify environmental outcomes of conservation practices in major agricultural regions.**
- **Task 5.1**
 - **Identify preliminary modeling regions based on practical experience with the functions and characteristics of current models, the problems, local conditions (topography, soils, water, climate, management/conservation practices, etc.), situations, scenarios, system boundaries, that exist in the various regions.**
- **Task 5.2**
 - **Define the process and sub-process modules that will be needed in each region.**

TASK FORCE

- Committee met on February 14 and 15, 2005, in Fort Collins, CO

NRCS-Members

Jon Werner
Frank Geter
Fred Theurer
Jerry LeMunyon
Ken Rojas
Bill Merkel

ARS-Members

Laj Ahuja
Jim Ascough
Ron Bingner
Dennis Flanagan
Matt Römken

SUMMARY OF MEETING

- 1. Discussed various approaches of Regionalization relative to geography, problem type, etc.**
- 2. Settled on LRRs (= Land Resource Regions) which are subunits of LRAs or Land Resource Areas.**
- 3. Identified Problem Areas**
- 4. Identified for each problem Areas, the Resources of Concerns**
- 5. Determined for each combination of LRRs and Resource of Concerns the degree of concern: High, Medium, Low, Not addressed, Do not know.**
- 6. Matrix was obtained. The matrix will be circulated among CEAP participants for input.**

CEAP REGIONALIZED WATERSHED MODELS – Sub-Objective 5a:1 and 5a:2

Land Resource Region (LRR)

<u>LRR SYMBOL</u>	<u>LRR NAME</u>
A	Northwestern Forest, Forage, and Specialty Crop Region
B	Northwestern Wheat and Range Region
C	California Subtropical Fruit, Truck, and Specialty Crop Region
D	Western Range and Irrigated Region
E	Rocky Mountain Range and Forest Region
F	Northern Great Plains Spring Wheat Region
G	Western Great Plains Range and Irrigated Region
H	Central Great Plains Winter Wheat and Range Region
I	Southwest Plateaus and Plains Range and Cotton Region
J	Southwestern Prairies Cotton and Forage Region
K	Northern Lake States Forest and Forage Region
L	Lake State Fruit, Truck, and Dairy Region
M	Central Feed Grains and Livestock Region
N	East and Central Farming and Forest Region
O	Mississippi Delta Cotton and Feed Grains Region
P	South Atlantic and Gulf Slope Cash Crops, Forest, and Livestock Region

CEAP REGIONALIZED WATERSHED MODELS

-- Sub-Objective 5a:1 and 5a:2

CONTINUED...

Land Resource Region (LRR)

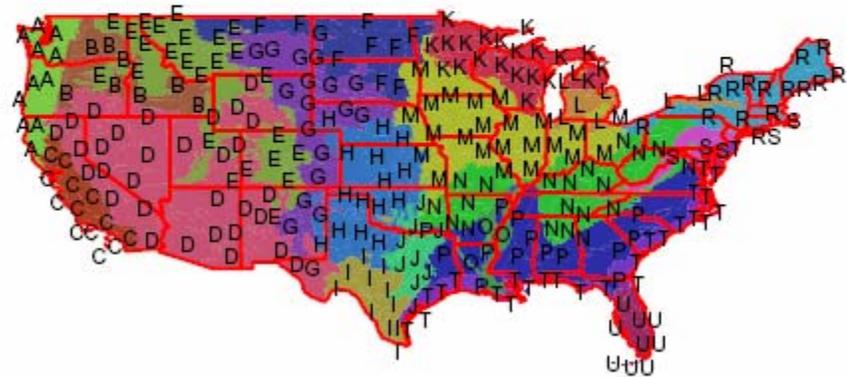
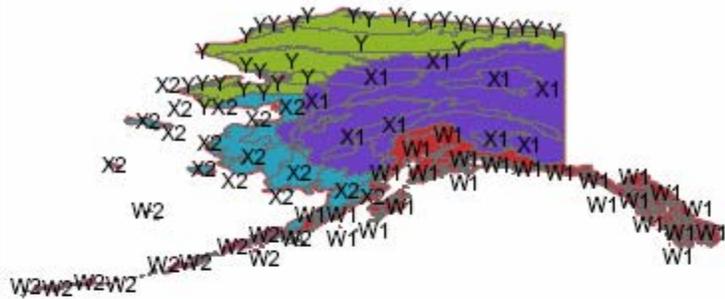
<u>LRR SYMBOL</u>	<u>LRR NAME</u>
S	Northern Atlantic Slope Diversified Farming Region
T	Atlantic and Gulf Coast Lowland Forest and Crop Region
U	Florida Subtropical Fruit, Truck Cop, and Range Region
V	Hawaii Region
W1	Southern Alaska
W2	Aleutian Alaska
X1	Interior Alaska
X2	Western Alaska
Y	Northern Alaska

In the following sheets codes will be used to signify degree of concern:

H	High concern	2/15/2005
<i>H</i>	High concern – entered by different team than assigned to do initial ranking	
L	Low concern	
(blank)	not addressed	2/15/2005
?	Don't know	

Note footnotes at bottom of pages where they occur

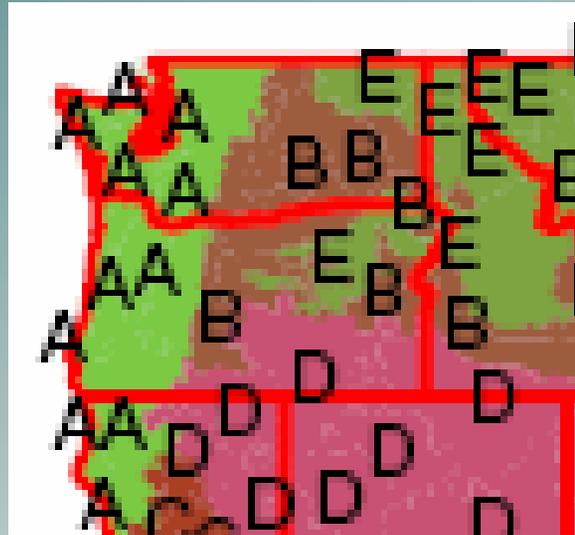
LAND RESOURCE REGIONS



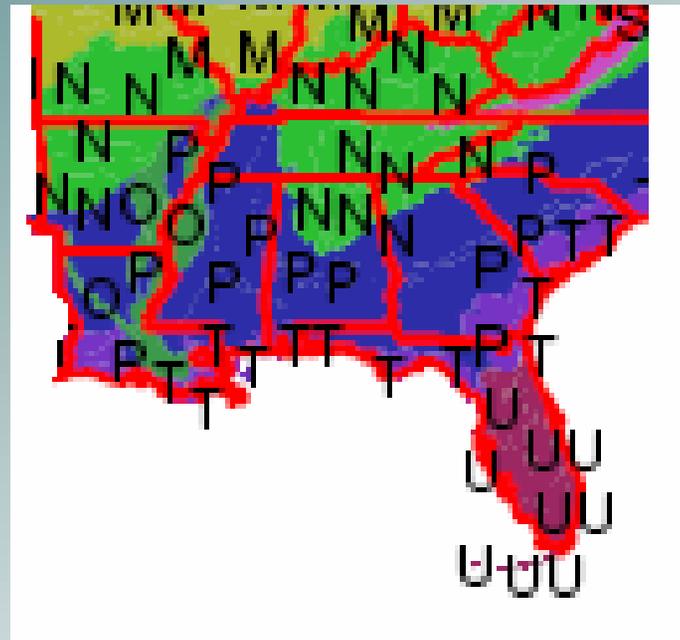
W W W W

Z Z Z Z

LRR in the NORTH WEST



MSA and SAA LRR



PROBLEM AREA

1. Soil Erosion
2. Surface Water Quality
3. Ground Water Quality
4. Soil Quality
5. Water Quantity
6. Air Quality
7. Eco-systems

SOIL EROSION

Type and Definitions of Resource of Concerns (ROCs)

- **Rill/Interill – Detachment and transport of soil particles caused by rainfall splash and runoff.**
- **Ephemeral gully – Small channels caused by concentrated surface water flow that can be easily obscured by tillage.**
- **Wind – Detachment and transport of soil particles caused by wind.**
- **Irrigation induced – Improper irrigation water application and equipment operation causing soil erosion.**
- **Stream bank – Accelerated loss of stream bank soils caused by stream water or head cutting.**
- **Classic gully – Deep, permanent channels caused by the convergence of intermittent surface runoff. They enlarge by head cutting and lateral widening.**

SOIL EROSION

CONTINUED...

- Tillage induced – Down slope displacement of soil through action of tillage equipment.
- Infield sediment deposition – Sediment deposition that damages or restricts land use and/or management and adversely affects ecological processes.
- *Sediment yield (wash load) – Sediment material transported from a land surface by overland flow.*
- *In stream sediment load – Quantity of sediment transported by the stream.*
- *Stream deposition – Accumulation of material dropped out of stream flow because of slackening movement of water.*
- *Impoundment deposition – Accumulation of material dropped out in basin reservoirs because of slackening movement of water.*

SOIL EROSION

LRR	Rill/ Interrill	Ephemeral Gully	Wind	Irrigation Induced	Stream/ Bank	Classic Gully	Tillage Induced	Infield Sediment Deposition	Sediment Yield	Instream Sediment Load	Stream Deposition	Impoundment Deposition
A					H					H (1)	H	
B	H	H	H	H	H		H	H	H	H	H	
C		H	H	H	H	H	H	H	H	H	H	H
D			H	H	H	H		H	H	H		
E					H					H	H	
F			H?									
G	H	H	H	H	H	H	H	H		H	H	H
H	H		H		H	H		H	H	H	H	H
I			H									
J	H		H									
K												
L	H	H			H	H	H	H	H	H	H	H
M	H	H			H	H	H	H	H	H	H	H
N	H	H			H	H	H	H	H	H	H	H
O	H	H			H		H	H	H	H	H	H
P	H	H			H	H	H	H	H	H	H	H
R												
S	H	H			H	H	H	H	H	H	H	H
T										H (2)	H (2)	
U					H							
V	H	H		H	H	H	H	H	H	H	H	
W1 & W2										H	H	
X1	H	H	H		H	H	H	H	H	H	H	
X2										H	H	
Y												
Z	H	H		H	H	H	H	H	H	H	H	

(1) The sources of the problems with A are dependent on sources of B

(2) The sources of the problems with T are dependent on sources of P

SURFACE WATER QUALITY

Type and Definitions of Resource of Concerns (ROCs)

- **Nitrogen – Contamination and pollution from natural or human induced nitrogen that degrades water quality**
- **Phosphorus – Contamination and pollution from natural or human induced phosphorus that degrades water quality**
- **Pesticides – Residues resulting from the use of pest control chemicals**
- **Organic carbon compounds – Contamination and pollution from natural or human induced carbon compounds that degrades water quality**
- **Pathogens – Kinds and numbers of organisms (viruses, protozoa, and bacteria) that induce diseases that are present in and degrade water quality**

SURFACE WATER QUALITY

CONTINUED...

- **Heavy metals – Natural or human induced metal pollutants present in toxic and hard harmful amounts**
- **Salts – Pollutants from salts such as Ca, Mg, Na, K, HCO₃, Cl, and SO₄ that degrade water quality**
- **Temperature – Undesirable thermal conditions degrade water quality**
- **Dissolved oxygen - Insufficient levels of oxygen in water to support desired aquatic ecosystems**
- **Organic solvents – Fuel, oil, gasoline and other hydrocarbons present in toxic amounts**
- **Sediment – Pollutants from organic or mineral particles that degrade water quality**
- **pH - Degree of acidity or alkalinity that causes adverse impacts on plant and aquatic life**

SURFACE WATER QUALITY

LRR	Nitrogen	Phosphorus	Pesticides	Organic Carbon	Pathogens	Heavy Metals	Salts	Temperature	Dissolved O ₂	Organic Solvents	Sediment	pH
A	H	H	H	H	H	H	H	H	H	H	H	H
B	H	H	H	H	H	H	H	H	H		H	
C	H	H	H	H	H	H	H	H	H		H	
D	H	H	H	H	H	H	H	H	H		H	
E					H	H		H				
F					H?							
G		H	H		H	H	H					
H	H?	H	H		H							
I		H										
J	H?	H			H							
K	H	H		H	H				H			H*
L	H	H	H	H	H	H			H	H	H	H
M	H	H	H	H	H	H			H	H	H	H
N	H	H	H	H	H	H			H	H	H	H
O	H		H	H		H			H		H	
P	H	H		H	H				H		H	H
R	H	H	H	H	H	H			H	H		H*
S	H	H	H	H	H	H			H	H		
T	H	H	H	H	H			H	H			H
U	H	H	H	H	H	H		H	H			H
V	H	H	H	H	H		H				H	
W1 & W2					H	H		H				
X1											H	
X2						H	H			H	H	
Y												
Z	H	H	H	H	H		H				H	

* Acid rain

GROUND WATER QUALITY

Type and Definitions of Concerns (ROCs)

- **Nitrogen – Contamination and pollution from natural or human induced nitrogen that degrades water quality,**
- **Phosphorus – Contamination and pollution from natural or human induced phosphorus that degrades water quality,**
- **Pesticides – Residues resulting from the use of pest control chemicals.**
- **Pathogens – Kinds and numbers of viruses, protozoa, and bacteria that induce disease that are present in and degrade water quality.**
- **Heavy metals – Natural or human induced metal pollutants present in toxic and hand harmful amounts.**

GROUND WATER QUALITY

CONTINUED...

- **Salts – Pollutants from salts such as Ca, Mg, Na, K, HCO₃, Cl, and SO₄ that degrade water quality.**
- **Organic solvents – Fuel, oil, gasoline and other hydrocarbons present in toxic amounts.**
- **pH - Degree of acidity or alkalinity that causes adverse impacts on plant and aquatic life.**
- **Preferential flow – Water movement containing dissolved or attached contaminants through large pores, cracks, or channels that by-passes the soil matrix.**
- **Micronutrients – Nutrient elements that may impact soil, plant, or aquatic ecosystems.**

GROUND WATER QUALITY

LRR	Nitrogen	Phosphorus	Pesticides	Pathogens	Heavy Metals	Salts	Organic Solvents	pH	Preferential Flow	Micronutrients
A	H	H	H	H	H	H	H	H	H	H
B	H		H	H						
C	H		H	H	H	H	H			
D	H	H	H		H	H	H			
E										
F	H		H?	H?						
G	H		H?	H	H	H?			H	
H	H		H	H		H			H	
I	H?			H						
J	H		H	H		H			H	
K	H	H	H	H					H	H
L	H	H	H	H					H	H
M	H	H	H	H					H	H
N	H	H	H	H					H	H
O	H		H						H	
P	H			H						
R	H	H	H						H	H
S	H	H	H						H	H
T	H		H			H				
U	H	H	H	H		H			H	
V	H	H	H	H		H				
W1 & W2				H	H		H			
X1										
X2					H	H	H			
Y					H		H			
Z	H	H	H	H		H				

SOIL QUALITY

Type and Definitions of Resource of Concerns (ROCs)

- **Low fertility – Inadequate plant nutrition and soil fertility to support vegetation or soil biology.**
- **Residual pesticides- Pest control chemicals that have remained in the soil and have an adverse effect on non-target plants and animals.**
- **Organic matter depletion – Soil organic matter has diminished to a level that degrades the function of the soil.**
- **Pathogens - Kinds and numbers of viruses, protozoa, and bacteria that induce disease that are present in and degrade soil quality.**
- **Heavy metals – Inorganic elements that restrict the desired use of the soil or exceeds the soil's capacity to adsorb and retain.**
- **Salinity – Concentration of salts, measured by electrical conductivity, which adversely affects plant growth, soil-plant-water relations, and soil structure.**
- **Frozen soils – Impervious soil conditions caused by frozen water that restrict water movement and soil biological functions.**

SOIL QUALITY

CONTINUED...

- **Organic solvents - Fuel, oil, gasoline and other hydrocarbons present in toxic amounts that affect plant growth and soil biology.**
- **Sediment deposition - Sediment accumulations that damages or restricts land use and/or management and adversely affects ecological processes.**
- **Aggregation – Poorly exhibited process of binding primary soil particles (sand, silt, and clay) together.**
- **Available water content – Soil moisture not adequate or optimally utilized to produce desired production or effects.**
- **Infiltration and Permeability – Restricted movement of water and air into and through the bulk of the soil profile.**
- **Compaction – Compressed soil particles and aggregates caused by mechanical or natural processes into a restricting soil layer.**

SOIL QUALITY CONTINUED....

- **Subsidence – Loss of volume and depth of organic soils due to oxidation above the normal microbial activity caused by excessive drainage or extended drought.**
- **Restrictive soil layer – Dense soil layers that impede water, air, and roots thereby diminishing the functions of the soil.**
- **pH - Degree of acidity or alkalinity that causes adverse impacts on plant and soil life.**

SOIL QUALITY

LRR	Low Fertility	Residual Pesticides	Organic Matter Depletion	Pathogens	Heavy Metals	Salinity	Frozen Soils	Organic Solvents	Sediment / Deposition	Aggregation	Available Water Content	Infiltration / Permeability	Compaction	Subsidence	Restrictive Soil Layer	pH
A		H		H	H			H								
B		H	H	H	H	H	H	H	H	H	H		H			
C	H	H	H	H	H	H		H	H	H			H	H		H
D			H		H	H			H	H	H	H	H	H	H	
E							H									
F	H		H				H				H		H			
G	H	H	H	H							H	H	H		H	
H	H	H	H	H						H	H	H	H		H	
I	H					H				H	H	H	H		H	
J	H		H							H	H	H	H		H	
K				H			H									
L	H	H	H	H			H		H	H	H	H	H		H	
M	H	H	H	H			H		H	H	H	H	H		H	
N	H	H	H	H			H		H	H	H	H	H			H
O		H							H		H	H	H		H	
P	H	H	H						H	H	H	H	H		H	
R							H									
S				H	H		H									
T	H	H	H	H	H					H	H	H			H	H
U	H	H	H		H						H			H	H	H
V				H	H			H	H							
W1 & W2					H			H								
X1	H		H				H		H	H	H	H	H			
X2					H			H								
Y					H		H	H								
Z				H	H			H	H				H			

WATER QUANTITY

Type and Definitions of Resource of Concerns (ROCs)

- **Excess runoff** – Land loses surface water and becomes inundated restricting land use and management.
- **Excess surface seep** – Subsurface water oozing to the surface that restricts land use and management and carries nutrients and salts.
- **Snow distribution** – Wind-blown snow deposits and accumulates around and over surface features that restrict even distribution of soil moisture.
- *Snowpack balance* – *A low amount of snow mantle or accumulation of snow over the soil surface at any time.*
- **Soil water storage** – Low amounts of soil moisture that remains in the soil profile after free drainage.
- **Water use efficiency** – Poor relationship (usually low) between the quantity of water used and the production of a crop.

WATER QUANTITY CONTINUED...

- **Surplus/deficiency of surface water – Inappropriate amounts of water on the soil surface that affect crop growth or soil biology.**
- **Surplus/deficiency of subsurface ground water – Inappropriate amounts of water in the soil profile, usually the root zone, that affect crop growth or soil biology.**
- *Inadequate supply – Lack of soil moisture or irrigation water to produce or maintain desired plant production or soil biology.*
- **Aquifer overdraft – Water withdrawals exceed recharge rates.**
- **Reduced capacity of water courses and storage – Sediment deposits in water courses and storage areas reduce the desired capacity.**
- **Insufficient flow of water courses - Water flows are not consistently available to support the desired ecological processes and land use.**

WATER QUANTITY

LRR	Excessive Runoff	Excessive Surface Seep	Snowpack Distribution	Snowpack Balance	Soil Water Storage	Water Use Efficiency	Surplus/Deficiency Surface Water	Surplus/Deficiency Ground Water	Inadequate Supply	Aquifer Overdraft	Reduced Capacity of Water Courses, Storage	Insufficient Flow of Water Courses
A	H											
B	H		H	H	H	H			H	H	H	H
C	H				H	H	H	H	H	H	H	H
D		H	H		H	H	H	H	H	H	H	H
E				H								
F		H	H	H	H	H			H			
G	H		H	H	H	H	H	H	H	H		
H	H	H	H	H	H	H			H	H		
I					H	H			H	H		
J					H	H				H		
K	H		H	H			H					
L	H		H	H	H		H	H			H	
M	H		H	H	H	H	H	H			H	
N	H		H	H	H							
O	H				H	H	H	H	H	H	H	H
P	H	H			H		H	H				
R	H		H	H								
S	H		H	H								
T	H				H	H	H	H				
U	H				H	H	H	H	H	H		
V	H	H							H		H	H
W1 & W2												
X1			H	H					H			
X2												
Y	H		H	H								
Z	H	H			H	H			H		H	H

AIR QUALITY

Type and Definitions of Resource of Concerns (ROCs)

- **Chemical drift – Pest control and nutrient materials move down wind and contaminate or injure non-target features.**
- **Greenhouse gas (CH₄, CO₂, N₂O) – Increased gas concentrations are adversely affecting ecosystem processes.**
- **Odor – Land use and management produce offensive smells.**
- **Particulate matter – Particulate matter less than 10 (and 2.5) microns in diameter that are suspended in the air and caused potential health problems to humans and animals.**

AIR QUALITY

CONTINUED...

- **Reduced visibility – Sight distances are impaired by airborne particles causing unsafe conditions and impeded views.**
- **Ozone – High concentrations of ozone adversely affect human health, plant growth, and creation of smog.**
- **Ammonia – Nitrogen materials transform into ammonia compounds that emit odors, becomes a PM 2.5 precursor, and contributes to acid rain.**
- **Wind – Wind velocities, too little or too much, reduce animal and plant production. High wind velocity causes soil and plant movement.**

ECOSYSTEMS

Type and Definitions of Resource of Concerns (ROCs)

- **Population imbalances – Populations are not in proportion to available quantities and quality of food, cover, shelter, water, and space.**
- **Habitat – Cover and shelter for the species of concern is unavailable or inadequate.**
- **Food – Quantity and quality of food is unavailable to meet the life span of the species of concern.**
- **Space – Lack or fragmentation of areas of habitat that disrupt life span requirements of the species of concern.**

ECOSYSTEMS

CONTINUED...

- **Water – Quantity and quality of water is unacceptable for the species of concern.**
- **Fragmented populations – Plant and animal communities have insufficient structure, extent, or connectivity to provide ecological functions or achieve management objectives.**
- **Endangered species – Populations of species have reached a level that they are in danger of or threatened with extinction.**
- **Invasive species – Migration and establishment of organisms from one area to another where it is not welcome**

PLANS

- **To circulate the tentative matrix of identified problem areas within the LRR. Membership will be asked to review and provide input.**
- **We expect to make simplifications**
- **We need to interface with modelers to select the most pertinent Conservation Practices and determine what combination of LRR and Problem Area models should be focused on in major agricultural areas.**